Compositionality in Formal Semantics

Selected Papers by Barbara H. Partee

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Explorations in Semantics

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Barbara H. Partee
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Chapter 1

Reflections of a Formal Semanticist

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1.1   A Personal History within the Development of Formal Semantics

What follows is a personal view, as much about my own history in the field and my perceptions as the development of the field itself. I have written on the history of the field elsewhere (Partee 1988, 1996, 1997); here I focus more on the human side of the story. Within this section, the earlier periods (being more "historical") get more than their share of the space. Section 1.2 contains general reflections. An Appendix contains some of my best-known example sentences; they form a mini-history of their own.

1.1.1   "Preparation"

My early history is a mixture of lucky timing and of following my interests without any particular plan, ending up ideally prepared for a field that didn't exist as I was "preparing."

As an undergraduate at Swarthmore College from 1957 to 1961, I went into Honors, where you were supposed to have a major and two related minors. I wanted to do three apparently unrelated subjects – math, Russian, and philosophy – they were just the subjects I loved best. Mr Brinkmann, head of the Math Department, thought it might be possible to invent a connection. He'd heard of a new field called "mathematical linguistics" or "machine translation." He noted that computers use logic (part of my philosophy minor) and math; the Cold War was increasing the demand for Russian translation. So if I could write up some such story, my program would probably be approved.[1] I did, and it was.

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[1] I think I benefited in a way from the unconscious sexism of the times. No one considered it important that I plan for any particular future; I was free to study the things I loved most.

I then began to notice the word "linguistics" more frequently and to wonder what it really was. By serendipity,[2] I found my way into a linguistics seminar offered at Penn in the summer before my senior year, for students in mathematics, philosophy, or psychology – just perfect. David Lewis, Gil Harman and I all got our introduction to linguistics in that seminar. It was taught by Henry Hiż with guest lectures by Zellig Harris. It was an introduction to Harris's transformational grammar, and it was fun. We learned that Harris's student Chomsky was about to start a graduate program in linguistics at MIT. So since that sort of linguistics seemed to be great fun, I applied to those two schools.

I chose MIT over Penn for a rather timid reason. I learned from Carlota Smith, who was a graduate student at Penn visiting MIT in 1960–1, that the MIT program would be rather structured, whereas Penn left students free to design their own program. Since I knew nothing about linguistics, I thought I'd better go into a program where they would tell me what to do. So I went to MIT.

At MIT, syntax was the center of the universe, and I loved it. Students were immediately part of the team discovering and inventing all kinds of new stuff. We felt like pioneers, we wrote much more than we read, and it was very heady. Chomsky was inspiring, Halle was a great mentor, and Chomsky and Halle were both devoted teachers. I loved both Chomsky's and Klima's syntax courses, and noticed an interesting difference between them: Chomsky was interested in English syntax only as evidence for theory, and Klima was interested in theory for its help with puzzles in English syntax. I think I felt more Klima-like, but it was implicit that one wanted Chomsky as dissertation director, since it was theory that was Interesting with a capital "I."

What little semantics there was around MIT then was peripheral, mainly the developing work of Katz, Fodor, and Postal. Katz and Fodor, junior faculty at MIT, made the first proposals for semantic theory in generative grammar. They were clearly concerned with compositionality – what they called the Projection Problem. Because of negation and questions, Katz and Fodor (1963) computed meaning on the basis of "T-markers" representing the transformational history of an expression, analogous to Montague's derivation trees (Bach 1979). But their semantics was primitive, just bundles of "semantic features" and no attention to things like quantifiers. They aimed to capture ambiguity, synonymy, and semantic anomaly, which could all be expressed in terms of "readings" – how many, and same or different. There was no mention of truth conditions or entailment relations. There were thoughtful ideas about compositionality in their work, but the representation of meanings as bundles of features was clearly inadequate. But on my own I had no idea what a semantic theory should look like.

[2] My uncle, an MIT alumnus, heard of my interest in "mathematical linguistics," and sent me the program of the MIT conference (published as AMS 1961). I wrote to almost everyone on the program, asking what I could do in the summer to help me find out what linguistics was. A surprising number wrote back. Several suggested I contact Penn, which worked out wonderfully. The kindness of established linguists in replying to a naive young student made a big difference to me.

During my third year came the Katz–Postal hypothesis (Katz and Postal 1964), that transformations are meaning-preserving and meaning can be determined from Deep Structure. They put Neg and Q morphemes into Deep Structure to trigger the Negation and Question transformations, arguing that there was independent syntactic motivation. Their claim led to important debates. The architecture of the theory, with syntax mediating between semantics on one end and phonology on the other, was elegant (and laid some of the groundwork for Generative Semantics).

Chomsky's thinking was evolving from *Syntactic Structures* (Chomsky 1957) to *Aspects* (Chomsky 1965) while I was there, and despite his deep skepticism about semantics, he tentatively accepted Katz and Postal's suggestion. During the brief *Aspects* period there was rosy optimism that the form of the theory, including the Katz and Postal hypothesis, was stable. The idea that meaning was determined at this "deep" level probably contributed to the aura surrounding the notion of "language as a window on the mind." But it fell apart when quantifiers were noticed. The properties of quantificational NPs (see section 1.1.2) created conflicts between syntax and semantics, kicking us out of our Garden of Eden and into the "linguistic wars."

The papers I wrote in graduate school were on semantic issues, but without any semantics. I wrote papers on (the syntax of) quantifiers, and on negation. I did take Yngve's machine translation course in my first year, and wrote a computer program to translate a small subpart of first-order logic into English. In the seminar where we tried out potential dissertation topics, I worked on the *some/any* alternation, worrying about the optional meaning-changing *some*-to-*any* rule in Klima (1964), a violation of Katz and Postal's hypothesis. But I couldn't solve it without three *some*'s. So I abandoned that topic, which was just as well: it really wasn't a syntax problem, as Ladusaw later showed (Ladusaw 1979).

Later, by accident, I found a completely different dissertation topic, namely the syntax of subjects and objects and transformations that affected what we would now call argument structure. (The term "argument" came into syntax only later, via formal semantics.) Actually, my dissertation proposal, which Chomsky approved with enthusiasm, was for a transformational grammar of English, synthesizing what had been done up until then. But that was too much for one year, and luckily I had never heard of not finishing in a year – I thought it was a kind of one-year take-home exam.[3]

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[3] I also didn't know you could discuss your work with your dissertation committee (so I didn't until I was told to). There was a lot we didn't know, being the first class in a new program. Even the faculty were making up rules as we went along: there was a *de facto* merger of the first class (Tom Bever, Bruce Fraser, Terry Langendoen, Ted Lightner, Jim McCawley, me, and one student who dropped out) with the second class (Jim Foley, Samir Ghosh, Jeff Gruber, Paul Kiparsky, Yuki Kuroda, Brandon Qualls, Stan Petrick, Peter Rosenbaum, Sandy Schane, Arnold Zwicky) after it was decided just before our third year that qualifying exams should be in the second year.

Although the center of my life at MIT was syntax, other things I learned during those years helped prepare me for my (unimagined) future in semantics. At MIT, I minored in math, with a course in Automata Theory with E. F. Moore, and a wonderful course in logic and recursive function theory with Hartley Rogers, Jr. I had a philosophy of language course with Hilary Putnam, but not on his later interesting work: we read a book by Paul Ziff. Starting in my second year, I taught a course in mathematics for linguists each fall (which led to Partee 1979a, and my part of Partee et al. 1990). To learn more set theory, I took a course with Quine at Harvard built around a book in progress (Quine 1963); the demanding logic homework probably made Montague's work a little less intimidating. Michael Rabin's model theory course was over my head, but added some background that stood me in good stead later.

I went to UCLA in 1965, and by 1966, Stockwell, Schachter and I were engaged in our English syntax project (1966–8),[4] with a team of graduate students, which led to our book (Stockwell et al. 1973). We limited our attention to work in transformational syntax up to 1966, with few exceptions (mainly Fillmore's case grammar and Chomsky's lexicalism (Chomsky 1970), which we combined), and stayed out of semantics. That meant keeping away from the generative semantics–interpretive semantics debates, which was hard, but necessary. Each chapter had a faculty-led team; mine were "Determiners," "Pronominalization," and "Negation." With weekly team presentations and group discussion we were able to keep the grammar consistent. And because it was like a seminar with "homework," I was able to write my share of our 840-page book, although in general I'm too much of a procrastinator for book-sized projects.

But although the bulk of my output[5] during that period went into that project, I had one eye on the syntax–semantics fights. Lakoff and Ross had started to work together while I was writing my dissertation; their joint paper "Is deep structure necessary?" was written in 1967. My dissertation argued against Lakoff's analysis of transitive *open* as a causative. My classmate Jim McCawley was publishing generative semantics papers by at least 1968. Postal, a staunch Chomskian when I was at MIT, joined the generative semantics movement shortly afterwards. Jackendoff was a student at MIT right after I was, and he and Chomsky launched the counteroffensive of "interpretive semantics."

My instincts were mixed: the generative semanticists took semantics seriously and uncovered interesting generalizations. But their "abstract syntax" seemed wild (it might not now!). My first published paper (Partee 1970a), centered on example (A1),[6] was in reaction to Lakoff; Lakoff responded with

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[4]   That fulfilled my dissertation dream, which Stockwell and Schachter shared.
[5]   I mean my academic output. A considerable amount of energy also went into "life" issues – my marriage to Morriss Partee, and the birth of our three sons, Morriss, David, and Joel. When we got married, in 1966, I changed my name from Barbara C. Hall to Barbara Hall Partee. After our divorce in 1971, I kept that name in part because of my three Partee sons, and in part because of my publications; only my dissertation and one review were under the name Hall.
[6]   All examples with numbers beginning with A or B are found in the Appendix.

"Repartee" (Lakoff 1970). Soon afterward (Partee 1971), I analyzed the central issues I saw behind the debate, identifying the main problems on each side. I didn't reach a definite conclusion, and I thought that was a failure. In retrospect I think I helped clarify the issues, and over time I came to appreciate that impartial analysis was probably one of my worthwhile strengths.

Linguists were then beginning to discover that there was interesting relevant work in philosophy of language. I was struck by Donnellan's work on referential and attributive definite descriptions (Donnellan 1966), and attempted to apply it to the problem of specific and non-specific (and non-referential) indefinites in Partee (1970b, reprinted here, chapter 2), with some good examples, including (A2), but an unsatisfactory analysis.[7]

1.1.2   Montague and the beginnings of Montague grammar

One day David Lewis told me that Montague, whom I knew only by sight, was starting to apply his work in logic to the semantics of natural language. David and I had known each other since Swarthmore, and he knew me well enough to suggest that I would find Montague's work interesting. I first sat in on one of Montague's seminars in 1968, along with David and Frank Heny. David helped us decipher the logic.

Montague's approach was different from anything I had been exposed to. But with help (I had never seen a lambda before, nor did I know about intensions and extensions), I could follow well enough to begin to appreciate it.

Two aspects of Montague's approach looked especially exciting. The first was the revolutionary (to a linguist) idea that the core data were the truth conditions of sentences. Suddenly there was a non-subjective criterion of "observational adequacy" for semantics.

The second exciting aspect of Montague's approach was that his powerful logic could do some real work, which in turn could help keep the syntax clean and elegant. Semantic equivalence would then not require same deep (or any other) structure. The use of type theory let Montague interpret basic grammatical relations as function–argument application. In retrospect we can see that generative semanticists were hampered by the mismatch between natural language structure and the structure of first-order logic, the only logic most linguists knew. That's why lambdas, types, and the example of generalized quantifiers have such prominence in formal semantics.[8] Without them,

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[7]   I reported in a footnote a crucial counterargument from Lauri Karttunen. I'm glad that I didn't just withdraw the paper, and instead published it with the footnote; otherwise it would be in my list of regrets.

[8]   My Dutch colleagues still recall a sentence I uttered in my 1980 talk in Amsterdam "The first decade of Montague grammar": "Lambdas changed my life." Theo Janssen, who cited the quotation in Janssen (1994), says (personal communication) that "this quote is the best summary of Montague's revolution: it is the feature that made compositionality possible at all."

there was no way to assign a semantic type to the syntactic category NP. This was undoubtedly responsible for some of the "wilder" syntactic analyses by generative semanticists.

The uniform interpretation of all NPs as generalized quantifiers was one of the most exciting specifically linguistic innovations in Montague's work, first introduced in Montague (1970; hereafter UG), but best known from Montague (1973; hereafter PTQ). David Lewis (1970) also treated NPs as generalized quantifiers. There may be no way of ever knowing which of them had priority on this idea. But it was through Montague's work, with his rich and systematic framework, that the idea caught the imagination of linguists and became part of the foundation of formal semantics.

With the help of philosophers (especially David Lewis and David Kaplan), I began to learn, with some shock, that "West Coast" philosophers (especially Tarski and Carnap) had been developing possible worlds semantics and higher-order intensional logics while East Coast philosophers (especially Quine) were insisting that only first-order extensional logic was real logic. I hadn't understood that philosophers or logicians could be dogmatic or differ so strongly about what their fields were about. And this accident of geography made a huge difference to the field, as it had to my education.

At the fall 1970 conference at which Montague presented PTQ, I put all of my "discussant" efforts into describing key differences between Montague's syntax and transformational grammar (Partee 1973c). I couldn't yet say much about the semantics, but could show how it motivated Montague's syntax. That was my only presentation about Montague's work with Montague present, just months before he was killed in the spring of 1971. I was glad to have his assurance that I was not misrepresenting him.

I learned about Montague's shocking death from the newspaper over breakfast the morning after. It was one of those world-stopping moments like the deaths of President Kennedy and Martin Luther King, at least for my world.

Just at that time, I was writing a UCLA grant proposal for a project in which I would exploit Montague's appreciation of "puzzles" to try to provoke him to work on some constructions which seemed to require the transformational cycle. *There*-insertion, Passive, and Raising together would generate sentences like (1), which I couldn't see how to derive compositionally.

(1)   There was believed to be a unicorn[9] in the garden.

I never had a chance to ask Montague about such sentences, though there is a hint in PTQ that he might not object to the inclusion of meaning-preserving transformations. Michael Bennett, who had been working with Montague, and

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[9]   The unicorn is the "mascot" of Montague Grammar because of one of Montague's key examples, *John seeks a unicorn*. Bob Rodman put a unicorn on the cover of the UCLA volume (Rodman 1972); I did the same with Partee (1976), and unicorn T-shirts proliferated at Montague Grammar workshops. Clever unicorn-pictures head the chapters of Janssen (1983).

whose dissertation (Bennett 1974) David Kaplan and I co-chaired, included a fragment devoted to such constructions.

After Montague's death, the exploration of his ideas became a cooperative group effort, first mainly at UCLA, and then more broadly. I taught a one-quarter seminar on Montague grammar in fall 1971 at UCLA. Then, because we were all just beginning to get the hang of it and didn't want to stop, we continued[10] for a second quarter and all wrote papers, collected in Rodman (1972). I taught and lectured on Montague grammar (MG) a great deal in those first years, and much of my own research was focused on how to combine Montague grammar and transformational grammar. My basic one-hour talk became Partee (1973b), and my evolving course lecture notes became Partee (1975b), which served as a first quasi-textbook. It was replaced in that function by Dowty (1978) and then by Dowty et al. (1981).

Here is an example of an obstacle confronting the integration of Montague grammar into linguistics, whose solution felt like a "light bulb" idea. It was during the Philosophy-Linguistics Institute at Irvine in the summer of 1971 that I finally put my finger on the problem: what to do about deletion rules, such as the rule of "Equi-NP Deletion" by which (2a) was derived from a structure like (2b).

(2)a.   Mary wanted to win.
   b.   [$_S$ Mary wanted [$_S$ Mary win]]

In Montague grammar, there is nothing like "deleting" part of the meaning of a constituent. When I finally understood the problem, I had an idea for its solution, finally appreciating my philosopher friends' advice to "use lambdas." (I knew I didn't want them in the syntax, and it took me that long to catch on to how to use them to semantically interpret "syntactic deletion.") The key to the solution is intimately related to the way in which quantifiers destroyed the *Aspects* theory with its incorporation of the elegant Katz–Postal hypothesis.

For years, nobody had thought about the consequences of the analysis in (2) for a sentence like (3a), whose deep structure should accordingly be something like (3b).

(3)a.   Everyone wanted to win.
   b.   [$_S$ everyone wanted [$_S$ everyone win]]

The semantic problem is apparent. In Montague grammar, where infinitives were treated as VP type, I could see that the embedded sentence's subject

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[10]   When Stockwell, my chairman at UCLA, gave me permission to replace my scheduled seminar in mathematical linguistics with a second quarter of Montague grammar, he said, "This is all very interesting, Barbara, but when are you going to get back to doing linguistics?" That question fired me up and gave me my mission for the next half-dozen years, to convince him and the world that this *was*, or should be, part of linguistics.

should be a variable that gets bound by lambda abstraction (see the Derived VP Rule of Partee 1973b). In Chomskian syntax, a corresponding change was eventually made, replacing the identical NP by the null element PRO.

While "Montague grammar" was undoubtedly the principal vehicle by which the influence of model-theoretic semantics came into linguistics, there were other related lines of research. David Lewis had some influence on Montague's work, and did important early work of his own (Lewis 1969, 1970). Cresswell (1973) had a great deal of valuable discussion of foundational issues and many specific grammatical constructions. Parsons, Keenan, and Thomason and Stalnaker were also early and active contributors to linguistics–logic–philosophy exchanges (Keenan 1971; Parsons 1972; Thomason and Stalnaker 1973).

Interaction with philosophers was very important in the 1960s and 1970s. Linguists and philosophers operated by different principles, but one could see mutual respect and learning in conferences such as the 1969 conference that was the starting point for Davidson and Harman (1972), and in the 1971 Irvine summer institute. Philosophers had thought a great deal about reference, quantification, indexicality, intensionality, the semantics of interrogatives, and other semantic issues then new to linguists. Linguists generally knew more about syntactic structure and syntactic constraints on possible interpretations, and were good at generating examples that could challenge any suggested generalization.[11]

That 1971 Irvine summer institute was a memorable and influential event for me, not only because I figured out how to use lambdas to model "syntactic deletion," but for the immersion in philosophy of language. There were two three-week sessions, each with three philosophers and one linguist; the "students" were young philosophy professors, including Thomason, Stalnaker, Gareth Evans, and many others. I was the linguist for the first session, and attended the lectures by Davidson, Harman, and Grice. I commuted to the second session to attend the lectures by Strawson, Kaplan, Quine, and Haj Ross, plus Kripke's "Naming and Necessity" lectures. The lectures and discussions were a big part of my philosophical education, and the intense interactions led to a lasting camaraderie, which continued at our 1974 Linguistic Institute at UMass.

1.1.3   The first decade of Montague grammar

I moved to UMass Amherst in 1972, with appointments in Linguistics (my primary home) and Philosophy, and Terry Parsons moved there at the same

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[11]   In my workshop at the 1974 Linguistic Institute, several philosophers offered theories of the distribution of *any*, and we linguists sat there popping off with counterexamples. None of us had a good theory of *any* (this was before Ladusaw's dissertation), but we knew all the crucial examples.

time, in Philosophy. Emmon Bach came in 1973,[12] and soon started doing Montague grammar as well. Sometimes with National Science Foundation (NSF) grant support and sometimes without, Terry and Ed Gettier and Emmon and I and some graduate students[13] had frequent meetings to discuss Montague's papers and our own work, and Emmon and Terry and I taught joint linguistics and philosophy seminars in various combinations.

The UMass department was very young (departmental status approved in 1971), and a big event that helped put it on the map was the 1974 Linguistic Institute, in which semantics and philosophy of language, the areas I organized, were major components. I had a big Montague grammar course, and a research workshop whose participants, most also Institute faculty, included Emmon, Terry, David Lewis, Janet Fodor, Thomason, Stalnaker, Jackendoff, Keenan, Kamp, Karttunen, Anil Gupta, and Robin Cooper.

By the mid-1970s, UMass was definitely "on the map" and widely regarded as the center of formal semantics,[14] and we made major contributions to developing versions of Montague grammar (Cooper and Parsons 1976; Bach 1979; Partee 1979b). By then, Montague grammar and related work was flourishing as a linguistics and philosophy enterprise also in other parts of the US, in the Netherlands, Germany, Scandinavia, and New Zealand, and among individuals elsewhere. (By the late 1970s it was no longer possible to keep track.) There were many milestones in the second half of the 1970s: the first published Montague grammar collection (Partee 1976), the first issue of *Linguistics and Philosophy* in 1977, the starting of the biennial Amsterdam Colloquia.

There were interesting foundational issues to worry about. Montague grammar was having great successes, but there were principled objections from two sides: from linguists for whom truth-conditions seemed at odds with grammar being in the head of the native speaker, and from philosophers who found Montague's possible worlds semantics insufficiently intensional. As the field of cognitive science got going in the late 1970s, helped by the Sloan Foundation, such issues had a forum. I worried about them in quite a number of papers (for instance, Partee 1979c, 1980, 1988) but mainly "alongside" the actual "doing" of semantics, except for work on the semantics of propositional attitudes, where foundational issues are unavoidable. Those were not among my most successful papers, and none are included here. I still think these issues are important (see, for instance, Stalnaker 1984), but I haven't worked on them recently.

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[12] Emmon and I were married from 1973 to 1996, and were a bit like "Mom and Pop" of the department.
[13] Dissertations from that period include Robin Cooper, Muffy Siegel, Greg Carlson and Paul Hirschbühler in Linguistics, and Dave Davis and James Waldo in Philosophy.
[14] One indicator was that when Irene Heim received a fellowship to study anywhere in the US, she wrote to Chomsky that she was interested in pursuing syntax and semantics at MIT. He replied that if she seriously wanted to do semantics, she should consider UMass instead. She entered our PhD program in 1977. A later landmark, significant for me given Chomsky's long-standing skepticism about formal semantics, was when MIT hired Irene as their first formal semanticist in linguistics in 1989.

Formal semantics was still mainly "Montague grammar" in the 1970s, and mainly an optional "seminar" topic. At UMass, for instance, all of semantics was still optional in the 1970s. In the late 1980s, after the hiring of Angelika Kratzer gave us three semanticists, we increased the first-year program to 12 credits, and made the first semantics course (by then formal semantics) a required first semester course. By the late 1990s syntax, semantics, and phonology were very nearly co-equal core areas of the curriculum.

1.1.4   From interdisciplinary to disciplinary in the 1980s

My work in the 1980s combined investigations within Montague grammar with interdisciplinary explorations in the emerging field of cognitive science, involving philosophers, computer scientists, and psychologists. I think the height of interaction between linguists and philosophers had passed by 1980, followed by the rise of cognitive science, within which semantics thrived as an inherently interdisciplinary concern, and then by a greater specialization of semantics inside of linguistics proper.

The Sloan grants in Cognitive Science from 1978 through the 1980s were the occasion for many interdisciplinary conferences. I organized one on "Indefinite Reference," where Irene Heim got her dissertation topic (Heim 1982), and one showcasing the new Discourse Representation Theory (DRT–Kamp 1981) and Situation Semantics (Barwise and Perry 1981). I thought then that Kamp and Barwise might be starting to play Montague-like roles, bringing their logical expertise to bear on the formal structure of semantic theory.

Kamp's DRT and Heim's similar File Change Semantics were a big event in the early 1980s; his work and hers have diverged since then, both influential within somewhat different communities. Barwise and Perry's later work (Barwise and Perry 1983) was disappointing. Angelika Kratzer's very different situation theory (Kratzer 1989) has much more influence.

Godehard Link's exciting work on plurals and mass nouns (Link 1983), with his algebraic structuring of the entity domain, was an important new development in the 1980s and influenced developments in event semantics as well.

The period of the Sloan grants in Cognitive Science should have been as wonderful as the earlier linguistics–philosophy interactions. But somehow it wasn't quite as friendly or quite as productive, at least from my perspective. I can think of two possible reasons. One was the competition over domination of cognitive science, the other the competition for large grants. Although we all participated cooperatively in the many interesting conferences, and enjoyed having postdocs and even new hires[15] with Sloan money, the cooperation was tinged with competition, since each of the three successive

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[15]   Our own psycholinguist Lyn Frazier was hired in a position that wouldn't have been created without the incentive of a Sloan grant.

rounds of grant competition was for a smaller number of larger grants. And perhaps most divisive was the competition for the leadership of cognitive science between the AI-centered community and the theoretical linguistics-centered community. I still care about foundational issues in cognitive science such as finite representability and mental models, but I work on topics for which I have a good environment, and leave other appealing topics for some other lifetime.

One quiet but important figure for me in the 1980s was Ray Turner, a theoretical computer scientist and philosopher interested in applied logic and semantics. When he came to UMass on a Sloan postdoc in 1981–2, we organized a weekly interdisciplinary Model Theory seminar. A grant from the System Development Foundation (SDF) (1984–7) to work on Formal Foundations of Semantics supported his joint work with Gennaro Chierchia on property theory (Chierchia and Turner 1988), a postdoc for Fred Landman, and our conference on property theory and type theory (Chierchia et al. 1989).

Emmon and I spent 1982–3 at the Max Planck Institute for Psycholinguistics in Nijmegen, attending semantics seminars in Groningen or Amsterdam almost every week. Formal semantics was and is a vibrant enterprise in the Netherlands. The biennial Amsterdam Colloquium was my forum of choice for presenting new research through the 1980s.

In the meantime, there were important developments within linguistics proper. While some of us were still trying to integrate Montague grammar with transformational syntax, others realized that a powerful semantics might allow a more radically constrained syntax, with no transformations at all. Several developments in this direction began at the end of the 1970s and became major research enterprises in the 1980s: especially Generalized Phrase Structure Grammar (GPSG) (Gazdar et al. 1985), categorial grammar (Bach 1984; Bach et al. 1987; van Benthem 1987), and later Head-driven Phrase Structure Grammar (HPSG) (Pollard and Sag 1994). I have always felt very sympathetic to such work; see Partee (1996).

The growth spurt in "straight linguistic semantics" in the 1980s is reflected in the range of work of my dissertation students of that time.[16] Hans Kamp was at UMass briefly in the mid-1980s, and influenced the work of Roberts and Kadmon, as well as having already influenced some of my own work (Partee 1984b; Kamp and Partee 1995). The rethinking of the semantics of NPs in the work of Heim and of Kamp was a major impetus for my work on type-shifting (Partee 1986), which had started with my earlier work on conjunction with Mats Roth. Type-shifting was a departure from Montague's strong form of compositionality, with arguments coming largely from linguists. See more notes on this work in section 2 of this chapter.

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[16]   Elisabet Engdahl, Michael Flynn, Ken Ross, Irene Heim, Gennaro Chierchia, Mats Roth, Jonathan Mitchell, Craige Roberts, Nirit Kadmon, Jae-Woong Choe, Allesandro Zucchi, Karina Wilkinson. Emmon was involved in all of those as well, and chaired others.

1.1.5   Recent years

By the 1990s, students were not conscious that the core fields hadn't always been "phonology, syntax, semantics." Several semantics textbooks were published around 1990,[17] and more departments came to have at least two formal semanticists (even MIT).

In the 1990s, there was some divergence between formal semantics in the Netherlands and the US, with the Dutch working more on the logical side. In 1990 van Benthem and colleagues founded the European Foundation for Logic, Language, and Information (FOLLI) which sponsors a new journal (*JOLLI*) and annual summer schools (ESSLLI).

In the US, semantics is firmly inside linguistics. After fifteen years in which *Linguistics and Philosophy* was the preeminent journal for formal semantics, Heim and Kratzer launched *Natural Language Semantics* (*NALS*) in 1992. And the US-based conference SALT (Semantics and Linguistic Theory) had its first annual meeting in 1991. Both *NALS* and SALT permit authors to presuppose some syntax and don't require that everything be understandable to philosophers.

And the Bach–Kratzer–Partee NSF project on quantification (1988–92) was my first non-interdisciplinary project since the Stockwell, Schachter, and Partee project. In a foray into semantic typology, we studied determiner quantification and adverbial quantification cross-linguistically.[18]

Some semanticists work with Chomskian syntax and others with non-transformational approaches (extended categorial grammar, Lexical-Functional Grammar (LFG), HPSG, or Tree-adjoining Grammar (TAG)). Heim (1982) did much to make semantic sense of a notion of Logical Form in a Chomskian approach. All approaches are represented at conferences like SALT. I tend to declare myself agnostic about syntax, largely in order to co-exist compatibly in my mainly Chomskian department. I greatly value a department like ours in which people can really work together and talk to each other, even if it doesn't involve my own first choice of kind of syntax.

During the 1980s, I developed ties to the Prague school, particularly Eva Hajičová and Petr Sgall. During my fall 1989 semester in Prague, we made a start on connecting our research. With the help of a grant, we continued that work over several years, bringing UMass students to Prague, and Prague colleagues to the US. The UMass students organized a Focus Workshop in 1995, and edited Benedicto et al. (1998). After another sabbatical semester in Prague, we eventually completed a book (Hajičová et al. 1998). In spite of theoretical

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[17]   The textbook Gamut (1991) is the beginning of an answer to one of my dreams, that lambdas should be introduced in introductions to logic, and not only as an advanced topic, or in semantics courses.

[18]   Students in our lively quantification period included several whose dissertations I supervised (Portner, Brennan, Rullmann), and several supervised by Angelika (Berman, Diesing, Schwarzschild, von Fintel).

differences that put certain questions out of bounds, we made some progress on the interaction between quantification and topic-focus structure.

Since a life change in the mid-1990s,[19] I've spent half of every year in Moscow, with a new "mission" of bridging Moscow-school lexical semantics and Western formal semantics (see Partee and Borschev 2001). The Moscow-school lexical semanticists are working to construct a scientific foundation for lexicography, including systematically formulating the "components of meaning" that make up word senses. Vladimir Borschev and I find formal semantics and Moscow-school lexical semantics potentially compatible, each addressing semantic issues neglected by the other.

What's my place in the field now? I remember feeling an initial shock when I was asked to write a "historical article about Montague grammar" for van Benthem and ter Meulen (1997) – my first reaction was "What do you mean, historical?" But then I realized that students rarely study Montague grammar in its original form, just as they no longer study *Syntactic Structures*. And the fact that "Montague grammar" has now made it into the *Oxford English Dictionary* is a sure sign of historical status. So I have come to accept that in some sense, I'm now a historical figure. At the same time, I'm one researcher among many, working on whatever interests me most at the moment, currently the multifaceted problem of the genitive of negation in Russian. When I worked on that problem in graduate school, it was presupposed that a solution would consist of nice explicit syntactic rules. I never dreamed that I would come to see the genitive of negation as involving the interaction of syntax, compositional semantics, lexical semantics and diathesis shift, topic–focus structure, context, presupposition, and some still partly mysterious notion of perspective structure (Borschev and Partee 2002).

The field of formal semantics itself is fully international, heterogeneous but still collegial and friendly. No one figure and no one department is dominant; there are developments of many kinds coming from many places, including computational semantics, psycholinguistics and acquisition. I couldn't list all the journals in which work in formal semantics appears now, nor all the textbooks. And that's great.

1.2   General Reflections

A collegial environment is a wonderful thing. Mike Flynn managed to ask me his "really stupid question" in 1980 about the fact that Edwin Williams and I evidently got along very well and never disputed each other's framework; he wanted to know whether our frameworks were really compatible in some way he couldn't see, or if there was another reason behind our not arguing. Realizing that many students must wonder, I checked with Edwin and found

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[19] In 1997, I married Vladimir Borschev, whose background was in mathematical linguistics and the formal semantics of programming languages.

we had the same answer: not wanting to "shoot from the hip" at a theory we didn't fully understand, but not wanting to put in the effort to study a theory we were skeptical about. So for the benefit of the students and each other we decided to co-teach introductory semantics the following spring, ending with a unit to introduce Montague grammar and Chomskian "Logical Form" and to debate and try to identify some difference in empirical predictions. When we did it, we immediately uncovered misconceptions we had about each other's theory, and found holes in each theory in places the other theory considered important. When we finally found sentence (4), about which our theories (with the holes filled in on the fly) made opposite predictions, the students split 50–50 about whether control was possible in such a sentence! It was great to have such a spirited non-polemical debate.

(4)   On whom can you depend to do the dishes?

Theory diversity is a good thing: it enriches the stock, and it promotes challenging questions. But being able to discuss issues together with some common assumptions is also important. So it's a challenge to help diverse theories flourish without total fragmentation, within a department or within a field.

Personality diversity is a good thing too, and diversity in intellectual style and intellectual interests. I reassure students that there are many ways to be a good linguist, and no one "great linguist" is a good role model for everyone.

Formalization is an excellent thing in moderation. When there's too little, claims are fuzzy and argumentation is sloppy. But there can be too much formalization, or premature formalization. So one shouldn't hesitate to share ideas in an informal state; looking at things from many points of view may help a good formalization emerge.

Compositionality is a powerful working hypothesis, but it is well known that it can't be an empirical hypothesis all by itself.

Why has Chomsky been so resistant to compositionality? My own speculation – and this is pure speculation – is that it may be related to his deep resistance to any kind of functional explanations in syntax. Semantics may seem too close to general cognitive faculties for comfort,[20] so compositionality might seem to weaken the thesis of autonomy of syntax. In fact it doesn't weaken descriptive autonomy at all: syntax can be described independently of semantics but not vice versa. What it weakens is explanatory autonomy: compositionality makes it natural for the acquisition mechanism to work on syntax and semantics in parallel. But isn't that reasonable?

It's sometimes good to write down non-results as well as results. I'll describe one article I didn't write that I've always regretted. Chomsky attacked compositionality in his 1974 Linguistic Institute Golden Anniversary lecture (Chomsky 1975) with an argument based on sentences like (5). He argued that one has to know whether the "whole sentence" is singular or plural to know whether *have wheels* has a genuinely plural meaning.

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[20]   But I believe formal semantics studies a highly structured language-specific system.

(5)   Unicycles have wheels.

In my reply (Partee 1975a) I argued against Chomsky's analysis (see (A7)), but I had no compositional alternative. I spent the following summer looking for one, exploring several approaches but hitting problems with each one. So I didn't write up any paper, but whenever anyone proposed an analysis, I could usually find counterexamples in my notes. So I always regretted not publishing a paper on my attempted solutions and the counterexamples I had found.

You never know in advance what your most valuable contributions will be. I guess I now think my own most valuable contributions have been in two areas.

One is in the synthesis of various diverse ideas. My work synthesizing Montague and generative grammar was my first big effort of that kind. That project has in a sense never ended.

My type-shifting work, which some colleagues regard as some of my best work, was also mostly synthesis. I respected the motivations behind different treatments of NP semantics, particularly Montague's vs. Heim's and Kamp's, and wanted to find a way that they could all be right. Back in Partee (1984a), I had discussed challenges to compositionality from cases where the "meanings of parts" seem not to be autonomous. And Rooth and I argued in our work on conjunction that the meanings of parts may shift in ways that allow composition to work smoothly. I began to see that when one part influences a meaning shift in another part, it isn't a violation of compositionality but something that happens because compositionality is one of several constraints that have to be satisfied.

My current work is also synthesis, of Russian and Western approaches to semantics, and lexical semantics with compositional semantics.

I think my other most valuable contribution has been in teaching, advising, working with students, especially graduate students. I'm very gratified when students say I'm good at making difficult things clear, and that I'm simultaneously demanding and supportive. I am at least as proud of the students I have worked with as of my publications. And I am grateful to them too; they have been as stimulating to work with as anyone could possibly wish for.

I think my strengths in teaching and in research are probably related. It's said that I'm good at understanding where questions are coming from and good at drawing connections. I suppose that's at the heart of my teaching and of my work – I like looking at things from different points of view, finding connections, and finding ways to bring together seemingly incompatible attractive ideas. I have definitely had wonderful environments to work in. I am grateful to colleagues and students in linguistics and philosophy at UCLA and at UMass, as well as in places where I have spent shorter periods. I'm not the kind of person who could have developed ideas in isolation. I'm grateful to all the teachers and students, friends and colleagues and family, who have touched my life and my work and helped to make it such an exciting, rewarding and joyful adventure.

Appendix: Example Sentences

Here is an annotated chronological list of some "Partee examples".[21] Following those, to set the record straight, is a "B-list" of examples I didn't invent which became known through my work or in my variants.

Part I   The A-list

(A1)   Few rules are both explicit and easy to read.
     In: Partee (1970a: 154), also as example (142) in Stockwell et al. (1973: 105).

This example and its non-equivalence to (6a) or (6b) were part of my argument with Lakoff about syntax and semantics.

(6)a.   Few rules are explicit and few rules are easy to read.
   b.   Few rules are explicit and to read few rules is easy.

The conjunction must be "phrasal conjunction" to get the semantics right, but then *easy to read* must be available as a phrase to be conjoined. Neither a classical transformational derivation nor a generative semantics derivation would provide that. I had no solution then, but it can be solved with the tools Montague provided (Partee 1973b), and with later non-transformational approaches.

(A2)   My home was once in Maryland, but now it's in Los Angeles.
     In: Partee (1970b: 369, ex. 37, and in footnote 10, p. 384), reprinted in Partee (1972: 245) and in this volume (chapter 2); also in Stockwell et al. (1973: 202).

This example is related to the well-known example (7).

(7)   The alligator's tail fell off, but it grew back.   (Postal 1967)

The point of my example was to contrast the behavior of *house* and *home* with respect to the kind of identity involved in coreference.

(A3)   John is building a house.
     In: Bennett and Partee (1972), pp. 13, 15 in 1978 version (chapter 4 in this volume.)

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[21]   Many colleagues helped me build a list, remembering examples, helping me figure out whether examples are "mine," helping track down citations, and giving encouragement with the project. My thanks to Luis Alonso-Ovalle, Emmon Bach, Greg Carlson, Shai Cohen, David Dowty, Elisabet Engdahl, Irene Heim, Paul Hirschbühler, Larry Horn, Theo Janssen, Nirit Kadmon, Angelika Kratzer, Jeff Pelletier, Craige Roberts, Hotze Rullmann, Roger Schwarzschild, Muffy Siegel, Anna Szabolcsi, Rich Thomason, Ede Zimmermann, and Sandro Zucchi. Space limitations required shortening the resulting list. I take full responsibility for inaccuracies, and would like to be informed of them.

I produced this example during discussion with Michael Bennett as he was writing his dissertation. It was a key piece of evidence for interval semantics, first proposed in our paper, reprinted in this volume.

(A4)   **The temperature is rising.**
       The temperature is ninety.
       do not together entail: Ninety is rising.
   In: Montague (1974: 267), originally in Montague (1973).

This is sometimes referred to as the "Partee puzzle." I first gave this example, in the form of a question, to David Lewis. He had stated (Lewis 1970) that intransitive verbs are never intensional with respect to subject position, and I was just learning about intensionality and trying to understand what that meant. So I tried to think what a counterexample should look like, and came up with examples about the temperature or the price of milk rising or changing, and wondered why they didn't count as intensional. And David told them to Montague, who provided an analysis in PTQ. But Dowty, Wall, and Peters (1981) have arguments against Montague's solution.

(A5)   **I didn't turn off the stove.**
   In: Partee (1973a: 602), reprinted (chapter 3) in this volume.

I used this example to argue against the standard tense–logic treatment of past tense as existential quantification over past times and in favor of considering tenses as pronoun-like. But the argument is not conclusive, because suitable domain restriction on the range of the variables could rescue a narrow-scope existential quantifier analysis, as various authors have pointed out. The debate continues.

(A6)a.   **Fred was trying to find the minutes before the meeting began.**
    b.   **Fred was looking for the minutes before the meeting began.**
   In: Partee (1974: 99, examples 53 and 54).

I used these examples to argue against decomposing *look for* into *try to find*. Sentence (A6a) has a scope ambiguity that (A6b) lacks. (This contrasts with the matched scope behavior of *want* and *want to have*.) This rather slender evidence is pitted against a strong constraint that intensional contexts are always proposition-embedding contexts. I think the jury is still out.

(A7)   **The boys gave the girls nickels.**
   In: Partee (1975a: 206).

This was my counterexample to Chomsky's claim that in *Unicycles have wheels*, where *wheels* is not "semantically plural," plurality should be a feature of the whole sentence. The dependent plural *nickels* can have either subject or object "licenser."

(A8)   **John is being hard to please/*It is being hard to please John.**
   In: Partee (1977: 303, examples 34 and 35).

I used this pair as a further argument (cf. A1) for deriving *easy/hard to please* as predic-ates. It was part of an argument for the existence of an "active verb *be*," bolstered by

examples (63) *John is being noisy* and (64) **The river is being noisy* on p. 307 of the same article. My conclusion that "active verb *be*" has a meaning something like "act" is challenged by Déchaine (1993).

(A9)a.   Green bottles have narrow necks.
    b.   The Coke bottle has a narrow neck.
    c.   ??The green bottle has a narrow neck.
(A9a) in Carlson (1977, 1980: 199); (A9b,c) in Krifka et al. (1995: 11, examples 24a, 24b).

Although I was sure that these were all in Carlson's dissertation, only the first is. The earliest instance (A9b,c) seems to be in Krifka et al. (1995). Greg (personal communication) supposes that he presented them in talks and in unpublished work, because they were definitely well known before 1995. Jeff Pelletier (personal communication) accepts responsibility for the fact that Krifka et al. (1995) say (p. 11) that (A9b,c) come from Carlson (1977) and that Carlson there attributes them to Barbara Partee. Jeff also believed that they were in Greg's dissertation, and Greg did always credit the examples to me. But Greg and others have searched the dissertation with care, and they're not there. The issue they illustrate is certainly there: non-natural kinds are fine in bare plurals, but in order to use a definite singular to denote a kind, the kind has to be "well established."

(A10)a.   One of the ten balls is missing from the bag. It's under the couch.
    b.   Nine of the ten balls are in the bag. #It's under the couch.
In: Partee (1989a: 363, fn. 13). Earliest occurrence is in Heim (1982: 21), in the following version (credited to me, but this version may be her variation):

(21)a.   I dropped ten marbles and found all of them, except for one. It is probably under the sofa.
    b.   ?I dropped ten marbles and found only nine of them. It is probably under the sofa.

In either version, the contrasting pairs provide an argument for Heim's file change semantics: the pronoun needs a linguistic antecedent, not just a salient entity.

(A11)   The department wants to hire a phonologist or a phonetician.
In: Partee (1983: 375, example 37).

A comparable example, *Mary is looking for a maid or a cook*, occurs in Rooth and Partee (1982: 355, example 13). In both versions, the puzzle is the existence of a reading on which each disjunct is understood intensionally (non-specifically), and yet *or* has wide scope ("but I don't remember which"). The problem is a central topic of Rooth and Partee (1982).

(A12)   Every search for two men with red hair failed.
In: Rooth (1985: 114), attributed to me with no particular source.

I believe I first began using this example in class and in oral discussions in the early 1980s. There is a three-way ambiguity, where one reading (where "two men" has

narrower scope than *every* but is outside the scope of *search for*) requires "Quantifying In" to the CNP, in addition to an *in situ* reading and a widest scope reading.

(A13)   any triangle such that two sides are equal.
   In: Marsh and Partee (1984: 187), also cited in Pullum (1986: 136).

This NP has a *such-that* relative clause containing no bound pronoun. We used it as evidence that *syntax* does not prohibit "vacuous binding," although the clause is interpreted as a property of triangles (as if "sides *of it*"). We noted that putting such constraints in the syntax could affect the generative power required. We suggested that any constraints on vacuous binding belong in the semantics, since semantics must deal with variable-binding anyway. Higginbotham (1984) dismissed my example as ungrammatical but interpretable, and argued that English is not context-free. See discussion in Pullum (1986).

(A14)   John often comes over for Sunday brunch. Whenever someone else comes over too, we (all) end up playing trios. (Otherwise we play duets.)
   In: Partee (1989a: 358, example 27), in this volume (chapter 13).

This example shows that *we* can consist of deictic *I* plus a "coreferential" pronominal part (coreferential with *John*) plus a bound pronominal part.

(A15)a.   My 2-year-old son built a really tall snowman yesterday.
   b.   The DU fraternity brothers built a really tall snowman last weekend.
   In: Kamp and Partee (1995: 142).

We used this pair to support the claim, from Kamp (1975), that an adjective like *tall* is extensional but vague and context-dependent. The noun is the same in both cases, but the sentences as a whole evoke contexts with different norms for heights of snowmen.

(A16)   a midget giant *vs.* a giant midget *vs.* (be) a giant and a midget
   In: Kamp and Partee (1995: 159).

We used these to argue that in "calibrating" vague context-dependent Adj–Noun combinations in context, one first calibrates the noun in context, and then one calibrates the adjective in the context as restricted by the noun.

Part II   The B-list

(B1)   Either this house doesn't have a bathroom or it's in a funny place.
   In: Roberts (1989: 702).

The example is mine, generated during a lecture of Hans Kamp's in 1982. But I wasn't the first to think up such examples. Roberts (1989: 702) cites my example, and mentions in a footnote a very similar example from Evans (1977): *Either John doesn't own a donkey, or he keeps it very quiet*. I had read Evans, and I may have unconsciously plagiarized. Nirit Kadmon points out (personal communication) the similarity to Gazdar–Soames

presupposition examples such as *If Mary's boss doesn't have children, then it wasn't his child who won the fellowship.*

But the example is evidently memorable and attribution to me has continued. Roberts (1996: 243), cites it again and states "Examples like [B1], originally due to Partee, are often cited in discussions of anaphora in discourse," and she lists numerous citations. The variant *Either Morrill Hall doesn't have a bathroom or it is in a funny place* is attributed to me in Chierchia (1995: 8, example 23a).

(B2) John needed and bought a new coat.
    In: Partee and Rooth (1983: 366, example 15).

This is an example of a conjunction of an intensional and an extensional verb, handled correctly by our rules for generalized conjunction. As our footnote 8, p. 365, says: "We owe the observation that the conjunction of an intensional and an extensional verb fits the predictions of the schema to Wynn Chao."

(B3) Every man faced an enemy.
    In: Partee (1984a: example 34).

This example and several other related ones may indeed be mine, but the first such examples came from my dissertation student Jonathan Mitchell, who noticed context-dependence with words like *local.* Mitchell later completed his dissertation (Mitchell 1986), but did no more on the topic. I continued to develop it in Partee (1989a), which includes example (A14) as well as (8) with *local*, attributed to Mitchell, and (9) with *notice*, from Dowty (1982).

(8) Every sports fan in the country was at a local bar watching the playoffs.

(9) Every man who shaves off his beard expects his wife to notice.

Attributions of examples with *local* are a bit circular. In my papers cited above, I present the examples with *enemy* as mine, but I attribute examples with *local* to Jonathan Mitchell in Partee (1989a). But Craige Roberts's memory is that I invented an example like (8) for Jonathan's dissertation. Probably I did invent the specific example (8); I think Jonathan had examples with *local newspaper*, and I was concerned that *local newspaper* had an interfering reading as a *kind* of newspaper.

(B4) There were few faculty children at the 1980 picnic.
    In: Partee (1989b: 395), with attribution to Alison Huettner.

The example is due to Alison Huettner, from an unpublished, untitled UMass 1984 term paper on *few* and *many* for a seminar co-taught by Bach, Kamp, and Partee. The point of the example, a novel idea of Huettner's, is that sometimes "few" can be "all," and in such cases it clearly must be cardinal, not proportional.

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Chapter 2

Opacity, Coreference,
and Pronouns

2.1   Introduction

The main concern of this paper is the relation between pronouns and their antecedents. A view widespread among linguists, first stated by Postal (1968), is that the relation is one of (presupposed) *coreference*. Philosophers tend to regard pronouns in the vernacular as generally analogous to variables in a logical notation, and many linguists are coming to share this view for at least some instances of pronouns. In order to dispute the adequacy of coreference as a basis for all pronominalization[1] (section 2.3), it is necessary first to discuss the distinction between referential and non-referential noun phrases (section 2.2). The treatment of pronouns as variables is brought up in section 2.3.3, and the possibility of treating all pronouns in that way is discussed in section 2.4.

2.2   Referential and Non-referential Noun Phrases

In both the philosophical and the linguistic literature there has been general recognition of the ambiguity of sentences like the following:

(1)   John would like to marry *a girl his parents don't approve of.*

The description of the ambiguity can take a variety of forms. Informally, we can say that in one case John has a particular girl in mind to marry, and the fact that his parents don't approve of her is descriptive information about that girl; in the other case, no particular girl is meant and it might even be the case that no such girl exists – here having the disapproval of his parents is not a description of a particular girl whose hand John is seeking but an attribute John will consider in his wife-hunting. Some linguists (e.g. Fillmore 1967) have suggested that the ambiguity be represented as a distinction between two

indefinite articles, distinguished by a feature [±Specific]. Some linguists and many philosophers prefer to represent the ambiguity as one of scope of an existential quantifier (in some sense realized as the indefinite article), i.e. as (2) vs. (3) or something of the sort.

(2) $(\exists x)$ (x is a girl John's parents don't approve of $\wedge$ John would like to marry x)

(3) John would like $(\exists x)$ (x is a girl John's parents don't approve of $\wedge$ John marries x)

Another way of describing the ambiguity follows the distinction made for definite noun phrases by Donnellan (1966) between a *referential* and an *attributive* use of a noun phrase, about which more will be said below. Still others have characterized the difference as stemming from whether or not there is a presupposition on the part of the speaker and/or on the part of John[2] that an object fitting the description actually exists.

   These characterizations of the ambiguity of (1) are not unrelated to each other, and without further evidence there is no particular reason to regard any one of them as more incisive than any other. It is therefore helpful to consider what sorts of sentences (1) may be taken as exemplifying. The sentence contains the verbal expression *would like*, an expression which is commonly said to designate a 'propositional attitude' (e.g. Quine (1960)), like *believes, hopes*, and perhaps *tries*. Such verbs can be followed by sentences (which may be transformed into infinitive phrases or gerunds, depending on the syntactic requirements of the governing verb), and the noun phrase positions in these embedded sentences are *opaque*, according to Quine's definition (1960: 142–6), since substitution of coreferential terms in these positions does not necessarily preserve truth-value: cf. examples (4) and (5).

(4) John believes that *Cicero* denounced Catiline.

(5) John believes that *Tully* denounced Catiline.

The type of ambiguity exemplified by sentence (1) has quite commonly, I believe, been held to occur only in opaque contexts. Thus further examples would typically be:

(6) Dick Tracy believes that *a man with the third finger of his right hand missing* killed the Painted Lady.

(7) Bill is trying to catch *a snipe*.

And it is ordinarily assumed, I think, that the indefinite noun phrases in the following sentences are unambiguous, having only the sense of 'a particular individual'.

(8)   John married *a girl his parents didn't approve of*.

(9)   Bill caught *a snipe*.

This view stems, I imagine, from thinking of the ambiguity in (1), (6), and (7) as characterized primarily by the presence or absence of the presupposition that an object fitting the given description exists. Clearly in (8) and (9), unlike (1) and (7), there is such a presupposition of existence. Sentences (1) and (7), but not (8) and (9), could be followed without anomaly by the clause 'but no such creature exists'.

   I think there may be a confusion here, however, and that by comparing an ambiguity in definite noun phrases discussed by Donnellan (1966), one may come around to the view that opaque contexts just make particularly signific-ant an ambiguity which is actually present in a much broader range of cases. Consider example (10):

(10)   John wants to murder *the man who lives in Apt. 3*.

The object of the embedded sentence is a definite noun phrase, and any inter-pretation of the sentence includes a presupposition that such a man exists. But there are still two different interpretations of the sentence which are quite parallel to the two interpretations of sentence (1). Under one interpretation, the object of John's hatred is a particular individual, and the definite descrip-tion is being used by the speaker to refer to that individual. Under the other interpretation, John may not know who lives in Apt. 3, but because he lives directly below Apt. 3 and is fed up with the noise above him he has decided that he wants to kill whatever man it is that lives up there. This second use of the definite noun phrase is what Donnellan calls 'attributive' as opposed to referential. Now if it is true that this ambiguity is parallel to the ambiguity in (1), then there is something more than a presupposition of existence at stake, since both senses of (10) include such a presupposition. Furthermore, it is quite easy to see that opacity is not necessary to produce ambiguities like those in (10). Consider (11), which is a slight variant of an example of Donnellan's:

(11)   *The man who murdered Smith* is insane.

There is no evident opacity involved, but there are still two ways the definite noun phrase may be understood: either the speaker is asserting of a particular individual, referred to by the definite noun phrase, that that individual is insane; or the speaker is asserting that whoever it is that murdered Smith is insane – i.e. the definite noun phrase gives a characterization of an individual not necessarily otherwise known,[3] and the sentence asserts that whatever indi-vidual is so characterized may be further characterized as insane. But the existence of such an individual is still presupposed in both interpretations, since the use of the definite article always carries such a presupposition. Thus

the distinction between the referential and attributive uses of noun phrases must be independent of the distinction between noun phrases with existential presuppositions and those without, at least for definite noun phrases.

Now let us turn back to the indefinite noun phrases. Consider (12):

(12)   John succeeded in marrying *a girl his parents didn't approve of*.

It seems to me that there is now a clear presupposition that such a girl exists, but that there are still two interpretations matching those of (1): i.e. either he succeeded in marrying *that girl* or he succeeded in marrying *such a girl*. I am not clear as to whether philosophers would typically regard 'succeed in' as setting up an opaque context or not; but I am quite sure that (8) and (9) would not be regarded as opaque, and just a little exercise of the imagination can, I think, convince one that they can be used as reports of success with the same ambiguity[4] as (12).

What I am trying to suggest is that the ambiguity exemplified by sentence (1) is restricted neither to indefinite noun phrases nor to opaque contexts; it is present in most of the examples considered so far, although one interpretation may be much more natural than the other in some contexts. The prominence of one or the other reading appears to depend on the relation between the significance of the description used in the noun phrases and whatever else is asserted in the sentence. The italicized noun phrases in the following sentences are most likely to be interpreted referentially, since their descriptive content has no particularly strong semantic relation to the content of the rest of the sentence, and is much more easily interpretable as intended to identify or partially identify a particular individual.

(13)   John is dating *a girl from Alabama that he met several summers ago*.

(14)   We left the dog tied to *the back fence*.

Names are almost always used referentially, since they have virtually no descriptive content; the same is true of indefinite noun phrases of the form *a certain x*.

In the non-referential, or attributive, use of a noun phrase, the concern is not with naming a particular object but with giving descriptive characteristics which are semantically significant as part of the content of the sentence. There may often be an associated object, as in (8), (9), (12) and in (15) below, and presumably with all the definite noun phrases. But in such cases the rest of the sentence is not simply about the object *qua* object, however; the particular description used is essential to the meaning of the sentence. An example which seems unambiguously non-referential may help to illustrate this point:

(15)   Since I heard that from *a doctor*, I'm inclined to take it seriously.

In (15) we may suppose that whatever it was that the speaker heard was something to which the special competence of doctors is relevant. If we replace *a doctor* by some other phrase, we get rather different interpretations of what sort of thing was heard:

(16)   Since I heard that from *a fellow who lives upstairs*, I'm inclined to take it seriously.

Note that the most natural interpretation is still attributive rather than referential; but now to make any sense of it we must assume that what was heard was something to do with conditions on the upper floors or the like – i.e. something to which this fellow's living upstairs has relevance. Why, by the way, are we disinclined to read either (15) or (16) as referential? Such an interpretation would be something like 'Since I heard it from x, I'm inclined to take it seriously', where x is a particular individual whom we identify to our hearer by some description. Now either the hearer also knows x or he doesn't; if he does, then we will use a definite noun phrase rather than an indefinite one; and if he doesn't, then we will want to find a description which indicates to our hearer why x's word is to be taken seriously – but this *is* to use the description attributively.

There are some interesting ways in which such a noun phrase can be interpreted referentially.[5] Suppose, for sentence (16), speaker and hearer share the information that all the fellows who live upstairs are engineering students who know all about engines and motors and such, and thus count as reliable sources of information about car troubles, for instance. Then (16) *may* be (although it still need not be) taken as referential, in that the speaker might just as well have said 'John Jones', but has chosen not to pick out for his hearer *which* member of this set they are both familiar with he is talking about. Then living upstairs is not itself what makes the fellow's word reliable, but simply provides a description which is sufficient to narrow down the class of possible referents to some whose reliability is accounted for by other characteristics.

If sentence (17) below is to be regarded as contained in sentence (15), the fact that *a doctor* in (15) is interpreted non-referentially would seem to offer further support to the claim that even a non-opaque sentence like (17) should be represented as ambiguous.

(17)   I heard that from *a doctor*.

Otherwise, if (17) is regarded as necessarily referential, (17) cannot be contained in (15). Furthermore, the following two-sentence discourse, which certainly contains (17), would be quite bizarre if *a doctor* could not be understood attributively.

(18)   I heard that from *a doctor*. That's why I'm inclined to take it seriously.

Having argued that the ambiguity in sentence (1) is quite general in both definite and indefinite noun phrases, let us return to the question of how it is to be regarded. The ambiguity does not depend on a presupposition of existence, as witnessed by all the examples with definite descriptions and by sentences like (12). The ambiguity also does not seem to be uniformly regardable as a scope difference, since (a) examples like (8), (9), and (11) have no place to vary scope; and (b) cases with definite noun phrases like (10) remain ambiguous even if the scope of the definite description is varied (i.e. *The man in Apt. 3 is such that . . .* is still ambiguous).

The two remaining possibilities for representing the ambiguity, namely Fillmore's [± Specific] indefinite article and Donnellan's referential/attributive distinction suffer only from the fact that the former is restricted to indefinites[6] and the latter to definites. It seems reasonable, therefore, to suggest that one or the other term be generalized to cover both the indefinite and the definite cases. I will continue to use the terms referential/attributive or referential/ non-referential for both cases (even though there may be some discomfort felt in using the term 'referential' for indefinites) since they are easiest to relate directly to the notion of coreference. Whether the ambiguity should be considered syntactic, semantic, or pragmatic, I still leave open.

2.3   Semantic Relations between Pronouns and their Antecedents

2.3.1   Linguistic treatments of pronouns; coreference

The linguistic literature on pronouns is extensive and increasing rapidly; I will give here only a brief sketch of the aspects most relevant to the present discussion.[7]

In the earliest transformational grammars, it was suggested that a pronominalization transformation optionally replaces a repeated noun phrase by a personal pronoun. Thus (20) could be derived from (19), and (22) from (21).

(19)   John lost *a black pen* yesterday and Bill found *a black pen* today.

(20)   John lost *a black pen* yesterday and Bill found *it* today.

(21)   I pushed *the empty box* and *the empty box* fell over.

(22)   I pushed *the empty box* and *it* fell over.

On such a view, all anaphoric pronouns were regarded as what Geach (1964) calls 'pronouns of laziness'; reference was considered irrelevant to the syntax.

Later the pronoun *one* was brought into the picture as an alternative replacement for a repeated indefinite noun phrase:

(23)   John lost *a black pen* yesterday and Bill found *one* today.

The contrast between *one* and the personal pronouns has been variously regarded. Some linguists consider (23) and (20) both to be directly derivable from (19), the choice of pronouns resulting in different semantic interpretations as to coreferentiality. Others argue that only (23) is directly derivable from (19), with (20) passing through an intermediate stage, (24) below, so that the difference in coreferentiality is pinned on the 'definitization transformation'.

(24)   John lost *a black pen* yesterday and Bill found *the black pen* today.

Following this latter tack, it has been suggested that the pronoun *one* in fact never replaces noun phrases at all, but only nouns, and does so regardless of whether the containing noun phrase is definite or indefinite. Examples (25) and (26) below show this possibility clearly, and example (23) can be regarded in the same way, since it can be argued that rules are independently needed which would change *a black one* to *a one* and then to *one*[8] (see Stockwell et al. 1973).

(25)   John lost a black *pen* yesterday and Bill found a gray *one* today.

(26)   I pushed the empty *box* and the full *one* fell over.

Postal (1968) was one of the first to seriously argue that reference should be represented in the syntactic structure, and that the formation of personal pronouns should depend on coreferentiality, not simply on formal identity. According to his proposals, the italicized noun phrases in (19) would carry referential indices, and (20) would be derived (via (24)) only if those indices were identical.

Other recent suggestions include the possibilities that definitization and pronominalization may not be transformational rules at all, so that all of the definite articles and personal pronouns in sentences (19)–(26) might be generated directly in the base component, with semantic rules assigning the possible anaphoric relations. But even within such an 'interpretive' approach to pronominalization, coreference is accepted as the fundamental relation to be assigned to a personal pronoun and its antecedent by such interpretive rules.

A first look at some sentences whose noun phrases can be interpreted non-referentially will support the view that coreference is the basis of the pronoun–antecedent relation. Consider the following sentences:

(27)   John was looking for *a gold watch* and Bill was looking for *a gold watch* too.

(28)   John was looking for *a gold watch* and Bill was looking for *the gold watch* too.

(29)   John was looking for *a gold watch* and Bill was looking for *it* too.

(30)   John was looking for *a gold watch* and Bill was looking for *one* too.

   If both noun phrases in (27) are interpreted as referential, and the referents are the same, then (27) must be converted into either (28) or (29), which are synonymous. If both are referential but the referents are not the same, then (27) may optionally be converted to (30), but not to (28) or (29). The same is true if neither noun phrase is referential. It is hard, perhaps because of the parallel structure of the two clauses, to imagine an interpretation with one of the noun phrases referential and the other not. Such an interpretation may be possible for a sentence such as the following:[9]

(31)   She's marrying *a doctor* next week – someday I would like to marry *one* too.

If this can be interpreted with the first *a doctor* referential and the second non-referential, then it appears that the same pronominalization facts hold for such a case as for the cases where both noun phrases are non-referential or both are referential but with different referents.

   It would appear from sentences (27)–(31) then that a personal pronoun is substituted for one of two noun phrases only when both noun phrases are referential and furthermore coreferential;[10] all other combinations appear to allow only pronominalization to *one*. In the following section, we will show that the situation is not so clear-cut.

2.3.2   Pronouns with non-referential antecedents

2.3.2.1   *Definite noun phrases*.   The following sentences are similar to (27)–(29) except for containing definite noun phrases:

(32)   John was looking for *the man who murdered Smith* and Bill was looking for *the man who murdered Smith* too.

(33)   . . . and Bill was looking for *him* too.

Here both sentences are ambiguous as between referential and non-referential use of the noun phrases. (Whether it is possible here to interpret one noun phrase as referential and the other not is a question beyond the subtlety of my intuitions.) The puzzling thing about (33) is that *him* can occur in the interpretation where neither noun phrase is referential, although it couldn't in the corresponding indefinite case, (30). It is possible to maintain that coreferentiality is involved even in this non-referential case, however, by looking at the presuppositions involved in the use of the definite article with a singular noun phrase.

Compare (27) and (32) in the senses where neither noun phrase is referential. In both cases John and Bill will each consider their searches successful when they find something that fits the given description. However, the use of the indefinite article in *a gold watch* signals the presupposition that there may be more than one gold watch (or possibly none), whereas the use of the definite article in *the man who murdered Smith* signals a presupposition that there is one and only one such man. Hence in the definite case only, the object of John's search, to be consistent with the presuppositions of the sentence, *must* be coreferential with the object of Bill's search even though neither of them may have any idea what particular object that object is. The coreferentiality is here determined by inference from the presuppositions underlying the use of definite article. In the case where the noun phrases are used referentially, the coreferentiality could be determined simply by comparing the referents to see if they are the same; but the non-referential case suggests that the notion of coreferentiality that is playing a role in pronominalization is not dependent in this way on a prior identification of referents for the noun phrases.

Although the foregoing argument may seem a plausible way to save the primacy of coreferentiality, examples like the following appear to refute it.

(34)   John claimed to have found *the solution to the problem*, but Bill was sure he had found *it*.

(35)   Senator Green believed that he had nominated *the winner of the election*, but Senator White believed that she had nominated *him*.

(36)   John thought *the author of that book* was probably a man, but Bill thought *it* was more likely a woman.

Each of these sentences is ambiguous as between referential and non-referential use of the noun phrases. In the referential sense, the three sentences describe disputes over which of two people found a certain solution, which senator nominated a certain person, and what the sex of a certain known individual is, respectively; in all of these cases, coreference is involved in the ordinary way. In the non-referential senses, however, the disputes seem actually to be over the referents of the descriptive phrases. In (34), for instance, John claims that the thing he has found is the solution to the problem, while Bill claims that the solution is the thing he has found. Thus in spite of a presupposition that there is one and only one solution to the problem, the two noun phrases apparently have different referents. In (35), similarly, the non-referential sense involves an argument over who the winner of the next election will be, the one nominated by Green or the one nominated by White. Thus the argument appears to be over the referent of the noun phrase, so that again the two occurrences are not coreferential. Sentence (36) is similar, with the added twist that *it* is used here for a human, in spite of the fact that *he* is the usual sex-neutral human pronoun; the use of *it* may perhaps be

explainable on the grounds that the gender in this case is not simply unknown but actually in dispute, and either *he* or *she* would seem to beg the question.

Sentences (34)–(36) in their non-referential senses thus appear to violate the principle of coreference. The noun phrase pairs appear instead to be 'codesignative', or 'cosignificant', but so presumably are the non-referential interpretations of the noun phrases in an indefinite case such as (27), and these do not allow personal pronouns. Thus sentences like (34)–(36) appear to constitute a real problem for any attempt to find a uniform basis for the pronoun–antecedent relationship.

It may be possible to argue that coreference is still the basic relation even in these cases by appealing to the sort of examples given in note 10, one of which is repeated below as (37). That is, if I can talk as in (37) about *my home* having been in one place and now being in another even though two different 'physical referents' are involved, it seems a small step to imagine a dispute taking place as to where my home is, as in (38).

(37) *My home* was once in Maryland, but now *it*'s in Los Angeles.

(38) John thinks *my home* is in Maryland, but Bill thinks *it*'s in Los Angeles.

Now in (38) the speaker is clearly not involved in the dispute, and there is therefore no reason to say that he assigns two different referents to the two noun phrases. But from (38) it is not such a large step to sentences (34)–(36), so perhaps we should conclude that the mere fact that a sentence describes a dispute over the referent of a noun phrase does not by itself establish non-coreferentiality. (The speaker may take sides in the dispute, but he cannot, as it were, take both sides at once.)

2.3.2.2 *Indefinite noun phrases.* Let us now turn to some examples which violate the earlier generalization suggested for pronominalization with indefinite antecedent. What was suggested on the basis of sentences (27)–(31) was that with indefinites, both referentiality and coreferentiality were required for the use of the personal pronoun; but in the examples given, there was no way to imagine coreferentiality holding independently of referentiality. But there is a class of sentences which has been discussed recently in the linguistic literature (e.g. Baker 1966; Karttunen 1968a, 1968b; Dean 1968) where personal pronouns can have non-referential indefinite antecedents.

(39) John wants to catch *a fish* and eat *it* for supper.

(40) If John marries *a girl his parents disapprove of*, they will make life quite unpleasant for *her*.

(41) I expect that John will buy *a car* and that he will drive *it* to work every day.

Sentences (39)–(41) are all perfectly well-formed and interpretable as having non-referential noun phrases in the antecedent position. They are clearly different from (29) – note that we could insert parenthetically 'any old fish' after 'a fish' in (39), but we could not insert 'any old gold watch' after 'a gold watch' in (29). How can we account for this pronominalization then?

We clearly cannot infer coreferentiality from any presuppositions here as we could for the non-referential reading of (33). What's happening here seems to be more complex: let us look particularly at sentence (40) and consider what sorts of noun phrase could paraphrase the final pronoun. I claim that (42) provides a rough paraphrase but (43) does not:

(42)   . . . , they will make life quite unpleasant for *the girl he marries*.

(43)   . . . , they will make life quite unpleasant for *the girl they disapprove of*.

From this we can conclude that the second clause of (40) carries a presupposition that John marries one and only one girl, since such a presupposition is generally signalled by the definite article, but does not presuppose that only one girl fits the description provided by the indefinite noun phrase in the first clause. (That the presupposition is still in some sense a hypothetical one is signalled by the use of a simple present tense *marries* in the final relative clause of (42) rather than a plain future *will marry*. This kind of tense shift is characteristic of if-clauses and other 'hypothetical' subordinate clauses.) Janet Dean (1968) has pointed out that for sentences like (39) and (41), the noun phrase most nearly equivalent to the pronoun is as in (44) and (45), not (46) or (47):

(44)   John wants to catch *a fish* and eat *the fish he catches* for supper.

(45)   . . . and that he will drive *the car he buys* to work every day.

(46)   John wants to catch *a fish* and eat *the fish he wants to catch* for supper.

(47)   . . . and that he will drive *the car that I expect him to buy* to work every day.

Thus one way of looking at these sentences is to say that in the first part of the sentence, the context describes a possible state of affairs or possible world in which an object of a certain sort is involved. Fulfillment of this state of affairs is in all these cases such that there would then be a unique object responsible for making the hypothetical world actual. That is, in (39), where John wants to catch a fish, we know what defines success, namely the first fish he catches (whether or not he then catches others); similarly, the satisfaction of the antecedent of (40) involves John's getting married, which then establishes a unique girl to whom he is married (note that John's marriage would *not*

establish a unique girl his parents disapprove of); in (41), if the first part of my expectation is fulfilled, there will then be a unique car whose purchase fulfilled that expectation.

The second part of the sentence, the part containing the pronoun, makes sense in all of these cases only when interpreted as presupposing the actualization of this possible state of affairs. That is, John can't eat a fish until he actually catches one; John's parents are not going to harass such a girl until John has gotten married to one; John isn't expected to drive a car until he has bought one. Consequently the second part of the sentence presupposes the existence of the unique object which was responsible for actualizing the state of affairs – the caught fish, the married girl, the bought car. Coreference then is *not* directly between the noun phrase in the first part of the sentence and that in the second; the antecedent for the coreference is in fact not expressed *as a noun phrase* anywhere in the sentence. Coreference rather seems to be with that unique though hypothetical entity which would be crucially involved in actualizing the possible world characterized in the first part of the sentence.

Notice how this kind of account properly excludes (29) from being interpreted with the first noun phrase non-referential. The first part of the sentence could indeed describe a hypothetical state of affairs which would become actual on John's finding a gold watch. But the second half of the sentence does *not* presuppose the actualization of that state of affairs and hence does *not* presuppose the existence of a unique gold watch found by John.

Also excluded are (48) and (49) below (in a non-referential sense), since the hypothetical state of affairs described in the first clause cannot be correlated with a unique entity which could then be presupposed in the second clause.

(48)   *John probably won't catch *a fish*, though he'd like to eat *it* for supper.

(49)   *I expect that John will not buy *a car* and that he will not drive *it* to work every day.

But note the following sentence, which does allow pronominalization in a context superficially similar to that of (48).

(50)   John won't buy *a car* because he wouldn't have room for *it* in his garage.

Here the explanation, syntactically suggested by the conditional *wouldn't* in the second clause,[11] seems to be that (50) is actually a result of ellipsis from something like (51):

(51)   John won't buy *a car* because if he did buy *a car*, he wouldn't have room for *it* in his garage.

Then the second *a car* can be seen to be a proper antecedent for the *it* exactly in the manner of (40).

Note the difference incidentally, between a second occurrence which pre-
supposes actualization and a second occurrence which asserts it: only the
former allows pronominalization if the first occurrence is non-referential.

(52)   John was trying to catch *a fish*. He wanted to eat *it* for supper.

(53)   John was trying to catch *a fish*. He finally caught *it*.

The second sentence of (53) is not a possible continuation of the discourse if
a fish in the first is non-referential because it asserts instead of presupposing
the actualization of the fish-catching.

The pair of sentences of (52) also show that pronominalization with non-
referential indefinite antecedent is not a matter of both noun phrases being
within the same opaque context, since neither *want* nor *try* in (52) is under the
scope of the other. In fact, the second of a pair of non-referential noun phrases
within a single opaque context does *not* ordinarily pronominalize to *it*, but
only to *one*, just as in the non-embedded examples (27)–(31).

(54)   John wants to catch *a fish* or buy *one*.

(55)   If Susan married *a rich man* and Sally married *one* too, Clara would be
       jealous.

For this reason, the following examples are somewhat puzzling, since they
do seem to involve a pair of noun phrases being within the same opaque
context, without the second occurrence presupposing any sort of fulfillment
of hypothesis.

(56)   The agency is looking for *a model* to use in the toothpaste ad; *she* must
       have red hair and freckles.

(57)   We need *a secretary* and we need *her* soon.

Note that (57) is very closely paraphrasable by (58):

(58)   We need *a secretary* and we need *one* soon.

It seems that (57) comes closer than (58) to presupposing that one will in fact
find a secretary, but the second clause of (57) cannot be said to presuppose the
actual finding in the way that the second clause of (39) or (52) presupposes the
catching of a fish.

There are no straightforward syntactic clues that serve to identify those
non-referential cases where pronominalization is appropriate; the following
sentence pairs certainly have very similar superficial syntactic structure, and
I know of no arguments for giving them clearly contrasting deep structures.

Yet the pronoun in (59) is quite normal and that in (60) bizarre; (60) would sound natural with *one* instead of *him*.

(59)   Susan would like to marry *a millionaire* and run off with all his money. If she doesn't divorce *him* within a couple of years, her plan will probably go awry.

(60)   Susan would like to marry *a millionaire* and run off with all his money. If she doesn't meet *him* within a couple of years, her plan will probably go awry.

The only difference between (59) and (60) is that between the verb *divorce*, which presupposes marriage, and *meet*, which (in our culture at least) excludes that presupposition.[12]

2.3.2.3   *Quantified noun phrases and related cases.*   In all of the examples treated so far, it has been possible to regard the personal pronoun as in some sense a replacement for a noun phrase identical to the antecedent noun phrase, i.e. as a 'pronoun of laziness'. But when the antecedent contains a quantifier or a word like *only*, it is no longer semantically plausible to so regard the pronoun.

(61)   *No one* would put the blame on *himself*.

(62)   If *anyone* had been there, I would have seen *him* (*them*).

(63)   *Nearly every doctor* gives special attention to patients whose cases interest *him*.

Logicians have typically been much more concerned with pronouns of this sort than with the sorts exemplified earlier, and therefore need no introduction to the idea, found for instance in Quine (1960, 1961), that pronouns might be represented as bound variables. I discuss it here in part because it is still a relatively new approach within the linguistic literature, but more importantly in order to raise some questions about the domain of its applicability. Geach (1967) for one has made it clear that he does not regard all pronouns as corresponding to bound variables, but neither he nor anyone else that I know of has tried to draw a sharp line between those pronouns that can (or should) be regarded as bound variables, and those that cannot (or should not). As a preliminary to opening up this problem (to which I do not have a solution), I will indicate in this section some of the uses of pronouns to which the bound variable treatment seems particularly appropriate.

In sentences (61)–(63), the pronouns are clearly not substitutions for *no one*, *anyone*, and *nearly every doctor*. Furthermore, the question of who the pronouns refer to does not even seem to make sense. In the examples of the preceding section, singular pronouns appeared to have some sort of reference, even when

the individual referred to was in some sense hypothetical. But in (61)–(63) the singular pronoun certainly does not refer to any one individual, even hypothetically. Nor, as Quine and Geach have pointed out, do the antecedents refer to any individual or any set; sentences (61) and (62) say something about the set of all people and (63) about the set of all doctors, but not because the italicized noun phrases in any sense *refer* to those sets.

The notation of quantificational logic was designed in part to represent perspicuously just such pronoun usage. Sentences (61)–(63) can be represented in something quite close to that notation with relatively little violence to their overt syntactic structure,[13] e.g. as in (64)–(66) below:

(64)   Not (there is some person *x*) (*x* would put the blame on *x*)

(65)   ([for] any person *x*) (if *x* had been there, I would have seen *x*)

(66)   ([for] nearly every doctor *x*) (*x* gives special attention to patients whose case interests *x*)

Note that this sort of representation requires an overt distinction between the two roles simultaneously played by a quantified noun phrase in the vernacular, namely the binding by the quantifier and the role of the noun phrase as one of the arguments of some predicate. In the formula (65) there has in addition been a change in the relative scopes of the quantifier and the *if*, since the surface form of (62) does not show how the pronoun can be within the scope of the quantifier.[14] Whether such differences should be regarded as due to some sloppiness in natural language or as unnatural artifacts of the formal language is an open question.

Another instance of the usefulness of variables and binding to elucidate the role of pronouns is a classical example which is discussed by Geach (1962) and more recently by a number of linguists. The formulas below the two sentences suggest very roughly how variables may be involved.

(67)   Only *Lucifer* pities *Lucifer*:
       only for *x* = Lucifer (*x* pities Lucifer)

(68)   Only *Lucifer* pities *himself*:
       only for *x* = Lucifer (*x* pities *x*)

The non-referentiality of *himself* in (68) matches that of the prefix *self-* in (69) below:

(69)   Only Lucifer is self-pitying.

The following pair of examples appear at first blush to resemble the plain non-referential indefinite cases of the preceding section,[15] since the antecedent

is clearly non-referential in each case; but the semantic connection between pronoun and antecedent is clearly not of the 'hypothesis – presupposition of fulfillment' type.

(70)   John couldn't catch *a fish* if *it* jumped into his lap.

(71)   Susan wouldn't marry *a man with less than a million dollars* if *he* were the last man alive.

Note that *a* in these two examples could be replaced by *any* and that the *if*s are implicitly *even if*s. Thus the sentences might be represented roughly as follows:

(72)   (any fish *x*) (even if *x* jumped into John's lap, John couldn't catch *x*)

(73)   (any man with less than a million dollars *x*) (even if *x* were the last man alive, Susan wouldn't marry *x*)

   (The sentences (70) and (71) seem to be unusual in that *one* or *such a one* could be used instead of the personal pronouns with virtually no change in the total meaning of the sentence. But actually the usual difference between *one* and a personal pronoun is present here as well: if *one* were used in (70) or (71) it would be only by our understanding of the situation described by the sentence that we would infer any sort of sameness between a fish to be caught and a fish in the lap, or a man to be married and the last man alive.)
   Another interesting case where the use of variables does not at first seem called for is the following ambiguous sentence, to be read with primary stresses (´) on *John* and *Bill* and weak stresses (˘) on *his wife*.

(74)   *Jóhn* was kissing *hĭs* wĭfe and *Bíll* was kissing *hĭs* wĭfe too.

One's first impression is that all the noun phrases are referential, the ambiguity resting simply on whether the second *his* is *Bill's* or *John's*. If the second *his* is interpreted as *John's*, a purely referential reading seems quite appropriate. The stress pattern is then like that of (75):

(75)   Jóhn was kissing Mǎry and Bíll was kissing Mǎry too.

But I want to suggest that the other reading is not simply a substitution of *his* for *Bill's*. Suppose Mary is John's wife and Susan is Bill's wife; one cannot with the stress pattern of (74) and (75) say:

(76)   *Jóhn was kissing Mǎry and Bíll was kissing Sŭsan too.

Nor is *too* permissible in (76), at least not in the sense of 'and so was Bill'. The well-formed way to say something like (76) is as represented in (77); the same stress pattern is found in (78) and (79).

(77)   Jóhn was kissing Máry and Bíll was kissing Súsan.

(78)   Jóhn was kissing Jóhn's wǐfe and Bíll was kissing Bíll's wǐfe.

(79)   Jóhn was kissing hís wǐfe and Bíll was kissing hís wǐfe.

But (79) is not what we started with, i.e. the reading of (74) in which the second *his* seemed to be *Bill's*. Sentence (79) is indeed a case of fully referential noun phrases, and the two pronouns can be taken as substitutions for the respective nouns. But sentence (74) has a reading not yet accounted for, and it is here that the notion of variables comes into play.

   The stress pattern of (74) is typical of conjoined sentences with contrasting subjects and identical predicates; hence it would be optimal from the point of view of the phonology to be able to represent *kissing his wife* identically in both clauses. One might suggest that it is only the superficial form of the words that counts in determining such a stress pattern, but then the pattern of (79) is unaccounted for. (Note that (75) has no analog to (79).) The rather unnatural paraphrase (80) below clearly has identical predicates on the two subjects. The evidence thus suggests that the reading of (74) in question must involve the binding of variables as in (81) rather than directly referential pronouns.

(80)   Jóhn was ǒwn-wǐfe-kǐssing and Bíll was ǒwn-wǐfe-kǐssing too.

(81)   (for x = John and for x = Bill) (x was kissing x's wife)[16]

   The examples of this section serve to suggest some of the situations in which the notion of bound variables or something like it seems necessary to explain the pronoun–antecedent connection. Further relevant examples can be found in Karttunen (1969b). Next we turn to the question of how far this view can be extended.

2.4   The Problem of Treating Pronouns Uniformly

The notion of coreferentiality, taken as holding between two noun phrases each of which has a referent, has been seen to cover only a subset of the uses of personal pronouns. The notion could be extended to include a sort of 'hypothetical coreferentiality' for the cases with non-referential indefinite antecedents, such as (39), (40), (41). Possibly it could also be extended to include the non-referential definite cases, except that it does not seem to be a satisfactory notion for examples like (34)–(36). Something like 'codesignation' seems to be more appropriate for such cases, but that kind of notion would clearly not be generalizable, both because it would apply equally well to pronominalization with *one* and because proper names, which certainly can be pronominalized with personal pronouns, presumably have reference but not designation.

The most serious problems for the notion of coreferentiality as a fully general basis for pronominalization arise in the cases that must be treated as variables. Certainly there is some kind of sameness between two instances of a single variable, but equally certainly it is not a sameness of reference, and furthermore the variable treatment requires breaking up the noun phrase into structurally very separate parts.

A striking counterexample to the claim that coreference might underly all pronominalization is provided by Karttunen (1969b); the *his* is to be interpreted as *his own*.

(82) The man who gave *his paycheck* to his wife was wiser than the man who gave *it* to his mistress.

We must conclude that the notion of coreferentiality cannot provide a uniform basis for the treatment of pronouns. Since it fails primarily because of the need to treat some pronouns as variables, the most promising hope for a uniform treatment would seem to lie in regarding all pronouns as variables. Quine appears to hold such a position,[17] and Geach seems at least to regard it as possible, although in practice he often discriminates between pronouns as bound variables and pronouns of laziness. But as Karttunen points out, examples like (82) above are incompatible with the treatment of pronouns as variables, just as they are with the primacy of coreference. The *it* in (82) must be treated as a pronoun of laziness.[18]

If some pronouns must be treated as pronouns of laziness and others must not be, the problem is then to find either a clear criterion for distinguishing the two types or else some justification for regarding many pronouns as ambiguous. I have no solution to this problem, but I want to bring up some matters that seem relevant.

Geach (1962) argues that some pronouns which *could* be regarded as pronouns of laziness *should* rather be regarded as bound variables. His argument runs as follows (p. 128):

(83) If *any man* owns a donkey, *he* beats it.

(84) If *Smith* owns a donkey, *he* beats it.

The pronoun 'he' is replaceable by 'Smith' in (84) without changing the import of the proposition; it is not thus replaceable by 'any man' in (83); so it looks as if it were a pronoun of laziness in (84), but not in (83). All the same, (84) predicates of Smith precisely what (83) predicates of any man; both contain the same unambiguous complex predicable 'If – owns a donkey, he beats it,' which is incomplete in sense, . . . as any one-place predicable is until it is attached to a subject or quasi subject. On the other hand, the proposition:

(85) If Smith owns a donkey, Smith beats it.

contains the completely different predicable 'If – owns a donkey, Smith beats it'; . . . Thus the wholly different sense of the predicable . . . shows that even in (84) 'he' has a definite logical role of its own, and is not a mere pronoun of laziness – not a mere device for avoiding the repetition of 'Smith.'

Note, by the way, the misleadingness of the word 'mere' in the light of (82), where the pronoun must be treated as one of laziness precisely to account for its logical role.

The kind of argument used by Geach above can be extended to many other cases. For instance, the sentence (74) above (in the sense of (80)) provides a similar kind of evidence for positing a variable in (86), even though (86) in isolation could be handled simply as a case of a pronoun of laziness.

(86) *John* was kissing *his* wife.

But Geach's claim that 'he' in (84) is unambiguously not a replacement for 'Smith' seems to me somewhat problematical. Consider a simple reflexive sentence like (87):

(87) *Timmy* dressed *himself*.

By Geach's type of argument, the pronoun would not be regardable as a replacement for 'Timmy' because of sentences like (88):

(88) *Only one two-year-old* dressed *himself*.

And yet to say that the predicable '—dressed Timmy' does not occur in (87) should preclude the possibility of discourses like (89) or (90) which seem perfectly well-formed:

(89) Has anyone dressed Timmy yet? Yes, Timmy dressed himself.

(90) Whoever dressed Timmy must be color-blind. Timmy dressed himself, so Timmy must be color-blind.

Similarly, the pronoun in (91) below could not, by Geach's kind of argument, be one of laziness because of sentences like (92), and yet should be so regardable if (91) is to be related to (93).

(91) *John* set off a burglar alarm when *he* walked in.

(92) *Someone* set off a burglar alarm when *he* walked in.

(93) Something happened when *John* walked in.

Thus it would seem that Geach's line of argument should lead to the conclusion that many pronouns are syntactically ambiguous as between bound

variables and pronouns of laziness. (The fact that most of the sentences may be semantically unambiguous would not be a crucial counterargument; cf. Geach's 'cancelling-out fallacy' (1962).) Perhaps at this point some further more narrowly syntactic investigation of the relevant phenomena may prove to be of value. Certainly much more needs to be done to explain systematically the kinds of relations that can hold between a pronoun and its antecedent and the contexts in which the various relations can hold. What I have tried to do here is primarily to indicate some of the facts that need explaining and some of the problems that are likely to confront any attempts at simple explanations.

Notes

   The most important sources for the present work are the following: among linguists, Postal (1968), for bringing the notion of coreference to prominence; Bach (1969, 1970), for first pointing out some fundamental problems with the treatment of pronominalization as a substitution process; McCawley (1968, 1971), for his attempts to show logical notation, including the use of variables, to be of linguistic relevance; and Karttunen (1968a, b), who has been exploring many of the same problems as are discussed here, and from whom a number of the examples below are taken or adapted (some of which are originally due to Baker (1966)). Among philosophers, the main sources are Quine (1960), for the notion of opacity and its relation to reference; Donnellan (1966), for claiming a referential/attributive distinction in definite noun phrases even in transparent contexts; and Geach (1962) for distinguishing 'pronouns of laziness' from pronouns used like variables.

1 The term *pronominalization* suggests that pronouns arise by a syntactic process (of substitution), and such was quite generally assumed to be the case by virtually all linguists until quite recently. I retain the terminology here for want of a substitute, but everything I say here is meant to be quite independent of any proposals as to the syntactic treatment of pronouns.

2 In sentences like (1) it is important, but not always easy, to try to clearly distinguish the presuppositions, descriptions, etc. which may be ascribed to the speaker of the sentence from those which may be ascribed to the subject of the sentence. For the most part such distinctions are not drawn here, however.

3 Donnellan's claim for a referential/attributive ambiguity in definite noun phrases and my extension of it to indefinites both suffer from an oversimplification pointed out to me by David Kaplan (cf. Kaplan 1968–9), namely the following: having a particular individual in mind (the 'referential' case) and knowing nothing about an individual other than some single descriptive phrase (the 'attributive' case) may be just two extremes on a continuum of 'vividness'. One may consider, for

instance, the case of a detective tracking down a criminal and obtaining more and more clues, including perhaps fingerprints, voice recordings, photographs of varying clarity, etc. It is not at all clear at what point the detective, who may be described as 'looking for the man who did so-and-so', stops looking for 'whoever it is that did so-and-so' and starts looking for a particular individual. The appropriateness of the term 'ambiguity' for the referential/attributive distinction may be questioned on other grounds as well (see Reference 4), and nothing in what follows appears to hinge on acceptance of that term.

4   I have not met with universal agreement on this point. Donnellan himself suggests that sentences like (11) should be regarded as 'pragmatically ambiguous' and not syntactically ambiguous. For sentences like (8) and (9) the question of whether the term *ambiguity* is appropriate is complicated by the question of whether indefinite noun phrases can ever be said to refer. If one considers a sentence in isolation, ignoring the speaker's and hearer's roles, an indefinite noun phrase certainly cannot be said to refer in the way that a definite noun phrase can. But from the speaker's point of view, which is how Donnellan is looking at definite noun phrases, I would claim that a distinction very similar to Donnellan's can be drawn in the indefinite cases. Perhaps the indefinite cases analogous to Donnellan's 'referential' should be called 'semi-referential', since the speaker does not specify uniquely for the hearer what individual he has in mind.

5   This possibility was pointed out to me by Frank Heny.

6   From the point of view of Fillmore's original proposal, the [± Specific] distinction has another problem. Fillmore intended the feature both to mark the ambiguity of sentences like (1) and to control the *some/any* suppletion rule in negative sentences. Thus the sentence represented abstractly as (6-1) below would have two surface forms, (6-2) if the *some* was [+ Specific] and (6-3) if the *some* was [– Specific].

(6-1)   NEG John answered *some of the questions*.

(6-2)   John didn't answer *some of the questions*.

(6-3)   John didn't answer *any of the questions*.

But a sentence like (6-4) below is ambiguous in the same way as sentence (1), even though the *some* must be marked [+ Specific] or it would have changed to *any* (and thence to *none*: cf. Klima (1964)).

(6-4)   The teacher thinks that *some of the girls* won't pass the test.

In comments received after this paper was submitted, Lauri Karttunen has pointed out to me some fundamental inadequacies in the notion of a dichotomous feature like [± Specific]. Crucial examples, which were overlooked in part as a result of the simplification mentioned in Reference 2, might include

(6-5)   Sally believes that John would like to marry *a girl his parents don't approve of*.

(6-6)   Every teacher in the school is convinced that *one student* is responsible for all the disruptions.

Although I agree that a dichotomous feature is indeed inadequate, I am not convinced by Karttunen's arguments (which utilize the notion of a deleted performative verb) that all of the ambiguities can be treated as scope differences. At this point I have no satisfactory alternative hypothesis.

7   In particular, almost nothing will be said here about the syntax proper of pronouns, e.g. the claim that personal pronouns are suppletive forms of definite articles (Postal 1966), and the considerable literature on possible syntactic positions of a pronoun relative to its antecedent (e.g. Langacker 1969, Ross 1967, 1968, Bach 1969, 1970). Nor will anything be said about the different conditions governing the use of reflexive and non-reflexive pronouns. For a fuller synopsis of both the syntactic and semantic treatment of pronouns, see Stockwell et al. (1973).

8   It is argued in Stockwell et al. (1973) that the step from *a one* to *one* involves suppletion of *a* by *one*, not simply the deletion of *a*.

9   This example is due to Frank Heny.

10   As some examples of Postal's have made clear, the relevant sense of coreferentiality is not sameness of physical object, but rather some sort of identity relative to the speaker's mental picture of the world. Relevant examples include:

(10-1)   *The alligator's tail* fell off, but *it* grew back.

(10-2)   *My home* was once in Maryland, but now *it*'s in L.A.

(10-3)   *The unicorn* carried the damsel to safety because she had shown *it* great kindness.

   (Note, incidentally, how (10-2) seems to justify the adage that 'a house is not a home', since if *house* were substituted for *home*, the sentence would be true only if the actual physical object had been moved cross-country.)

11   In general, the auxiliary *would*, except when expressing volition or habit, requires the presence of a subordinate clause with *if* or *unless*.

12   There is even a difference in the interpretation of the phrase *within a couple of years* which correlates with the presence or absence of the presupposition of marriage: in (59) the phrase can be understood either as 'from now' or 'from the time of marriage'; in (60) it can only be 'from now'.

13   Restricted rather than unrestricted quantification is necessary if the natural language syntax is to be preserved as far as possible, since otherwise additional clauses would be required (and in a case like (66), the form such additional clauses should take is not at all clear). The suggestion that the first, or binding, occurrence of a given variable occur in apposition to a (singular or general) term I take from Quine (1960).

14   The change is logically justifiable by the equivalence between $((\exists x)\ Px) \supset Q$ and $(x)\ (Px \supset Q)$. Such equivalences seem reasonable candidates for inclusion in natural language semantics; within a 'generative semantics' framework they would presumably also have to be included in the syntax. It would be linguistically more desirable to account uniformly for the fact that *any* corresponds sometimes to an existential quantifier and sometimes to a universal one, and perhaps to correlate this fact with the fact that quantifier phrases in the vernacular do not readily occur outside the scope of *if-then* as in (65). The ordinary logical notation appears to obscure rather than clarify such questions.

Since this paper was submitted, Prof. Quine has kindly reminded me that Quine (1960) contains a discussion of sentences like (62) with the proposal that *any* can be treated uniformly as a universal quantifier which 'always calls for the longer of two possible scopes' (p. 139). However, that claim would appear to be too strong as it stands, because of the ambiguity of sentences like the following, first brought to my attention by Frank Heny:

(14-1)   If *any of those books* can be used to fulfill the requirement, standards have certainly dropped.

15   If their two clauses were inverted, with a corresponding interchange of pronoun and noun phrase (so that the pronoun still followed its antecedent), the sentences would indeed be of the type discussed in Section 2.2.2.

16   The question of the form the variable-binding operator should take here and for examples like (84) below is a difficult one. Quine (1960) has shown how names used as singular terms can be eliminated in favor of names used only as general terms in predicates of the form 'is——', so that (81) might be better represented as:

(16-1)   (for each person x) (if x is John or x is Bill, then x was kissing x's wife).

But such a representation is unlikely to receive much linguistic justification, both because of the introduction of an *if*-clause and, more importantly, because names are certainly not restricted to predicate position in natural language. On the other hand, a name used as a singular term does not have the power to bind variables and therefore could not be used to represent the sense of (80) as (81) does.

17   Prof. Quine has corrected me on this point; his 'oft reiterated identification is merely the converse: variables are pronouns.'

18   The conditions on the occurrence of non-coreferential pronouns of laziness as in Karttunen's example are not clear; note for instance that even though *his wife* in sentence (74) above has a possible non-referential interpretation, it cannot on that reading be pronominalized to *her*:

(18-1)   John was kissing *his wife* and Bill was kissing *her* too.

There are some speakers who find (82) impossible on the intended reading. If for such speakers there are no instances of pronouns which must be treated as pronouns of laziness, while for the rest of us there is no other way of accounting for examples like (82), then we are faced with the frustrating but unfortunately not uncommon situation of finding idiolectal variation in what would appear to be theoretically crucial examples.

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Chapter 3

Some Structural Analogies between Tenses and Pronouns in English

The area of tense logic and its relation to English covers a wide range of problems, but I want to narrow my attention here to certain aspects of the uses of the two English tense morphemes *Past* and *Present*,[1] and compare them with related uses of the personal pronouns (*he, she, it*, etc.). I will argue that the tenses have a range of uses which parallels that of the pronouns, including a contrast between deictic (demonstrative) and anaphoric use, and that this range of uses argues in favor of representing the tenses in terms of variables and not exclusively as sentence operators.

In restricting my attention to the two tenses *Past* and *Present*, I am following the syntactic analysis of the English auxiliary system first set out by Noam Chomsky.[2]

(1) Aux → Tns (Modal) (have + en) (be + ing)

$$\text{Tns} \rightarrow \begin{Bmatrix} \text{Present} \\ \text{Past} \end{Bmatrix}$$

$$\text{Modal} \rightarrow \begin{Bmatrix} \text{will} \\ \text{may} \\ \text{can} \end{Bmatrix}$$

In this system, the affixes *Present, Past, en*, and *ing* are subsequently attached by a transformation to the verb stems immediately following them. For example, the underlying form *Past have en eat* is transformed into *had eaten*; *Past can be ing go* becomes *could be going*. The so-called "future tense" is analyzed as *Present* plus the modal *will*, and is not syntactically a tense parallel to *Past* and *Present* (although it seems to be a tense in some other languages). Given the

naturalness of a tripartite division of time into past, present, and future, it is one of the interesting open questions whether it is simpler to treat English as having a three-way tense distinction on some "deeper" level, which is then transformationally mapped into the forms that Chomsky treated as under- lying, or simpler to start from Chomsky's representation of the syntax and build a semantics on that. This is one of the questions I am not going to treat, although the fact that it is only the *Past* and *Present* tense morphemes that show the behavior I am about to illustrate may provide some prima facie evidence for the Chomsky analysis.

The English personal pronouns have a number of uses; I am going to discuss various uses separately for expository purposes, but I am not thereby claiming that all these uses should be analyzed as distinct or unrelated. I will try to show that there are uses of the tenses parallel to each of the uses of the pronouns, suggesting that the best representation of the English tenses should be struc- turally similar to the representation of pronouns (leaving open for the time being what form that representation should take).

3.1   Deictic Pronouns and Tenses

The deictic use of pronouns can be illustrated by a sentence such as (2), which may be accompanied by a gesture to point out the referent.

(2)   He shouldn't be in here.

The first- and second-person pronouns are used primarily deictically. The similarity of the deictic use of *Present* tense and the deictic use of the pronoun *I* is well-known and has been captured in various systems, e.g., by including both among the indices in a "point of reference" for possible-worlds semantics or by defining them as "time of utterance" and "utterer," respectively. It seems that *I* has only a deictic use; that is certainly not true of the *Present* morpheme, as will be illustrated presently.

The deictic use of the *Past* tense morpheme appears in a sentence like (3):

(3)   I didn't turn off the stove.

When uttered, for instance, halfway down the turnpike, such a sentence clearly does not mean either that there exists some time in the past at which I did not turn off the stove or that there exists no time in the past at which I turned off the stove. The sentence clearly refers to a particular time – not a particular instant, most likely, but a definite interval whose identity is generally clear from the extralinguistic context,[3] just as the identity of the *he* in sentence (2) is clear from the context. In the case of deictic *Past* tense there is no analog to the pointing gesture that is often used with deictic pronouns. But deictic pronouns need not be accompanied by gestures; the referent may be understood from

the context without being physically present, as in (4), uttered by a man sitting alone with his head in his hands:

(4)   She left me.

The identification of the time in (3) and the woman in (4) can be made by any hearer who has the requisite knowledge of the situation plus an appreciation of the general conversational requirements of relevance.

   The *Present* tense, like the pronoun *I*, clearly has a unique and unambiguous referent when used deictically. The *Past* tense often seems to be much vaguer in its reference, and is perhaps to be compared to some uses of the pronoun *they*. Compare the pronoun in (5) with the tense in (6).

(5)   They haven't installed my telephone yet.

(6)   John went to a private school.

These are not picking out particular referents in the way we generally think of deictics doing; but they are certainly not generic or anaphoric either. 'They' in (5) seems to be referring to whoever it is that's supposed to install the telephone, and *Past* in (6) seems to refer to whenever it was that John went to school. I haven't any more to say about this nonspecific deictic use, except to point out that again the pronouns and tenses are parallel.

3.1.1   Interlude: a shared non-property

Before discussing anaphoric and bound-variable-like uses of pronouns and tenses, we need to consider what the analog in the tense system is to nonpronominal term phrases. Tenses, like pronouns, do not describe or name what they refer to. When a pronoun is not used deictically, it is used in connection with some full term phrase, which may be a proper name, a definite description, or some quantified term phrase. What, if anything, plays the role of such term phrases in the tense system? The answer seems to be time adverbials. There is clearly one major nonparallelism here, in that every full clause contains a tense whether it contains a time adverbial or not, whereas a sentence containing a full noun phrase need not contain a pronoun in addition. Thus, in a sentence like (7), the tense seems to be redundant, since the time specification is provided by the time adverbial.

(7)   We climbed Mt Baker three weeks ago.

The nearest thing to this sort of redundancy with pronouns comes in sentences like (8), which are natural in some dialects and frequently found in children's speech.

(8)   The woman in the house next door, she almost ran over me.

There are some languages which have an obligatory subject-marker (some-times also an object-marker), virtually a pronoun, as an affix on the verb whether or not the subject (or object) is overtly expressed; these languages, if they also obligatorily include a tense in every clause, would be more parallel in their tense and pronoun systems. A language could also have more parallel tense and pronoun systems if it omitted the tense morpheme in clauses con-taining an explicit time adverbial, but I do not know whether there are any languages of that sort.[4]

3.2   Anaphoric Pronouns and Tenses with Specific Antecedents

In sentence (9), the pronoun *it* is used anaphorically to refer back to the object referred to by *the car*; whether the pronoun should here be viewed as a bound variable bound by the definite-description operator or whether it should be viewed as a "pronoun of laziness"[5] going proxy for a repetition of the same phrase, or ambiguously as either, I leave open here.

(9)   Sam took the car yesterday and Sheila took it today.

In any case, there are comparable uses of tenses, where the time is specified in one clause and the tense of a subsequent clause refers to the same time.

(10)   Sheila had a party last Friday and Sam got drunk.

The antecedent may be a time-clause, as in (11).

(11)   When Susan walked in, Peter left.

Sentence (11) presents at least two choices of analysis; to view both tenses as pronoun-like is to regard (11) as parallel to archaic forms like (12):

(12)   He who stole my cow, he will suffer the penalties.

A more natural form is (13), with no pronouns, but sentences like (13) are themselves problematical to analyze.

(13)   Whoever stole my cow will suffer the penalties.

Sentence (11) could be viewed as more like (13) than (12), with the time-clause providing a descriptive specification of the time for the main clause and both tense morphemes redundant except insofar as they indicate that the time

described was in the past rather than the present or future. In either case the logical form of (11), as of both (12) and (13), would seem to be most simply represented as involving a definite-description operator connecting identical variables in the two clauses.

3.3   Pronouns and Tenses as Bound Variables

Consider a sentence like (14) in contrast to a simple clause like (15):

(14)   If Susan comes in, John will leave immediately.

(15)   John will leave immediately.

In (15) if we analyze the auxiliary verb as *Present + will*, we can say that *Present* is used deictically to refer to the time of utterance, and that *immediately* inter-acts with *will* so that the time of John's leaving is asserted to be in the imme-diate future measured from the time of utterance. In (14), on the other hand, the immediate future is understood to be measured from the time of Susan's arrival. This interpretation requires that we treat the *Present* in *Present + will + leave* in (14) not as the deictic use of *Present*, but as connected to the *Present* in the *if*-clause. That occurrence of *Present* is not deictic either, and in fact has no specific reference. This kind of case, more clearly than the sort of anaphora described in the preceding section, seems to cry out for an analysis involving bound variables. As a first approximation, a representation such as (16) might do, letting φ be 'Susan come in' and ψ be 'John leave'.

(16) $(\forall t)(\varphi(t) \supset \psi((\text{Imm}(\text{Fut}))(t)))$

One deficiency of (16) is that it does not distinguish (14) from (17) below:

(17)   Whenever Susan comes in, John immediately leaves.

Sentence (14) suggests that a single possible future occurrence is at issue, while (16) generalizes in a way that seems more appropriate to (17). But if we want to represent (14) with a formula that begins 'if there is a time when Susan comes in, then . . .' , we are left with an unbound variable in the second clause, unless we introduce a definite description and finish with 'then John will leave in the immediate future from the time at which Susan comes in', i.e., (18):

(18) $(\exists t)\varphi(t) \supset \psi((\text{Imm}(\text{Fut}))((\iota t)\varphi(t)))$

These two competing analyses of (14) are closely analogous to competing analyses, both widely suggested, of the pronoun usage in a sentence like (19):[6]

(19)   If one of the arrows hits the target, it's mine.

   But whatever the best analysis is [and (18) certainly seems preferable to (16) for these examples], it seems clear that explicit time variables are required, rather than tense operators alone. It may be that tense operators are appropriate for tense and aspect notions like future, progressive, and perfect, whereas variables are appropriate representations for the functions of the two tense morphemes *Past* and *Present*. But there seems to be no way for tense operators alone to capture the fact that the immediate future in (14) must be with respect to the time at which the *if*-clause event occurs.
   Similar variable-binding can be seen in the following examples. The (a) examples involve tense, and the (b) examples show similar uses of pronouns.

(20)a.   When you eat Chinese food, you're always hungry an hour later.
    b.   Every student spoke to the student in front of him.

(21)a.   John never answers when I call his home.
    b.   No one could tell what he was being tested for.

(22)a.   Most of the time, if I write John a letter, he answers within a week.
    b.   Mostly, if a man commits perjury, he has to continue committing perjury.

(23)a.   Richard always gave assignments that were due the next day.
    b.   Every Englishman worships his mother.

   When other elements are present in the auxiliary verb in addition to the tense morpheme, it is still only the tense morpheme that seems to behave as a bound variable, with the other elements bearing their usual relationships to whatever reference point is indicated by the tense. Thus in addition to (21a) we find examples like (21c)–(21e) below:

(21)c.   John never talks when he is eating.
    d.   John never changes his mind when he has made a decision.
    e.   John never drives when he has been drinking.

I do not want to try to analyze the progressive or perfect aspects here, but it seems clear that (21c), for example, can be (artificially) paraphrased by (21c') below, where the progressive in 'he is eating at t' bears the same relation to each time t that the progressive in a simple sentence such as 'He is eating' bears to the time of utterance.

(21)   c'. There is no time t such that John talks at t and John is eating at t.

It is my hypothesis that it is the tense morpheme in these sentences that is serving as the variable quantified over by the adverbs *never*, *always*, etc. Under

this hypothesis, the relation of the rest of the auxiliary to the tense is uniform for both deictic and bound variable uses of the tense.

3.4   Scope Matters

Sentence (24) is ambiguous.

(24)   If John had married Susan, he would have had everything he wanted.

The ambiguity hinges on the relation of 'everything he wanted' to the rest of the sentence. On one reading, the phrase 'everything he wanted' is referential; the *Past* tense refers to some actual past time (presumably some time at which he might have married Susan, though this seems to be extralinguistic interpretation of a deictic use of *Past*, and not an anaphoric connection with the tense in the *if*-clause). On the other reading, the modal construction *would have* appears to be applying to the whole clause 'he have everything he want'; the subpart 'everything he wanted' is not referential, and the *Past* tense is acting as a pro-form linking the time or times of the wanting with the time or times of the having. This interpretation could be accounted for by an analysis which posits an identical time variable in each of the subclauses: 'he t have everything he t want'; "quantifying in" the auxiliary *would have* (i.e., *Past will have + en*), which applies to the whole clause, is then done by substituting the full auxiliary for the first occurrence of t and its pro-form, *Past*, for the second occurrence. Such an analysis would neatly parallel the analysis of ordinary pronominalization in which a full term phrase is substituted for one occurrence of a given variable and the appropriate pronoun for the remaining occurrences.

The ambiguity of (24) between a deictic and an anaphoric interpretation of *Past* parallels the ambiguity of virtually every sentence which contains a potentially anaphoric pronoun, since such a pronoun can just about always be interpreted deictically instead.

It is interesting that *Past* seems to be the pro-form for all the auxiliaries that contain a morphological *Past*, such as *would have*, even when the *Past* tense does not represent a past time. Correspondingly, *Present* seems to be the pro-form for all the auxiliaries containing a morphological *Present*. The following examples further illustrate this phenomenon; both of them have, like (24), both an anaphoric and a deictic interpretation for the tense in question.

(25)   John will have everything he *wants*.

(26)   If you were king, you could cut off the heads of everyone who *offended* you.

In all of (24)–(26) the modal construction (*would have*, *will*, *could*) has a complex clause in its scope. The embedded clause can also contain its own modal, as in (27).

(27) If Max had gotten in here, he would have eaten everything he could
      find.

   In this case, the complex clause that *would have* applies to seems to be some-
thing like (28):

(28) he eat at *t* everything he can find at *t*.

Since the pro-form for *would have* is *Past*, the *Past* tense morpheme is substi-
tuted for the *t* in the embedded clause, where it combines with *can* to give *could*.
Thus a larger auxiliary may contain an anaphoric tense as a subpart, just as a
full term-phrase like *his mother* may contain an anaphoric pronoun as a subpart.
This fact is also illustrated in examples (21c)–(21e) of the preceding section.

3.5   Conclusion

My main hypothesis has been that there is a considerable and striking parallel
in the behavior of tenses and pronouns, at least in English. The corollary
seems to be that if pronouns have to be treated as variables and not as sentence
operators (the latter being a view I have never heard advanced or seen any
evidence for), the same must be true of tenses, though not of the other ele-
ments of the auxiliary, namely modals, perfect, and progressive. The evidence
given for the main hypothesis has been informal and fragmentary, and I have
not even begun to offer the explicit syntactic and semantic rules that would be
necessary to turn the hypothesis into a substantive claim about the structure of
English. I have suggested an approach to the treatment of tenses which seems
to lead from the observed parallels, but I can't make any strong claims about it
without working out a full analysis, and that remains as a future project.

Notes

1 I will use '*Past*' and '*Present*' to refer to the English tense morphemes, and 'past' and
   'present' to refer to times.
2 *Syntactic Structures* (The Hague: Mouton, 1957).
3 It occurs to me that it might be possible to construct a Gricean counterargument to
   this claim, and contend that the sentence asserts only that there is some time in the
   past at which I did not turn off the stove, with the narrowing down to relevant
   times explainable by conversational principles, particularly the principle of relevance.
   If such a proposal could be defended for what I am calling the deictic use of *Past*, it
   would remain to be seen if an analogous proposal could be made for the deictic use
   of third-person pronouns.
4 Some interesting suggestions about the interdependencies between tenses and time
   adverbials are made by Wunderlich in *Tempus und Zeitreferenz im Deutschen* (Munich:
   Max Hueber, 1970); his remarks concern German, but most of them apply equally to

English. My remarks about the connections between time adverbials and tenses in this section and the next clearly oversimplify a number of complex issues; so whatever evidence I adduce therefrom is quite vulnerable.

For some remarks on apparent disadvantages of having a tense in every clause, see W. V. O. Quine, *Word and Object* (Cambridge, MA: MIT Press, 1960), section 36.

5 See Peter Geach, *Reference and Generality* (Ithaca, NY: Cornell, emended edition, 1968).

6 See Gilbert A. Harman, "Deep Structure as Logical Form," in Donald Davidson and Harman, eds., *Semantics of Natural Language* (Dordrecht: D. Reidel, 1972), pp. 25–47.

Chapter 4

Toward the Logic of Tense and Aspect in English

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Michael Bennett and Barbara H. Partee

Much of the recent work in linguistics has focused on the problem of giving a precise syntax for English. There is now an increasing awareness of the need for some kind of semantic theory. Some recent work of the logician Richard Montague has great promise in this regard. Montague's main goal was to give a completely successful analysis of logical consequence for ordinary language. He approached this end by giving such an analysis for what may be regarded as limited portions of English, or fragments of English. A fragment is a formal language in that it has a rigorous syntax and a model-theoretic semantics. The semantics provides a characterization of the notions of a true sentence (under a given interpretation) and of logical consequence. There are three papers by Montague where he presents such fragments: Montague [3], Montague [4], and Montague [6]. (Henceforth, we shall refer to these papers as EFL, UG, and PTQ, respectively.)

We believe that this approach to linguistic theory might lead to advances in the field of ordinary language question answering systems. First, a formalization of an ordinary language would greatly facilitate machine processing of that language. Second, having an analysis of logical consequence for ordinary language would facilitate developing machine deductive-inference capability with respect to that language.

A long-range goal of the present research is to implement features of tense and aspect in an English question answering system. In order to achieve this end, the first step is to obtain as clear an understanding as possible of the logic of tense and aspect in English. That is, it is desirable to have an analysis of logical consequence for declarative sentences of English which vary in features of tense and aspect.

The importance of having such an analysis can perhaps best be appreciated by considering some examples of question answering situations. Suppose the question answering system has the following fact stored:

(fact)   John walked for two hours yesterday[1]

The system is given the following question:

(question)   was John walking yesterday

The system changes the question into its declarative transform and attempts to derive the declarative sentence from the facts stored. In this case, intuitively the system should be successful and answer the question affirmatively. Notice that the system will have to have logical analyses of the simple past tense and the past progressive tense.

In cases where the system fails to derive the declarative transform from the facts stored, it should attempt to derive its negation. If it is successful, then it should answer negatively. However, if it fails to derive the negation of the declarative transform as well, it should reply that it does not know the answer to the question.

The next example shows the need to have logical analyses of verbs such as *begin*, *resume*, *continue*, and *finish*. Suppose the system has the following fact stored:

(fact)   John will eat a fish tomorrow

The system is given the following question:

(question)   will John finish eating a fish tomorrow

The system changes the question into its declarative transform and attempts to derive the declarative sentence from the facts stored. In this case, intuitively the system should be successful and answer affirmatively.

The next example shows the need to have logical analyses of adverbs of frequency such as *seldom*, *sometimes*, *occasionally*, *often*, *frequently*, *almost never*, *usually*, and *almost always*. Suppose the system has the following facts stored:

(fact)   John is dating Mary at most five times a month

(fact)   John is dating Mary at least once a month

The system is given the following question:

(question)   is John occasionally dating Mary

Here the system must determine the precise frequency the user intends with the adverb *occasionally* before it can attempt to answer the question.

The next example shows the need to have logical analyses of the simple future tense and the future perfect tense. Suppose the system has the following fact stored:

(fact)   John will walk to Rome today

The system is given the following question:

(question)   will John have walked to Rome by tomorrow

In this case, intuitively the system should answer affirmatively.

Of course, not all questions can be answered with a simple "yes" or "no" answer. The next example is of this sort. Suppose the system has the following fact stored:

(fact)   John read *Emma* four times in March last year

The system is given the following question:

(question)   how many times did John read *Emma* last year

Since the question cannot be answered with a "yes" or "no", there is no declarative transform for the question. In this example, the best answer for the system is the following:

(answer)   John read *Emma* at least four times last year

Although the answer logically follows from the fact, the process of arriving at this answer is obviously more complicated than in the previous examples.

The next example shows the need to have logical analyses of adverbial subordinate clauses. Suppose the system has the following facts stored:

(fact)   John left when Mary arrived today

(fact)   Mary arrived at two o'clock

The system is given the following question:

(question)   when did John leave today

The system should give the following answer:

(answer)   John left at two o'clock

   This paper begins with a review and criticism of some of Montague's work on tense and aspect in English. In particular, we focus on his paper PTQ. Montague's approach is in the tradition of tense logic and is based on the notion of a true sentence (under a given interpretation) at a moment of time. We find that a new notion seems to be required for an adequate analysis of tense and aspect – the notion of a true sentence (under a given interpretation) at an interval of time. Using this new notion, we give semantic analyses of the following tenses: simple present, simple past, simple future, present perfect, past perfect, future perfect, present progressive, past progressive, future progressive, present perfect progressive, past perfect progressive, future perfect progressive. We also give semantic analyses of various kinds of temporal adverbial phrases, e.g., *yesterday*, *frequently*, *for two days*, *when Mary left*, which are involved in the analyses of the various tenses.

4.1   Montague's Analyses of Tenses in PTQ

In PTQ Montague gives syntactic and semantic analyses of the simple present, the present perfect and the simple future. His analyses of the present perfect and simple future depend upon his analysis of the simple present. The relationships are roughly indicated by the following:

> *John has walked* is true at time p if and only if there exists a time t such that $t < p$ and *John walks* is true at t.

> *John will walk* is true at time p if and only if there exists a time t such that $p < t$ and *John walks* is true at t.

However, a sentence like (a) is ambiguous in English.

(a)   John walks

We sometimes give it a dispositional reading, that is, take it to be synonymous with (b).

(b)   John is disposed to walk

We also give (a) frequentative readings such as (c)

(c)   ⎧occasionally⎫
            ⎪frequently ⎪
   John   ⎨regularly   ⎬ walks
            ⎪habitually ⎪
            ⎩usually   ⎭

Let us call these readings NONREPORTIVE readings. Such readings are to be contrasted with the REPORTIVE reading which asserts that John performs the act of walking at the present moment. When the simple present is used in speech, a nonreportive sense is usually intended.

   Montague does not explicitly state which sense of the simple present he intends to be analyzing. Possibly he intends to be giving an unrefined analysis which covers several of these senses. Although we do not know of any *conclusive* evidence which settles the matter, we believe that there is some evidence which shows that he intends to be analyzing the reportive sense of the simple present.

(d)   John finds a fish

Montague considers (d) to have only one reading and that reading entails that there is at least one fish. But if we give (d) a nonreportive sense, intuitively it has a reading which does not entail that there is at least one fish. For example, (e) has a reading which does not entail the existence of fish.

(e)   John frequently finds a fish

   Montague probably did not treat the simple past, the past perfect and the future perfect because he thought that their syntactic and semantic analyses are considerably more complex than the tenses that he did treat. He probably viewed their complexity as follows. Whenever a sentence in one of these tenses is used to make a statement, there exists a time, which the speaker can more or less specify, which stands in a certain relation with the time of utterance. Consider the following sentences in the simple past.

(f)   John walked on Monday

(g)   John walked yesterday

(h)   John walked last year

(i)   John walked in 1948

In each of these examples, a time, which is made definite to some degree, is referred to by way of a name or an indexical expression. Let us call this time

the SPECIFIED TIME. In the above sentences, the event described by the verb phrase is asserted to occur at the specified time. We sometimes use sentences in the simple past which do not contain any expression for referring to the specified time. In such cases, the specified time is determinable from the previous discourse or extralinguistic features of the context of utterance. The central difference between the simple past tense and the present perfect tense is that the former involves a specified time whereas the latter involves only an unspecified time, or indefinite time, supplied by the existential quantifier.

   This picture of the tenses is somewhat different than the standard picture in linguistics and traditional grammar. The divergence probably has its origin in tense logic. It is a commonplace in tense logic to have the sentence operators H and W which may be read "it has been the case that" and "it will be the case that". The operators are interpreted just as Montague interprets them in his intensional logic in PTQ. Montague uses these operators in his analyses of the present perfect tense and the simple future tense. The result is that the two tenses are treated as if they are "mirror images".

simple present

present perfect

simple future
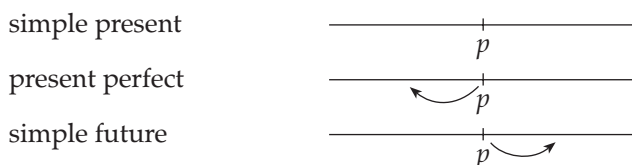
In the graphic representation above and those below, '|' represents a definite time ('p' being the present moment or time of utterance) and the arrows represent indefinite times earlier or later than the definite time at which they originate. The pairing of the present perfect tense with the simple future tense is nonstandard in linguistics and traditional grammar. The standard picture (more or less) is that the simple past tense and the simple future tense are "mirror images".

simple present

simple past
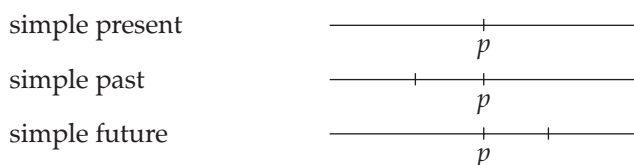
simple future

The perfect tenses (the present perfect, the past perfect and the future perfect) are thought of as being derived, in some sense, from the simple tenses by some uniform operation.

present perfect

past perfect

future perfect
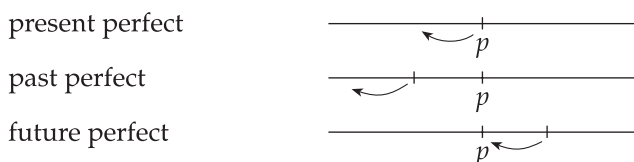
In section 4.5, we give analyses of these tenses which are more in the direction of the standard picture in linguistics and traditional grammar than Montague's analyses. However, our treatments differ in significant ways from the standard picture as well.

4.2 Some Problems with Montague's Treatment of the Tenses

4.2.1   A problem with Montague's treatment of the simple future tense

Montague's analysis of the simple future tense is such that (a) and (b) are logically equivalent.

(a) John will eat the fish

(b) John will eat the fish some time

Sentences (a) and (b) are true at the present moment if there exists some future interval of time during which (c) is true.

(c) John eats the fish

We regard this analysis of the simple future tense as inadequate since it does not treat the full range of cases. In section 4.5.4 below we suggest that the "mirror images" of the simple past tense and the present perfect tense are conflated to form the simple future. Our reasons for this view will emerge. But, because of these similarities, in order to present our understanding of the simple future, we shall first make some observations about the simple past tense.

We accept, more or less, the account given in section 4.1 of the simple past tense. More precisely, we regard the simple past as always involving a reference to a definite interval of time which starts at some point in the past and possibly includes the present moment, or the moment of utterance. The described event is asserted to obtain within this interval of time but previous to the present moment. The final point of the described event may not coincide with the present moment.

We regard the simple future tense as being almost a "mirror image" of the simple past. The only difference is that the initial point of the described event may coincide with the present moment. More importantly, we regard the simple future tense as always involving a reference to a definite interval of time which ends at some point in the future and possibly includes the present moment. Some evidence for this view is that sentences in the simple future

can take adverbial phrases which either name, describe, or point out such intervals.

(d)   John will eat the fish Monday

(e)   John will eat the fish today

(f)   John will eat the fish the day after tomorrow

   Montague's analysis of the simple future can be viewed as a special case of our analysis. In the case of sentence (b), although a definite interval of time is not referred to by way of a name, indexical expression, or description, one is referred to by way of an indefinite description.
   Of course we sometimes use sentences in the simple future or simple past which do not contain an adverbial phrase which refers to a definite interval of time. We believe that in all such cases there is always an implicit reference to such an interval which is determinable from the previous discourse or the extralinguistic features of the context of utterance.

4.2.2   A problem with Montague's treatment of the present perfect tense

Montague's analysis of the present perfect tense is such that (a) and (b) are logically equivalent.

(a)   John has visited Rome

(b)   John visited Rome at one time

Sentences (a) and (b) are true at the present moment if there exists some past interval of time during which (c) is true.

(c)   John visits Rome

We regard this analysis of the present perfect as *incorrect*. The present perfect always involves a reference to a definite interval of time which starts at some point in the past and includes the present moment, or the moment of utterance. The described event is asserted to obtain within this interval. Possibly the final point of the described event coincides with the present moment. Some evidence for this view is that sentences in the present perfect can take temporal adverbial phrases which refer to intervals of this sort but cannot take temporal adverbial phrases which refer to other kinds of intervals.

(d)   John has just left

(e)   John has walked today

(f)   John has eaten the fish since March

Sentences (d), (e), and (f) are acceptable but (g) through (i) are not.[2]

(g)   *John has left two days ago

(h)   *John has walked yesterday

(i)   *John has eaten the fish last year

(j)   *once John has kissed Mary

The central difference between the present perfect and the simple past is that the former always involves reference to an interval of time which includes the present moment whereas the latter involves reference to an interval of a wider class – in particular, a class which contains intervals which do not include the present moment.

Just as with the simple past and the simple future, we sometimes use sentences in the present perfect which do not contain an adverbial phrase which refers to a definite interval of time. We believe that in all such cases there is always an implicit reference to such an interval which is determinable from the previous discourse or the extralinguistic features of the context of utterance.

4.2.3   Montague's treatment of the present progressive tense and a problem with it

We need some definitions. $\leq$ is a SIMPLE (that is, linear) ORDERING OF a set T if and only if $\leq$ is a reflexive, transitive, antisymmetric, and connected relation having T as its field. ($\leq$ is ANTISYMMETRIC if and only if $t = t'$ whenever $t \leq t'$ and $t' \leq t$.) '$t < t'$' abbreviates '$t \leq t'$ and not $t = t'$.' $\leq$ is a DENSE SIMPLE ORDERING OF T if and only if $\leq$ is a simple ordering of T and for all t, t' in T such that $t < t'$, there exists t'' in T such that $t < t''$ and $t'' < t'$.

Montague has given an analysis of the present progressive tense.[3] Let us suppose that the nonempty set of moments of time T has a dense simple ordering $\leq$. We can indicate his analysis by way of an example.

> *John is walking* is true at time p if and only if there exists an open interval of moments of time, say I, such that p is a member of I and for all times t in I, *John walks* is true at t.

In PTQ Montague only requires that time, T, be simply ordered. He does not require that T be dense. However, given his analysis of the present progressive tense, this requirement is intuitively necessary. Without it we have the unintuitive result that (a) does not entail (b).[4]

(a)   John is walking

(b)   John has walked

It is possible to give an alternative analysis of the present progressive similar to Montague's which allows for time to be discrete.[5] However, we believe that the notion of time as being simply ordered and dense is rooted in intuition.

This analysis of the present progressive is inadequate for certain verb phrases. It is interesting that the very example which Montague uses to illustrate his analysis, (c), points out the deficiency of the analysis.

(c)   Jones is leaving

(d)   Jones has left

Given Montague's analysis of the present perfect in PTQ, we have the unacceptable result that (c) entails (d).[6]

There seem to be at least two different kinds of verb phrases, verb phrases like *walk* and verb phrases like *leave*.[7] In section 4.3.3 we attempt to give an explanation of the difference between the two kinds.

4.2.4   A problem with Montague's treatment of the reportive simple present tense

It is difficult to imagine a context where one would use (a) in the reportive sense to make a statement.

(a)   John builds a house

It is a fact that we seldom, if ever, use sentences like (a) in the reportive sense to make statements. Why is this? We regard a speech act as occurring at a moment of time and understand the assertion as being true at that moment. Accordingly, we are inclined to only use the reportive simple present when the act being described seems to be almost instantaneous and to be occurring at the moment of utterance. Since we know that house-building takes a while, it is difficult to imagine using (a) to make a statement. Possibly such a statement could occur in a children's story or during a brief narrative of someone's life history, for example. But in these cases we are, so to speak, "speeding up the action" and thus are willing to use the reportive simple present since the acts being described are viewed as being almost instantaneous. This explains

why we seldom, if ever, use sentences like (a) in the reportive sense to make a statement. Ordinarily, if we wish to describe an act of house-building which overlaps the present moment, we use the present progressive tense.

The notion, prevalent in tense logic, of a sentence being true at a moment in time is intuitive because we regard a speech act as occurring at a moment of time and understand the assertion as being true at the moment. However, Montague extends this notion to cover sentences such as (a). This is *unintuitive* since it is difficult to imagine a context at a moment of time where one would use (a) to make a statement.

There is no similar difficulty with (b).

(b)   John has built a house

However, Montague's analysis of the present perfect is such that the truth condition for (b) depends on the truth condition of (a).

> *John has built a house* is true at time p if and only if there exists a time t such that $t < p$ and *John builds a house* is true at t.

Intuitively it seems that the truth condition for (b) should concern some past interval of time during which John is building a house and eventually completes it. Instead the condition is that (a) is true at some past moment of time and this is unintuitive.

There is little plausibility in thinking that (a) is true at the moment of time that John completes the house, that is, the moment when he drives in the last nail. For if someone says that John built a house last month, no one asks which day and at what time he did it.

4.3   A Somewhat Different Approach to Tense and Aspect

Tense logic has focused on the notion of a sentence being true at a moment of time. We believe that a new notion is required in order to give an adequate analysis of tense and aspect – the notion of a sentence being true at an interval of time.[8] If we consider moments of time to be intervals, then the new notion can be viewed as a generalization of the old notion.

4.3.1   Time and intervals

Let T be the real numbers. T is to be regarded as the set of moments of time. Let ≤ be the standard dense simple ordering of T. I is an INTERVAL OF T if and only if I $\subset$ T and for any $t_1, t_3 \in$ I such that $t_1 \leq t_3$ if t_2 is such that $t_1 \leq t_2 \leq t_3$, then $t_2 \in$ I. We shall use the conventional notation for intervals. Let t_1, t_2 be members of T such that $t_1 \leq t_2$. The following illustrates the notation:

'$[t_1, t_2]$' abbreviates '$\{t: t_1 \leq t \leq t_2\}$'

'$(t_1, t_2]$' abbreviates '$\{t: t_1 < t \leq t_2\}$'

'(t_1, t_2)' abbreviates '$\{t: t_1 < t < t_2\}$'

'$(-\infty, t_1]$' abbreviates '$\{t: t \leq t_1\}$'

'(t_2, ∞)' abbreviates '$\{t: t_2 < t\}$'

Notice that to each moment of time there corresponds an interval which is the singleton of that moment of time. That is, to each moment of time t there corresponds an interval $[t] = [t, t] = (t, t] = [t, t)$. For convenience, we will sometimes call $[t]$ a moment of time and simply refer to it with 't'. Also notice that all open intervals of the form (t, t) are identical to the empty interval or the empty set. Let [T] be the set of all intervals of T except the empty interval.

Let I′ be a member of [T]. I is a (PROPER) SUBINTERVAL OF I′ if and only if I ∈ [T] and I ⊆ I′ (I ⊆ I′ and not I = I′). I is an INITIAL SUBINTERVAL OF I′ if and only if I is a subinterval of I′ and there do not exist $t' \in I' - I$ and $t \in I$ such that $t' < t$. I is a FINAL SUBINTERVAL OF I′ if and only if I is a subinterval of I′ and there do not exist $t' \in I' - I$ and $t \in I$ such that $t < t'$.

[<] is a STRICT PARTIAL ORDERING of set [T] if and only if [<] is an asymmetric and transitive relation having [T] as its field. ([<] is ASYMMETRIC if and only if not y [<] x whenever x [<] y.) ≤ induces a strict partial ordering [<] on [T]. Let I, I′ be members of [T]. I [<] I′ if and only if for all t in I and t' in I′, $t < t'$.

Let t be a member of T and I be a member of [T]. t is an INITIAL POINT FOR I if and only if $[t]$ is an initial subinterval of I. t is a FINAL POINT FOR I if and only if $[t]$ is a final subinterval of I. t is an ENDPOINT FOR I if and only if either t is an initial point for I or t is a final point for I. t is an INITIAL BOUND FOR I if and only if t is not in I and t is an initial point for I ∪ $\{t\}$. t is a FINAL BOUND FOR I if and only if t is not in I and t is a final point for I ∪ $\{t\}$. t is a BOUND FOR I if and only if either t is an initial bound for I or t is a final bound for I.

In choosing the structure of time, our choice must be made within certain constraints. First and foremost, our choice must have all the properties which English implicitly gives time. Second, our choice must be in accord with our metaphysical intuitions. If there are two or more types of structure in accord with these constraints, we can choose among them on the basis of simplicity.

We are motivated to choose the real numbers as the set of moments of time for a number of reasons. First, this choice reflects the intuition that time is infinite both ways. Second, it reflects the intuition that there is a dense simple ordering of time. Third, this choice gives [T] the convenient property that every interval which has an upper bound (or lower bound) has either a final point or bound (or initial point or bound).

4.3.2   The simple present tense and the present progressive tense

As in Montague's treatment, our analysis of the simple present underlies our analyses of all the other tenses. In section 4.1 we distinguished between the reportive sense of the simple present and the nonreportive senses. We only consider the reportive sense in this section. The nonreportive senses, more precisely, the frequentative senses, are considered in sections 4.4.2 and 4.5.1.

Suppose (a) in the reportive sense is true at interval I.

(a)   John eats the fish

The event of John's eating the fish is to be regarded as having occurred during interval I. If I has an initial point, then the event started at that point. If I has a final point, then the event stopped at that point.

The notion of a sentence being true at an interval of time leads to a natural analysis of the progressive tenses. The following illustrates our analysis of the present progressive tense.

> *John is building a house* is true at I if and only if I is a moment of time, there exists an interval of time I′ such that I is in I′, I is not an endpoint for I′, and *John builds a house* is true at I′.

In sections 4.4.2 and 4.5.7 we consider the frequentative senses of the present progressive.

Our analysis of the tenses are such that only sentences in the simple present can be true at an interval of time which is not a moment of time. Sentences in any tense other than the simple present can only be true at a moment of time. These restrictions conform with the intuitions expressed in section 4.2.4.

4.3.3   Different kinds of verb phrases

It seems that verb phrases can be sorted into three classes: stative verb phrases, subinterval verb phrases, and nonstative, nonsubinterval verb phrases.

STATIVE verb phrases are verb phrases which do not take the progressive form. Possibly there are no such verb phrases. But it seems that verb phrases such as *be happy*, *love Mary*, and *believe that Mary walks* are stative. (a) seems to be ungrammatical.

(a)   *John is believing that Mary walks

The syntactic rules must be formulated in such a way that sentences like (a) are not generated.

SUBINTERVAL verb phrases have the property that if they are the main verb phrase of a sentence which is true at some interval of time I, then the sentence is true at every subinterval of I including every moment of time in I. Examples of subinterval verb phrases are: *walk, breathe, walk in the park, push a cart.*

NONSTATIVE, NONSUBINTERVAL verb phrases are verb phrases which are neither stative nor subinterval. Examples of such verb phrases are: *die, walk to Rome, catch a fish, build a house.* Since these verb phrases take the progressive form, they are nonstative. They are also nonsubinterval. Consider *walk to Rome.* If it took an hour to walk to Rome, one did not walk to Rome within the first thirty minutes of the hour.

In making the distinction between subinterval verb phrases and nonstative, nonsubinterval verb phrases, it is important to focus on intransitive verb phrases rather than simply verbs. For instance, the verb *walk* is the main verb in both subinterval verb phrases (e.g., *walk, walk in the park*) and in nonstative, nonsubinterval verb phrases (e.g., *walk to Rome, walk out in front of a car*). The fact that some subinterval verb phrases, e.g., *walk*, are such that certain adverbial modifications result in subinterval verb phrases, e.g., *walk in Rome*, and certain other adverbial modifications result in nonsubinterval verb phrases, e.g., *walk to Rome*, poses some difficulties when one tries to implement such distinctions within Montague's framework in PTQ.

 Some verb phrases appear in more than one class because of the ambiguity of the main verb. For example, the following verb phrases have such ambiguity: *see a movie, eat a fish, keep a promise, enjoy a concert, play a sonata.* If *see* means to behold, then *see a movie* is stative. But if *see* means to watch from the beginning to end, then *see a movie* is nonstative, nonsubinterval. If *eat* means to chew, then *eat a fish* is subinterval. But if *eat* means to devour, then *eat a fish* is nonstative, nonsubinterval. If *keep* means to hold to, then *keep a promise* is subinterval. But if *keep* means to make good, then *keep a promise* is nonstative, nonsubinterval. If *enjoy* means to experience with pleasure, then *enjoy a concert* is subinterval. But if *enjoy* meads to experience with pleasure in entirety, then *enjoy a concert* is nonstative, nonsubinterval. Notice that *play a piano* seems to be subinterval whereas *play a sonata* seems to be nonstative, nonsubinterval. Our view is that it is the ambiguity of the verb *play* and not the change in direct object which causes the difference. In *play a piano* we usually take *play* to mean to perform on whereas in *play a sonata* we usually take *play* to mean to perform.

 Given that *walk* is a subinterval verb phrase, (b) entails (c).

(b) John is walking

(c) John walks

For suppose that (b) is true at interval of time I. Then I is a moment of time, there exists an interval of time I', such that I is in I', I is not an endpoint for I',

and (c) is true at I'. But if (c) is true at I', then (c) is true at I since *walk* is a subinterval verb phrase.

Sentence (c) does not entail (b) since (c) could be true at an interval of time which is not a moment of time whereas (b) can only be true at moments of time.

Sentence (e) does not entail (d) for the same reason that (c) does not entail (b).

(d)   John is building a house

(e)   John builds a house

Further, (d) does not entail (e) since *build a house* is a nonstative, nonsubinterval verb phrase.

The division between subinterval verb phrases and nonstative, nonsubinterval verb phrases is not clear-cut. We often use nonstative, nonsubinterval verb phrases in the progressive as if they are subinterval verb phrases in the progressive.

Remember that (d) is true at a moment of time p if there exists some interval of time about p at which (e) is true. This analysis of (d) implies, in some sense that John will finish building a house. We are hedging here because, as will be seen in sections 4.3.4 and 4.5.3, this reading of (d) does not entail (f) since (d) could be true at p in virtue of (e) being true at an interval of time about p of the form $[t, \infty)$, for example:

(f)   John will finish building a house at some time or John is finishing build-
       ing a house

However, we often use (d) to make a quite different statement, roughly a statement much like the statements we make when we use sentences such as (g), (h), and (i).

(g)   John is working to build a house

(h)   John is attempting to build a house

(i)   John is trying to build a house

Notice that these latter sentences definitely do not imply that John will finish building a house in any sense. Further, the verb phrases involved, *work to build a house*, *attempt to build a house*, and *try to build a house* are subinterval verb phrases.

We are not sure what to say here. Notice that we cannot simply say that a verb phrase such as *build a house* is ambiguous between a nonstative, nonsubinterval sense and a subinterval sense. This is because a sentence like (j) does not have a reading corresponding to the subinterval sense.

(j)   John built a house last year

We are inclined to say that in cases where we use (d) in the subinterval sense, we are letting (d) stand for a sentence such as (g), (h), or (i).

4.3.4   Initiation, resumption, continuation, and cessation verb phrases

By making the notion of an interval of time central to our analysis of tense and aspect, we can treat the following sorts of higher-order verbs:

initiation verbs
  begin
  start
  commence

resumption verbs
  resume
  recommence

continuation verbs
  continue
  *keep
  *keep on
  *go on
  *remain

cessation verbs
  *finish
  *stop
  cease

The verbs which are flagged with an asterisk only modify verb phrases whose main verb (or verbs in cases of conjunction or disjunction) is a present participle. The unflagged verbs also modify such verb phrases but they can also modify verb phrases of the form *to δ*. For example. English has sentences like (a) and (b).

(a)   John begins $\left\{ \begin{array}{l} \text{eating} \\ \text{to eat} \end{array} \right\}$ the fish

(b)   John finishes eating the fish

We use (b) rather than (c) so as to avoid suggesting (d).

(c)   John finishes to eat the fish

(d)   John finishes in order to eat the fish

   All sentences whose main verb phrase involves these higher-order verbs are nonstative. This is evidenced by the fact that they can take the progressive form. For example, (e) and (f) are acceptable.

(e)   John is beginning to eat the fish

(f)   John is finishing eating the fish

   Intuitively cessation verbs create nonstative, nonsubinterval verb phrases. This has the consequence, discussed in section 4.5.7, that (g) does not entail (h).

(g)   John is finishing crying

(h)   John has just finished crying

We are not clear as to whether initiation, resumption, and continuation verbs create subinterval verb phrases or nonstative, nonsubinterval verb phrases. Do sentences (i) entail their respective sentences (j)?

(i)   John is $\begin{Bmatrix} \text{beginning} \\ \text{resuming} \\ \text{continuing} \end{Bmatrix}$ to cry

(j)   John has just $\begin{Bmatrix} \text{begun} \\ \text{resumed} \\ \text{continued} \end{Bmatrix}$ to cry

   For each sort of higher-order verb there are special conditions which must be satisfied. These conditions vary depending on whether the verb phrase which is modified is stative, subinterval, or nonstative, nonsubinterval. We first indicate special conditions for initiation verbs.
   If (k) is true at interval of time I, then (l) is true at every moment of time in I.

(k)   John begins to love Mary

(l)   John loves Mary

   If (l) is true at every moment of time in interval I, t is either an initial point or bound for I, and there exists a moment of time t' such that $t' < t$ and (l) is

false for all moments of time in (t', t), then there exists an initial subinterval of I, I', at which (k) is true.

If (m) is true at interval of time I, then (n) is true at I.

(m)   John begins to walk

(n)   John walks

If (n) is true at interval of time I and either (i) there exists a moment of time t which is an initial bound for I and (n) is false at t, or (ii) there exists a moment of time t which is an initial point for I, there exists no moment of time t' such that $t' < t$ and (n) is true at (t', t), then there exists an initial subinterval of I, I', such that (m) is true at I'.

In the above formulation, we are regarding *begin to walk* as a subinterval verb phrase. Stronger conditions can replace the above if *begin to walk* is considered to be nonstative, nonsubinterval. They would parallel the conditions we give for *finish walking* below.

If (o) is true at interval of time I and there exists a moment of time t which is either an initial bound or initial point for I, then there exists an initial subinterval of I, I', such that (p) is true at I'.

(o)   John builds a house

(p)   John begins to build a house

On this analysis, if (o) is true at an interval $(-\infty, t]$, for example, then there is no guarantee that there exists an initial subinterval of $(-\infty, t]$ at which (p) is true. This can be guaranteed by omitting the second antecedent condition in the above formulation. With this alteration (q) entails (r).

(q)   John is building a house

(r)   John began to build a house at some time or John is beginning to build a house

We are less inclined to consider such an alteration for stative or subinterval verb phrases.

In considering the case where a resumption verb modifies a nonstative, nonsubinterval verb phrase, it is clear that the notion of a sentence being true at an interval of time is not adequate in general. A broader notion is required, that of a sentence being true at a UNION OF INTERVALS OF TIME. (See note 9.) We are only considering the simpler notion in order to minimize complexity. The need for the broader notion can be seen from an example. Suppose (s) is true at a union of intervals $I_0 \cup I_1 \cup I_2$ where $I_0 \, [<] \, I_1 \, [<] \, I_2$.

(s)   John builds a house

Intuitively (t) is true at some initial subinterval of I_1.

(t)   John resumes to build a house

  A similar analysis can be given where resumptive verbs modify stative and subinterval verb phrases.

  Continuation verbs are sometimes used like resumption verbs. However, they also have a distinctive use. Sentence (u) is true at an interval of time I if and only if there exists an interval of time I′ such that I is a subinterval of I′ but I is not an initial subinterval of I′ and (v) is true at every moment of time in I′.

(u)   John continues to love Mary

(v)   John loves Mary

  Sentence (w) is true at an interval of time I if and only if there exists an interval of time I′ such that I is a subinterval of I′ but I is not an initial subinterval of I′ and (x) is true at I′.

(w)   John continues to walk

(x)   John walks

This analysis for subinterval verb phrases carries over to nonstative, nonsubinterval verb phrases.

  We now indicate special conditions for cessation verbs. If (y) is true at interval of time I, then (z) is true at every moment of time in I.

(y)   John finishes loving Mary

(z)   John loves Mary

  If (z) is true at every moment of time in interval I, t is either a final point or bound for I, and there exists a moment of time t' such that $t < t'$ and (z) is false for all moments of time in (t, t'), then there exists a final subinterval of I, I′, at which (y) is true.

  If (a′) is true at interval of time I, then (b′) is true at I.

(a′)   John finishes walking

(b′)   John walks

  If (b′) is true at interval of time I and there exists a moment of time t which is a final bound for I, then (b′) is false at t if and only if there exists a final subinterval of I, I′, such that (a′) is true at I′.

If (b′) is true at interval of time I and there exists a moment of time t which is a final point for I, then there exists a moment of time $t′$ such that $t < t′$ and (b′) is false at $(t, t′)$ if and only if there exists a final subinterval of I, I′, such that (a′) is true at I′.

If (c′) is true at interval of time I and there exists a moment of time t which is either a final bound or final point for I, then there exists a final subinterval of I, I′, such that (d′) is true at I′.

(c′)   John builds a house

(d′)   John finishes building a house

On this analysis, If (c′) is true at an interval $[t, \infty)$, for example, then there is no guarantee that there exists a final subinterval of $[t, \infty)$ at which (d′) is true. This can be guaranteed by omitting the second antecedent condition in the above formulation. With this alteration, (e′) entails (f′)

(e′)   John is building a house

(f′)   John will finish building a house at some time or John is finishing build-
        ing a house

We are less inclined to consider such an alteration for stative or subinterval verb phrases.

These conditions guarantee certain entailments. For example, both (g′) and (h′) entail (i′).

(g′)   John begins to walk

(h′)   John finishes walking

(i′)   John walks

However, (i′) does not entail either (g′) or (h′).

Since *build a house* is a nonstative, nonsubinterval verb phrase, neither (j′) nor (k′) entails (l′).

(j′)   John begins to build a house

(k′)   John finishes building a house

(l′)   John builds a house

Further, (l′) does not entail either (j′) or (k′).

Given our analysis of the simple past in section 4.5.2 and the fact that *build a house* is a nonstative, nonsubinterval verb, (m′) entails both (n′) and (o′).

(m′)   John built a house last year

(n′)   John began to build a house last year

(o′)   John finished building a house last year

However, neither (n′) nor (o′) entails (m′). Sentence (p′) does not entail either (q′) or (r′) since *walk* is a subinterval verb phrase.

(p′)   John walked yesterday

(q′)   John began to walk yesterday

(r′)   John finished walking yesterday

4.4   Temporal Adverbial Phrases

Before we consider the various tenses in some detail, we will characterize some of the different kinds of adverbial phrases that interact with the tenses.[9]

4.4.1   Frame adverbial phrases

Frame adverbial phrases refer to an interval of time within which the described event is asserted to have taken place. Such adverbial phrases are often indexical in character. Some indexical examples are: *this morning*, *this afternoon*, *this evening*, *three days ago*, *the day before yesterday*, *yesterday*, *today*, *tomorrow*, *the day after tomorrow*, *three days hence*, *last week*, *this month*, *next year*, *on Monday*, *in June*. Some nonindexical examples are: *on June 7, 1848*, *in June, 1848*, *in 1848*.

Some frame adverbial phrases refer to moments of time: *now*, *at noon*, *at midnight*, *at three o'clock*, *an hour ago*, *ten hours from now*, *in ten minutes*. These are frequently used with initiation, resumption, continuation, and cessation verbs.

(a)   John started to eat a fish at noon

(b)   John will finish eating a fish in ten minutes

There are frame adverbial phrases which refer to an interval of time which has the present moment as an endpoint. Indexical adverbials which refer to an interval whose final point is the present moment are *since yesterday*, *within the last week*, *since three o'clock*. Indexical adverbials which refer to an interval whose initial point is the present moment are *within a few days*, *before three o'clock*.

In section 4.5 we consider some restrictions concerning which kinds of frame adverbials can be used with which tenses.

4.4.2   Adverbial phrases of number and frequency

Certain adverbial phrases indicate the number of times that a generic event is asserted to have occurred. Some examples are: *never* (*at no time*), *once* (*one time*), *twice* (*two times*), *at least once*, *at most once*, *α times*, *at least α times*, *at most α times* where α is a name in English for a finite cardinal other than one. Whenever we wish to be indefinite or vague about the number of times that a generic event occurred, we resort to the plural quantifiers and use adverbials such as: *on few occasions*, *on some occasions* (*sometimes*), *a few times*, *several times* (*often*), *many times*.

We can indicate what is involved in giving a formal semantics for such adverbial expressions by considering an example.

(a)   John walked to Rome two times last year

Sentence (a) is true at the present moment if (b) is true at the interval of time which is last year.

(b)   John walks to Rome two times

Sentence (b) is true at last year if there exist exactly two subintervals of last year at which (c) is true.

(c)   John walks to Rome

Intuitively a verb phrase like *walk to Rome two times* is a nonstative, non-subinterval verb phrase.

We indicate our understanding of the plural quantifiers by the following example.

(d)   John walks to Rome many times

We regard (d) as asserting something like (e).

(e)   John walks to Rome at least α times

The variable α ranges over natural numbers. Sentence (d) has, so to speak, a "free variable". We can only evaluate the truth of (d) at an interval of time with respect to an assignment for the "free variable".[10]

Sentences (f) and (g) are logically equivalent.

(f)   John will never leave

(g)   it is not the case that John will leave at some time

That is, (f) and (g) are true at the present moment if there does not exist a future interval of time at which (h) is true.

(h) John leaves

We understand the frequency of occurrence of a generic event to be the number of occurrences of the event for some specified unit of time. Some examples are: *hourly*, *once a week*, *twice a month*, *annually*, *ten times a year*. Adverbials such as *every second*, *every minute*, and *every day*, are elliptic for *once every second*, *once every minute*, *once every day* respectively (or possibly *at least once every second*, *minute*, *day*). Adverbials such as *always*, *regularly*, *continually*, *constantly*, *repeatedly*, and *at regular intervals* are ways of expressing that a generic event occurred once for every unit of time where the unit is not specified.

We can remain indefinite or vague about the number of repetitions for some specified unit of time by using expressions such as: *a few times a week*, *several times a month*, *many times a year*. We can remain indefinite or vague about both the number of repetitions and the unit of time by using expressions such as *seldom*, *occasionally*, *often*, *frequently*. An analysis of this last type of adverbial phrase is indicated by the following where α is some unspecified unit of time:

seldom rarely infrequently hardly ever scarcely ever not very often little	is $\begin{Bmatrix} \text{few} \\ \text{not many} \end{Bmatrix}$ times each α

sometimes some	is some times each α

occasionally intermittently on occasion at times now and then every now and then once in a while every once in a while from time to time every so often a little	is a few times every α

often	is several times each α

frequently very often a lot	is many times each α

We can indicate what is involved in giving a formal semantics for such adverbial expressions by considering an example.

(i)   John frequently smokes

We regard (i) as asserting something like (j).

(j)   John smokes many times each α

The variable α ranges over units of time. Sentence (i) has, so to speak, two "free variables" – one with respect to what constitutes many, the other with respect to what constitutes the unit of time. We can only evaluate the truth of (i) at an interval of time with respect to an assignment for the "free variables". For example, we might evaluate the truth of (i) with respect to the assignment indicated by (k).

(k)   John smokes at least ten times each hour

Intuitively sentences like (i) can be true at an interval of time which is not a moment of time. This is evidenced by the fact that the verb phrase in (i) can take the progressive form as in (l).

(l)   John is frequently smoking

Further, such verb phrases can take durative adverbial phrases as in (m).

(m)   John frequently smoked for three hours yesterday

Verb phrases modified by adverbs of frequency are nonstative. Intuitively such verb phrases are also subinterval. If (i) is true at an interval of time I, then (i) is true at every subinterval of I.

Incidentally, (n) has a reading which is different than that for (l).

(n)   John frequently is smoking

Sentence (n) asserts that what is frequently the case is that John is smoking.

It seems that our account is contradictory. We argued that speech acts are regarded as occurring at a moment of time and the assertion is understood as being true at that moment. We suggested that this explains why the use of the simple present in the reportive sense with a nonstative verb phrase is extraordinary whereas the use of the simple present with such a verb phrase in any of its nonreportive senses, in particular its frequentative senses, is ordinary. Sentences in the reportive simple present with a nonstative verb phrase are seldom used because they can be true at intervals of time which are not moments. But we have just argued that sentences in the simple present with a

frequentative sense can be true at intervals of time which are not moments. Why then is the use of the simple present with a frequentative sense ordinary? Apparently we use the simple present with a frequentative sense with the meaning of the present progressive with a frequentative sense. For example we use (o) with the sense of (p).

(o)   John frequently dates Mary

(p)   John is frequently dating Mary

Of course, we often omit the adverb of frequency when we use sentences like (o) and (p). Although we use (o) with the sense of (p), strictly, on our analysis, (p) is true at the present moment p if there exists some interval of time about p at which (o) is true.

   Another way that we express the frequency of occurrence of a generic event is with adverbials like *nine days out of ten*. This expression seems to mean either *once each of nine days out of ten* or *at least once each of nine days out of ten*. In the following discussion, we shall omit *once* or *at least once*. We can also say *most days out of every seven*, *most days out of every week*, or more colloquially, *most days of the week*. Expressions of this sort underlie one sense of the following adverbial expressions:

almost never
hardly ever
scarcely ever

usually
generally
move often than not

almost always

Again these adverbs, like *frequently*, allow us to be vague or indefinite. One sense of *usually* is something like *most α out of every β* where α and β are units of time and α is a smaller unit than β. For example (q) might be used to mean (r).

(q)   John usually wears a turban

(r)   John most days of the week wears a turban

   David Lewis's example, (s), seems to allow more than one reading.[11]

(s)   a Sikh usually wears a turban

(t)   every Sikh most α out of every β wears a turban

(u)   most Sikhs most α out of every β wear a turban

Almost never and *almost always* are more complex than *usually*. Their analysis is indicated by the following example. Sentence (v) has the form (w) which might be used to mean (x).

(v)   John almost never walks

(w)   John does not walk most α out of every β and he walks few times each β

(x)   John does not walk most days out of every month and he walks few times each month

Notice that we can use (y) to the same effect as (v).

(y)   John does not usually walk and he seldom walks

Quine points out a certain subtlety concerning *always*.[12]

(z)   Tai always eats with chopsticks

Sentence (z) might not be a statement of frequency of the event of eating with chopsticks; (z) can have the reading (a′).

(a′)   whenever Tai eats, he always eats with chopsticks

It might be that both (a′) and (b′) are true at the present moment and Tai seldom eats.

(b′)   Tai seldom eats with chopsticks

This ambiguity intuitively is present for *almost never*, *usually*, *almost always* and *always*. Sentences (c′) can have the readings (d′) respectively.

(c′)   Tai $\begin{cases} \text{almost never} \\ \text{usually} \\ \text{almost always} \\ \text{always} \end{cases}$ eats with chopsticks

(d′)   whenever Tai eats, he $\begin{cases} \text{almost never} \\ \text{usually} \\ \text{almost always} \\ \text{always} \end{cases}$ eats with chopsticks

Notice that it seems awkward to consider sentences like (d′) with adverbs of frequency such as *seldom*, *occasionally*, *sometimes*, *often*, and *frequently*.
    What is an analysis of Quine's reading for (e′)?

(e′)   Tai almost always eats with chopsticks

We regard (e′) as a sentence which could be true at an interval of time which is not a moment of time. Consider a given interval of time I. Consider the set of cases C of Tai's eating within I. Sentence (e′) is true at I with respect to an assignment which specifies what constitutes few and a finite sample size n if for every subgroup of cases of C of size n, most of the cases are cases of eating with chopsticks and few of the cases are not.

Possibly an adequate analysis of sentences like (e′) can be given in terms of probability theory.[13] Let B be the generic event of Tai's eating. Let A be the generic event of Tai's eating with chopsticks. A|B is the generic event of A on the condition that B. Sentence (e′) is true relative to an interval of time I if with respect to the range of times in I, the probability of A|B is r where r is a real number such that $0 \leq r \leq 1$ and r is of an appropriate size (what size?).

The notion of a case is central to David Lewis's discussion of adverbs of frequency. Lewis considers an example which requires the notion of a case. Sentences (f′) can be analyzed as sentences (g′) respectively.[14]

(f′)   a quadratic equation $\begin{Bmatrix} \text{never} \\ \text{seldom} \\ \text{sometimes} \\ \text{occasionally} \\ \text{often} \\ \text{frequently} \\ \text{usually} \\ \text{always} \end{Bmatrix}$ has two different solutions

(g′)   in $\begin{Bmatrix} \text{none} \\ \text{few} \\ \text{some} \\ \text{a few} \\ \text{several} \\ \text{many} \\ \text{most} \\ \text{all} \end{Bmatrix}$ out of every α cases, $\begin{Bmatrix} \text{do} \\ \text{do} \\ \text{—} \\ \text{—} \\ \text{—} \\ \text{—} \\ \text{—} \\ \text{—} \end{Bmatrix}$ quadratic equations have two different solutions

This use does not involve frequency of occurrence of a generic event but rather the frequency of a certain property among samples of a certain size. Here, it seems, the cases are not relative to some interval of time since quadratic equations are not arrayed in time.

Sentences like (h′) are analyzed as (i′) respectively.

(h′)   a quadratic equation $\begin{Bmatrix} \text{almost never} \\ \text{almost always} \end{Bmatrix}$ has two different solutions

(i′)   in most out of every α cases, quadratic equations $\begin{Bmatrix} \text{do not have} \\ \text{have} \end{Bmatrix}$ two different solutions and in few out of every α cases do quadratic equations $\begin{Bmatrix} \text{have} \\ \text{not have} \end{Bmatrix}$ two different solutions

4.4.3   Durative adverbial phrases

Durative adverbial phrases indicate the duration of the described event by specifying the length of time that it is asserted to take.

(a)   John walked for three hours last week

(b)   John was building a boat for three hours yesterday

(c)   John loved Mary for several years in his youth

Sentence (a) is true if there exists a three-hour interval within last week at which (d) is true.

(d)   John walks

Sentence (b) is true if there exists a three-hour interval within yesterday for which (e) is true at every moment of time within the interval.

(e)   John is building a boat

Sentence (c) is true if there exists an interval of time several years in length during his youth for which (f) is true at every moment of time in the interval.

(f)   John loves Mary

It is important to notice that a new notion has been employed in the last two analyses – that of a sentence with a stative verb phrase and a sentence in the present progressive being true at every moment of time within some interval. Intuitively this notion underlies (b) and (c). It is very similar to Montague's analysis of the present progressive described in section 4.2.3. The notion is central in the analyses of many of the adverbial subordinate clauses in section 4.4.4.

Notice that although (b) is acceptable, if (g) is given a reportive reading, it is unacceptable.

(g)   *John built a boat for three hours yesterday

It seems that durative adverbial phrases go with stative verb phrases, sub-interval verb phrases in both the progressive and nonprogressive form, and nonstative, nonsubinterval verb phrases in the progressive form only. That is, durative adverbial phrases do not go with nonstative, nonsubinterval verb phrases which are not in the progressive form. Sentence (g) is acceptable on a frequentative reading because the main verb phrase is being considered to be a subinterval verb phrase.

In some cases, an adverbial phrase serves both as a durative adverbial phrase and as a frame adverbial phrase.

(h)   John was hungry all day yesterday

(i)   John has been hungry for the last several hours

(j)   John will be absent for the entire day

(k)   John walked from two to three o'clock

(l)   John will be walking for the next several hours

(m)   John will be building a boat until tomorrow

Sentence (m) is true at the present moment p if (n) is true for all moments of time in the interval $[p, t)$ where t is the last moment of today.

(n)   John is building a boat

Since yesterday, unlike *until tomorrow*, can be used either as a durative adverbial phrase or merely as a frame adverbial.

(o)   John has been building a boat since yesterday

Sentence (o) can have the reading where it is true at the present moment if there exists a time since yesterday at which (n) is true.

4.4.4   Adverbial subordinate clauses

Certain adverbial subordinate clauses serve to locate in time a described event by relating it in time to another described event. These adverbial subordinate clauses are temporal locatives. Such clauses are headed by expressions such as *while, when, before, after, and then, since, until*.

While means "during the time that".

(a)   John left while Mary slept yesterday

(b)   John leaves

(c)   Mary sleeps

Sentence (a) is true at the present moment if (b) is true at an interval of time which is a subinterval (not necessarily proper) of an interval of time within yesterday at which (c) is true. Sometimes we compress an adverbial subordinate clause into a term. Sentence (d) is elliptic for (e).

(d)   John left during the show

(e)   John left during the time that the show was on

   When can either mean "during the time that" or "at the time that". Sentence (f) could be true because both (b) and (g) are true at the same moment of time yesterday.

(f)   John left when Mary arrived yesterday

(g)   Mary arrives

Possibly the difference between *while* and *when* is that the former requires that the sentence in the simple present which underlies the subordinate clause be true at an interval of time which is not a moment of time whereas the latter does not.
   A consequence of the above analysis for *while* is that (a) and (h) are not logically equivalent.

(h)   Mary slept while John left yesterday

   The truth conditions for sentences like (h) where one or both of the clauses are in the progressive are somewhat different. Sentence (i) is true at the present moment if (b) is true at an interval of time which is a subinterval (not necessarily proper) of an interval of time within yesterday where (j) is true at all moments of time within that interval.

(i)   John left while Mary was sleeping yesterday

(j)   Mary is sleeping

However, (k) is true at the present moment if (j) is true for all moments of time within some subinterval (not necessarily proper) of an interval of time within yesterday at which (b) is true.

(k)   Mary was sleeping while John left yesterday

   Before and *after* are used to indicate the order of events.

(l)   John left before Mary slept yesterday

Sentence (l) is true at the present moment if there exist some subintervals of yesterday I, I′, (b) is true at I, (c) is true at I′, and I [<] I′. *After* is the converse of *before. And then* and *and next* have the same analysis as *before.* They are used when the speaker wishes to indicate that he views the two described events as being contiguous in some discrete sequence of events entertained by the speaker.
   A sentence like (m) is elliptic for (n).

(m)   John got drunk and fell down last night

(n)   John got drunk and then he fell down last night

   Adverbial subordinate clauses like *since Mary arrived* function like frame adverbial phrases such as *since yesterday.* The independent clause can be in the present perfect but cannot be in the simple past.

(o)   John has left since Mary arrived yesterday

(p)   *John left since Mary arrived yesterday

   On one reading of (q), (q) is true at the present moment if there exists some subinterval of yesterday at which (b) is true and (j) is true at all moments of time up to the present since that interval.

(q)   Mary has been sleeping since John left yesterday

   Adverbial subordinate clauses like *until John leaves* function like frame adverbial phrases such as *until tomorrow. Until* means "up to the time that".

(r)   Mary will be sleeping until John leaves tomorrow

   Sentence (s) is unacceptable (on a reportive reading) because the adverbial subordinate clause functions, in part, as a durative adverbial phrase.

(s)   *John will leave until Mary is sleeping tomorrow

As remarked in section 4.4.3, nonstative, nonsubinterval verb phrases like *leave* cannot take durative adverbial phrases.
   Until, unlike *since*, can be used either in the simple future or in the simple past.

(t)   Mary was sleeping until John left yesterday

Sentence (t) is true at the present moment if there exists some subinterval of yesterday, I, at which (b) is true, there exists some interval I′ such that I′ [<] I, I′ ∪ I is an interval, and (j) is true for all times in I′.

4.5   Analyses of the Tenses

Below we give partial analyses of the various tenses. The treatments are sketchy and ignore many complications. It appears that some of the tenses require more than one analysis depending on the type of verb phrase involved (stative, subinterval, or nonstative, nonsubinterval) and the adverbial phrases present. Often comments we make about one tense with respect to certain verb phrases and adverbial phrases will carry over to other tenses in the expected way. We have yet to implement any of these analyses within Montague's framework.

4.5.1   The simple present tense

In section 4.3.2. we presented an analysis of the simple present tense in the reportive sense. We often use this tense in the reportive sense when the verb phrase in question is stative. However, we seldom use the present tense in this sense when the verb phrase in question is either subinterval or nonstative, nonsubinterval. Ordinarily, with such verb phrases we use the simple present in a nonreportive sense. As we indicated in section 4.4.2, this use is a disguised present progressive in a frequentative sense. For example, (a) and (b) are used with the sense of (c) and (d) respectively.

(a)   John dates Mary

(b)   John works in Rome

(c)   John is frequently dating Mary

(d)   John is regularly working in Rome

   Sentences like (e) seem to be atypical in that we use them in the reportive sense.

(e)   John $\begin{Bmatrix} \text{lives} \\ \text{resides} \end{Bmatrix}$ in Rome

It seems that the verb phrases *live in Rome* and *reside in Rome* are subinterval verb phrases.

The simple present can be used with the sense of the simple future. For example, (f) and (g) can be used to mean (h) and (i), respectively.

(f)   John builds a house today

(g)   John arrives today

(h)   John $\begin{Bmatrix} \text{is going to} \\ \text{will} \end{Bmatrix}$ build a house today

(i)   John $\begin{Bmatrix} \text{is going to} \\ \text{will} \end{Bmatrix}$ arrive today

The simple present in the reportive sense can be used with frame adverbials which refer to an interval of time which includes the present moment.

(j)   John is happy today

Sentence (j) is true at the present moment if (k) is true at the present moment.

(k)   John is happy

Sentence (l) is true at the present moment if there is no time within these days at which (k) is true.

(l)   John is never happy these days

4.5.2   The simple past tense

Sentences in the simple past can only take indexical frame adverbials of a certain kind. We indicate this class by the following:

> *John ate the fish* α is grammatical only if there exists a moment of time p such that if it is considered to be the present moment, α refers to an interval of time I such that there exists a subinterval of I, I′, and I′ [<] p.

This is not a sufficient condition as will be seen in section 4.5.4.

This characterization of grammaticality relative to the simple past and indexical frame adverbials accepts sentences such as (a) and (b) but rejects sentences such as (c) and (d).

(a)   John ate the fish yesterday

(b)   John began to eat the fish today

(c)   *John ate the fish tomorrow

(d)   *John began to eat the fish now

Sentence (d) is unacceptable because *now* refers to the present moment and the present moment does not contain a subinterval which precedes the present moment.

   We now state a truth condition for certain grammatical sentences in the simple past.

   John ate the fish α is true at interval of time I if and only if I is a moment of time, α refers to an interval of time I′ and there exists a subinterval of I′, I″, such that I″ [<] I and *John eats the fish* is true at I″.

   A special case of the simple past is (e).

(e)   John ate the fish at some time

Sentence (e) is true at the present moment p if and only if there exists an interval of time I such that I [<] p and (f) is true at I.

(f)   John eats the fish

This special case of the simple past is very similar to Montague's analysis of the present perfect tense in PTQ. (See section 4.1 above.)
   On our analysis, (g) is a grammatical sentence.

(g)   John ate the fish at two o'clock

However, given the above truth condition, (g) is true if and only if John ate the fish instantaneously. Ordinarily we use (g) to mean (h).

(h)   John began to eat the fish at two o'clock

Sentence (h) is true at the present moment if (i) is true at two o'clock.

(i)   John begins to eat the fish

Intuitively, (i) can be true at a moment of time.
   Intuitively, a sentence like (j) is ambiguous.

(j)   John sliced all of the bagels yesterday

Sentence (j) has at least three readings which are indicated by the following analysis trees.

John sliced all of the bagels yesterday

John   slice all of the bagels   yesterday

John sliced all of the bagels yesterday

all of the bagels   John sliced them$_0$ yesterday

John   slice them$_0$ yesterday

John sliced all of the bagels yesterday

the bagels   John sliced all of them$_0$ yesterday

John   slice all of them$_0$ yesterday
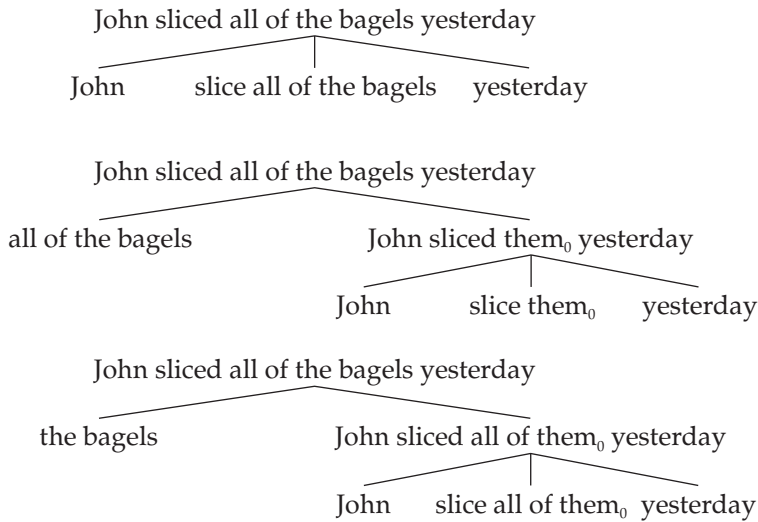
The first analysis tree corresponds to the reading which is true when (k) is true at some subinterval of yesterday.

(k)   John slices all of the bagels

This reading only concerns the entities which are bagels at the subinterval of yesterday. (That is, the set of entities which is the union of the extensions of bagel at every moment of time within the subinterval.) The second analysis tree corresponds to a reading which only concerns the entities which are bagels at the present moment. The reading asserts that each present bagel was sliced at some subinterval of yesterday. Possibly two bagels are sliced at different subintervals. The third analysis tree also corresponds to a reading which only concerns the entities which are bagels at the present moment. However, it asserts that John sliced all of them at the same subinterval of yesterday.

   Just as there are frequentative readings of the simple present, there are frequentative readings of the simple past. Sentences (l) and (m) have the readings (n) and (o) respectively.

(l)   John dated Mary last year

(m)   John worked in Rome last year

(n)   John frequently dated Mary last year

(o)   John regularly worked in Rome last year

Sentence (n) is true at the present moment if (p) is true at some subinterval of last year.

(p)   John frequently dates Mary

   Sentence (q) is a stylistic variant of (o).

(q)   John used to work in Rome last year

   Notice that the order of a durative adverbial phrase and an adverbial phrase of frequency sometimes makes a difference.

(r)   John slept repeatedly for half an hour yesterday

(s)   John slept for half an hour repeatedly yesterday

Sentences (r) and (s) are not equivalent. However, (t) and (u) seem to be equivalent.

(t)   John slept three times for half an hour yesterday

(u)   John slept for half an hour three times yesterday

4.5.3   The simple future tense

In section 4.5.2 we stated a necessary condition for when indexical frame adverbial phrases are suitable for the simple past tense. We shall not state such conditions for the remaining tenses since they can be determined from the truth conditions for the tenses.
   The simple future tense is almost the "mirror-image" of the simple past tense. For this reason, most of the remarks made about the simple past carry over to the simple future in the expected way.
   We now state a truth condition for certain grammatical sentences in the simple future.

> *John will eat the fish* α is true at interval of time I if and only if I is a moment of time, α refers to an interval of time I′ and there exists a subinterval of I′, I″, such that either I is an initial point for I″ or I [<] I″ and *John eats the fish* is true at I″.

   There is a minor asymmetry between the simple past tense and the simple future tense. On our analyses of the tenses, (a) is grammatical but (b) is not.

(a)   John will begin to eat the fish now

(b)   *John began to eat the fish now

Sentence (a) is true when (c) is true at the present moment.

(c)   John begins to eat the fish

  Notice that given the analyses of initiation and cessation verb phrases in section 4.3.4, (d) entails (e) and (f).

(d)   John will eat the fish today

(e)   John will begin to eat the fish today

(f)   John will finish eating the fish today

A similar remark can be made about the simple past tense.
  The expression *soon* can be used with the simple future tense. It refers to an interval of time where the present moment is either its initial point or its initial bound. *Soon* has a counterpart *just*.

(g)   John soon will eat the fish

(h)   John just ate the fish

Just refers to an interval of time where the present moment is either its final point or its final bound.
  There are frequentative readings of the simple future.

(i)   John will date Mary next year

Sentence (i) can have the reading (j).

(j)   John will frequently date Mary next year

4.5.4   The present perfect tense

We state a truth condition for certain grammatical sentences in the present perfect.

  John has eaten the fish α is true at interval of time I if and only if I is a moment of time, α refers to an interval of time I′, I is a member of I′, and there exists a subinterval of I′, I″, such that either I is a final point for I″ or I″ [<] I and *John eats the fish* is true at I″.

  On this analysis, the following sentences are grammatical.

(a)   John has eaten the fish within the last week

(b)   John has just eaten the fish

(c)   John has eaten the fish today

As we emphasized in section 4.2.2, the central difference between the present perfect tense and the simple past tense is that the former always involves a reference to an interval of time which includes the present moment whereas the latter involves a reference to an interval of a wider class – a class which contains intervals which do not include the present moment. This explains why (d) and (e) are unacceptable.

(d)   *John has eaten the fish yesterday

(e)   *John has eaten the fish at two o'clock

Another difference between the present perfect tense and the simple past tense is that the former allows for the described event to end at the present moment whereas the latter requires that the described event end before the present moment.

There is an interesting asymmetry in English. There are no distinguished "mirror-images" of the simple past tense and the present perfect tense. Rather their "mirror-images" are conflated to form the simple future.

(f)   John walked yesterday

(f')   John will walk tomorrow

(g)   John has walked since yesterday

(g')   John will walk before tomorrow

Sentences (f), (g) correspond to (f'), (g'), respectively. Notice that (f) and (g) cannot trade their frame adverbial phrases.

(h)   *John walked since yesterday

(i)   *John has walked yesterday

We have already considered why a sentence like (i) is unacceptable. However, our analysis of the simple past does not rule out using a frame adverbial like *since yesterday* as in (h). But, for some reason, they cannot be so used.

This analysis leaves unexplained a certain quality of the present perfect which has often been remarked by linguists. For example, Chomsky makes remarks to the effect that (j) "presupposes" (l) whereas (k) does not.[15]

(j)   John has visited Rome

(k)   John visited Rome at one time

(l)   John is alive

This is not strictly correct. We agree with McCawley that the force of the presupposition depends on stress.[16] If one utters (j) with the stress on *John* rather than on *Rome*, then one is talking about events of visiting Rome. Such a use does not presuppose that John is alive. However, Chomsky's observation touches on the fact that epistemological considerations influence whether a speaker chooses to use the present perfect or the simple past. Suppose we know that (m) and (n) are true.

(m)   John arrived this morning

(n)   John left this afternoon

If we are asked whether John has arrived today, we are more inclined to answer with (o) than with (p).

(o)   John arrived today

(p)   John has arrived today

This is because John's arrival does not have "present relevance" since he has already left. If John had not left, then we would be inclined to use (p) since this would suggest that his arrival might affect present or future events. We are inclined to view this aspect of the present perfect as a nonlogical feature.[17]

As we observed in section 4.4.3, in certain cases a frame adverbial also can serve as a durative adverbial phrase.

(q)   John has known Mary since June

(r)   John knows Mary

Sentence (q) is true at the present moment if at every moment of time since June (r) is true. A sentence like (s) intuitively has a similar reading.

(s)   John has walked since yesterday

As with the simple past, durative adverbial phrases can only be used with stative and subinterval verb phrases in the present perfect.

(t)   John has loved Mary for two years

(u)   John has walked for two days

(v)   *John has built the house for two months

However, all three kinds of verb phrases can take adverbials of number and frequency.

(w)   John has been happy several times within the last few months

(x)   John has run at least three times this year

(y)   John has frequently read *Emma* this last year

   The present perfect can be used with some adverbial subordinate clauses
but not others.

(z)   John has built a house since Mary left yesterday

(a′)   *John has built a house when Mary left yesterday

(b′)   *John has built a house while Mary left yesterday

4.5.5   The past perfect tense

We state a truth condition for certain grammatical sentences in the past
perfect.

> *John had eaten the fish by* α is true at interval of time I if and only if I is a
> moment of time, α refers to an interval of time I′, I′ [<] I, and there exists
> a moment of time I″ which is a member of I′ and *John has eaten the fish*
> β is true at I″.

This analysis involves a sentence in the present perfect being true at some
moment of time. The interval of time involved in the truth condition of the
present perfect sentence is not explicitly referred to in the sentence in the past
perfect. It is our belief that there is some implicit reference to such an interval
which is determinable from the previous discourse or the extralinguistic fea-
tures of the context of utterance.
   On this analysis, the following sentences are grammatical:

(a)   John had eaten the fish by some time last summer

(b)   John had eaten the fish by the day before yesterday

However, the analysis rules out a sentence like (c).

(c)   *John had eaten the fish by today

This is because *today* refers to an interval of time which includes the present
moment.
   The past perfect can be used with some adverbial subordinate clauses.

(d)   John had left when Mary arrived yesterday

Sentence (d) is true at the present moment if (e) is true when Mary arrived yesterday.

(e)   John has left

Similarly, (f) is true at the present moment if (g) is true when Mary had arrived yesterday.

(f)   John left when Mary had arrived yesterday

(g)   John leaves

   Both McCawley and Palmer notice that a sentence in the past perfect can depend on a sentence in the simple past rather than a sentence in the present perfect.[18]

(h)   John had left a week before Mary arrived last month

Sentence (h) is true at the present moment if (i) is true when Mary arrived last month.

(i)   John left a week ago

Sentence (h) cannot depend on (j) since (j) is ungrammatical.

(j)   *John has left a week ago

4.5.6   The future perfect tense

We state a truth condition for certain grammatical sentences in the future perfect. The variable α is assumed to be a frame adverbial which refers to an interval of time which has either an initial point or bound.

> *John will have eaten the fish by* α is true at interval of time I if and only if I is a moment of time, α refers to an interval of time I', either I is a member of I' or I [<] I', t is either the initial point or bound of I', there exists a moment of time t' such that t' is a member of I', and if β referred to [min(I, t), t'], then *John has eaten the fish* β is true at t'.

   On this analysis, the following sentences are grammatical:

(a)   John will have eaten the fish by tomorrow

(b)   John will have eaten the fish by three o'clock

(c)   John will have eaten the fish by today

   Although this analysis appears to treat (d), our intuition is that (d) should be given a different treatment such that it has the meaning expressed by (e).

(d)   John will have eaten the fish by now

(e)   it will be known that John has eaten the fish now

   On the present analysis, (f) entails (i) but not (j), (g) entails (i) and (j), and (h) entails (j) but not (i).

(f)   John ate the fish today

(g)   John will eat the fish today

(h)   John will eat the fish tomorrow

(i)   John will have eaten the fish by today

(j)   John will have eaten the fish by tomorrow

   Further, (j) entails (k).

(k)   John will begin to eat the fish today or John will begin to eat the fish tomorrow

4.5.7   The present progressive tense

In section 4.3.2 we presented an analysis of the present progressive tense in the reportive sense. However, there are some nonreportive senses of this tense. The present progressive has frequentative readings. For example, (a) and (b) are usually used with the sense of (c) and (d) respectively.

(a)   John is dating Mary

(b)   John is working in Rome

(c)   John is frequently dating Mary

(d)   John is regularly working in Rome

Sentence (d) is true at the present moment p if there exists an interval about p at which (e) is true.

(e)   John regularly works in Rome

We remarked in sections 4.4.2 and 4.5.1 that (e) and (f) are used with the sense of (d).

(f)   John works in Rome

However, sentences like (g) get the reportive reading.

(g)   John is $\left\{\begin{array}{l}\text{living}\\\text{residing}\end{array}\right\}$ in Rome

We consider the verb phrases *live in Rome*, *reside in Rome* to be subinterval verb phrases.
    The present progressive can be used with the sense of the simple future. For example, (h) and (i) can be used to mean (j) and (k) respectively.

(h)   John is building a house today

(i)   John is arriving today

(j)   John $\left\{\begin{array}{l}\text{is going to}\\\text{will}\end{array}\right\}$ build a house today

(k)   John $\left\{\begin{array}{l}\text{is going to}\\\text{will}\end{array}\right\}$ arrive today

    The present progressive can be used with frame adverbials which refer to an interval of time which includes the present moment.

(l)   John is building a house today

Sentence (l) is true at the present moment if (m) is true at the present moment.

(m)   John is building a house

    In section 4.2.3 it was pointed out that Montague's analyses of the present progressive and the present perfect fail to explain why (n) entails (o) but (p) does not entail (q).

(n)   John is walking

(o)   John has walked since yesterday

(p)   John is leaving

(q)   John has left since yesterday

We are in a position to explain this difference. We first show why (n) entails (o). Suppose (n) is true at p. Then there exists an interval I such that $p \in$ I, p is not an endpoint for I, and *John walks* is true at I. Since *walk* is a subinterval verb, *John walks* is true at p. Let *since yesterday* refer to the interval I′ where p is the final point of I′. Thus there exists an interval of time I″, namely p, which is a subinterval of I′, either p is a final point for I″ or I″ [<] p, and *John walks* is true at p. Thus (o) is true at p.

When we try to give a similar argument to show that (p) entails (q), the argument breaks down at point where *leave* is required to be a subinterval verb. It is nonstative, nonsubinterval and does not have the needed property.

4.5.8   The past progressive tense

We state a truth condition for certain grammatical sentences in the past progressive tense.

John was walking α is true at interval of time I if and only if I is a moment of time, α refers to an interval of time I′, and there exists a moment of time t such that t is a member of I′ and t [<] I and *John is walking* is true at t.

The past progressive has frequentative readings.

(a)   John was frequently dating Mary for a few months last year

Sentence (a) is true at the present moment if there exists a subinterval of last year which measures a few months at which (b) is true.

(b)   John frequently dates Mary

4.5.9   The future progressive tense

We state a truth condition for certain grammatical sentences in the future progressive tense.

John will be walking α is true at interval of time I if and only if I is a moment of time, α refers to an interval of time I', and there exists a moment of time t such that t is a member of I', either I = t or I [<] t, and *John is walking* is true at t.

4.5.10   The present perfect progressive tense

We state a truth condition for certain grammatical sentences in the present perfect progressive.

John has been walking α is true at interval of time I if and only if I is a moment of time, α refers to an interval of time I', I is a member of I', and there exists a moment of time t such that t is a member of I', either I = t or t [<] I, and *John is walking* is true at t.

Given our analyses of the present progressive, the present perfect progressive, and the future progressive, (a) entails both (b) and (c).

(a)   John is walking

(b)   John has been walking today

(c)   John will be walking today

However, neither (b) nor (c) entail (a).
   As we remarked in section 4.4.3, a sentence like (d) has two readings.

(d)   John has been eating the fish since yesterday

One reading is such that (d) is true at the present moment p if (e) is true for all moments of time in the interval $(t, p]$ where t is the last moment of yesterday.

(e)   John is eating the fish

The other reading is such that (d) is true if there is at least one moment since yesterday at which (e) is true.
   Sentence (f) is true at the present moment if (a) is true at every moment for the last hour.

(f)   John has been walking for the last hour

Here the durative adverbial phrase is also serving as a frame adverbial phrase.

4.5.11   The past perfect progressive tense

We state a truth condition for certain grammatical sentences in the past perfect progressive.

> *John had been walking by* α is true at interval of time I if and only if I is a moment of time, α refers to an interval of time I', I' [<] I, and there exists a moment of time I'' which is a member of I' and *John has been walking* β is true at I''.

Sentence (a) is true at the present moment if (b) is true when Mary arrived yesterday.

(a)   John had been walking for an hour when Mary arrived yesterday

(b)   John has been walking for the last hour

4.5.12   The future perfect progressive tense

We state a truth condition for certain grammatical sentences in the future perfect progressive. The variable α is assumed to be a frame adverbial which refers to an interval of time which has either an initial point or bound.

> *John will have been walking by* α is true at interval of time I if and only if I is a moment of time, α refers to an interval of time I', either I is a member of I' or I [<] I', t is either the initial point or bound of I', there exists a moment of time t' such that t' is a member of I', and if β referred to [min(I, t), t'], then *John has been walking* β is true at t'.

Notes

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1   Light italic is used in lieu of boldface type.
2   As usual, the asterisk indicates ungrammaticality.
3   Montague [5], p. 73. Montague's remarks suggest that the analysis might be due, to some extent, to Dana Scott.
4   Let t_n be in T for any nonnegative integer n. Suppose that $t_0 < t_2$ and there is no t_1 such that $t_0 < t_1 < t_2$. Also suppose that $t_2 < t_4$ and for all t_3 such that $t_2 \leq t_3 < t_4$, *John*

walks is true at t_3 but at no other times. Then *John is walking* is true at t_2 and *John has walked* is false at t_2.

5 This is discussed by Hans Kamp [1], pp. 112–13.

6 In the same paragraph in Montague [5] in which Montague presents his treatment of the present progressive, he discusses what he calls "the past tense operator" which is read "it has been the case that". It is exactly the operator that he uses for the present perfect in PTQ.

7 Aristotle appears to have been the first to notice these two different kinds of verb phrases. (Aristotle [2], 1048b 18–35 and Aristotle [1], 1174a 14–1174b 7.) The topic has been much discussed by current philosophers: Ackrill [1], Kenny [1] (chapter 8), Lemmon [1], Penner [1], Potts [1], Ryle [1] (chapter 5, section 5), and Vendler [1] (chapter 4). Michael Bennett is especially grateful to John Giuliano with whom he has spent many hours discussing this topic.

8 To some extent, Montague prefigures this idea in Montague [2], p. 161. There he analyzes an event as a property of moments of time – a function from possible worlds to sets of 1-place sequences of moments of time. An experience is analyzed as a function from possible worlds to sets of 2-place sequences of persons and moments of time. The latter is a minor variation of his analysis of the intension of a verb phrase in PTQ – a function from ordered pairs of possible worlds and moments of time to sets of individuals (actually individual concepts, but that is irrelevant here). Montague states in Montague [2] that his analysis of events is adequate for INSTANTANEOUS GENERIC EVENTS. In order to treat PRO-TRACTED GENERIC EVENTS, such events should be identified with properties of intervals, rather than moments, of time (or more generally with properties of unions of intervals of time). From this one can extrapolate a more general analysis of the intension of a verb phrase – a function from ordered pairs of possible worlds and intervals of time (or more generally, unions of intervals of time) to sets of individuals. On this line, a point of reference is an ordered pair of a possible world and an interval of time. Accordingly we would now consider the notion of a sentence being true (under an interpretation) relative to a possible world and an interval of time.

  Bruce [1] is a paper which is in the same spirit as ours. Although Bruce does not consider the notion of a sentence being true at an interval of time, intervals of time are central to his analysis.

9 See Hall [1] for an earlier formulation of some of the issues considered in section 4.4 and in other parts of the paper. Of course Reichenbach [1] is one of the first discussions of these matters along the lines of this paper.

10 See Bennett [1] for an analysis along these lines of the plural quantifiers of English.

11 See Lewis [1].

12 Quine [1], p. 91.

13 Montague, in Montague [1], p. 120, gives an analysis in terms of probability theory of a sentence operator which is read "it is almost always the case that".

14 Sentences (f') are based on Lewis's example. Our analysis of these sentences is somewhat different from that suggested by Lewis.

15 Chomsky [1], pp. 212–13, and Chomsky [2], p. 60.

16 McCawley [1], p. 106.

17 See Palmer [1], pp. 74–5, for an interesting discussion of "present relevance" and the present perfect tense.

18 See McCawley [1], pp. 102–3, and Palmer [1], pp. 76–7.

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Postscript (1978)

This paper is still a draft in the sense that we have always regarded it as incomplete and inadequate in several major respects which we discuss briefly below; however, we have decided to disseminate it as is in unpublished form for two reasons: (i) the paper is cited as one of the primary sources of the idea of interval semantics in a number of recent works, and we wish to make it more generally accessible as part of the literature on interval semantics; and (ii) our ideas about many of the issues treated here have changed sufficiently that if we were to revise the paper for publication now, the result would probably not be in any sense the same paper.

The paper was conceived and written during the summer and fall of 1972; a few changes were made in the winter of 1973. Since then nothing has been added, with the exception of a very few minor changes and added examples in January 1978.

Here we will sketch three major shortcomings of the paper, indicating along the way some of the developments in interval semantics since 1972.

One prominent inadequacy of the paper is that it does not provide a compositional syntax and semantics of the constructions treated. Truth conditions are given holistically for sample sentence forms such as (a),

(a)   John had eaten the fish by α

but we have not provided the rules that would be required in a Montague framework to build up and interpret such sentences from their parts. The truth conditions given reflect our (1972) view of what the outcome of such rules should be, but they do not provide any syntactic or semantic view of what the internal part–whole structure should be. Getting from truth conditions for whole sentences to a compositional semantics is by no means a mechanical task, and there are many difficult issues that are still unresolved in this area, e.g. whether one should start with tenseless sentences and have a present tense operator (see Vlach 1977), whether tense and aspect are sentence operators, verb phrase operators, or both (see Bach 1977), what the various temporal adverbs combine with (verb phrases, sentences, tense and aspect operators are among the possibilities; see Cresswell 1976), and a host of problems connected with the classification of verbs, verb phrases, and/or sentences as states, activities, and events (or states, processes, accomplishments, and achievements) (see Bach 1977; Vlach 1977; Dowty 1977). The truth conditions we gave for sample sentences of various types, even if correct, reflect the joint contribution of a host of such factors; separating out the individual contributions of the parts and how they fit together is a much harder task which remains to be done.

A second major inadequacy of the paper is the absence of a treatment of indexicals. Indexicality plays a prominent role in tenses and time adverbials, and we believe that no adequate treatment can ignore it. (See Bennett 1976, for a treatment of demonstratives and indexicals in Montague's framework based on some ideas of David Kaplan's.)

A third major problem with the paper is that our analysis of the progressive is demonstrably wrong. Consider sentence (b).

(b)   John was building a house at midnight on Tuesday

On our analysis, (b) is true at the present moment if there exists some interval of time I about midnight on Tuesday such that John is in the extension of *build a house* at I. So in some sense, (b) implies that John completes the house. But the fact that (c) can be true shows that this implication is wrong.

(c)   John was building a house when he died at midnight on Tuesday

This problem has been much discussed in the subsequent literature, and there have been several conflicting proposals for its solution. We were aware of the problem in 1972 (see the end of section 4.3.3), but gave the analysis we did for two reasons: (i) we did not have a better one to offer; (ii) we were inclined to think then (though we are not so inclined now) that the progressive did have a reading on which (c) could not be true and which was correctly captured by our analysis, and that (c) when true might be elliptical for something like (d).

(d)   John was working to build a house when . . .

  Recent proposals for treating the progressive so as not to obtain the unwanted "completion" implication include Dowty (1977), which makes use of branching possible worlds; Bennett (1977), which employs a distinction suggested by Glen Helman between open intervals as representing activities and closed intervals as representing performances; and Vlach (1977), which argues that the progressive for achievements and accomplishments must be in a certain sense non-topological, that is, that the set of times at which Prog (ϕ) is true is not a function of the set of times at which ϕ is true, even in Dowty's branching system.

  The three inadequacies just sketched are not the only ones we are aware of, but they seem to us the most significant. There has been progress in this area since 1972, particularly in the last couple of years. Some of it has been cited above, and more was in evidence at a symposium at Brown University on Tense and Aspect (January 1978), selected papers from which will be published by Academic Press as one of the volumes in their *Syntax and Semantics* series (Tedeschi and Zaenen 1981).

  The list of new references which follows includes works which refer to this paper and other works which relate to interval semantics.

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Chapter 5

Bound Variables and Other Anaphors

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When a noun phrase or a pronoun occurs in a sentence, it is frequently appropriate to ask what entity it refers to, but it is well known that not all uses of noun phrases and pronouns are referential in this simple sense. In computational approaches to language processing, I believe the main thrust in this area has been toward understanding those referential uses of NPs and pronouns which require the use of both linguistic and non-linguistic inferences to determine the most plausible referent for the expression. My emphasis in this paper will be somewhat different. I believe that recent work by linguists, logicians, and philosophers is leading to convergence on the view that there are two fundamentally distinct uses of pronouns which have to be treated quite separately: (i) a use that corresponds to the logician's use of *bound variables*, and (ii) a use which I will call, for want of a better name, a *pragmatic* use. It can be argued that bound variable pronouns are restricted to occurrences in syntactic construction with their antecedents, and are fully interpreted at the level of semantics, while pragmatic pronouns need not have linguistic antecedents at all, and require pragmatics as well as semantics for their interpretation.

5.1   The Basic Distinction

The clearest cases of bound variable anaphora involve antecedents like *every man* and *no man* which are singular in form but do not refer to individuals, as in (1) and (2).

Author's note 2003: The "other panelists" occasionally referred to in this paper were my fellow participants, a psychologist and one or two computational linguists, on a panel discussion on anaphora for which this paper was prepared.

(1)   *Every man* put a screen in front of *him*.

(2)   *No child* will admit that *he* is sleepy.

When the *he* of (2) is understood as anaphorically related to the noun phrase *no child*, the *he* clearly does not refer to a particular individual. Rather, the sentence can be understood as the result of binding an open sentence, (3), with a quantifier phrase, *no child*.

(3) He_0 will admit that he_0 is sleepy.

(It is immaterial for the purposes of this chapter whether we view the process in question as a generative one, as in Montague (1973) or Lakoff (1971), or as an interpretive one, as in Jackendoff (1972) or the I-grammar Montague variant of Cooper and Parsons (1976). The use of subscripted pronouns rather than xs and ys follows Montague's practice, but that distinction is also immaterial here.)

   The semantics of variable binding is well studied in logic; a particularly clear and brief account can be found in Quine (1970). The crucial point here is that the semantics involves consideration of a whole range of possible values for the variables, not the determination of any single value or referent. Equally crucial is that the interpretation of (2) involves an open sentence with *two* occurrences of the free variable he_0, one in the position of the antecedent noun phrase, the other corresponding to the surface pronoun.

   Using these clear cases, we can discover strong syntactic constraints on the occurrence of bound variable pronouns. With few exceptions, it appears that bound variables must be *in construction with* their antecedents (the observation is made by Evans (1977); the notion "in construction with" comes from Klima (1964): a constituent A is in construction with a constituent B if and only if A is dominated by the first branching node which dominates B; the term c-command is a more recent alternative name for the same notion). Thus the following do not permit a bound variable reading:

(4)a.   *Every man* walked out. *He* slammed the door.
   b.   John loves *every woman*, and he hopes to date *her* soon.
   c.   If *no student* cheats on the exam, *he* will pass the course.

By contrast, the bound variable reading is permitted in cases like (1) and (2) above, in which the pronoun is in construction with its antecedent.

   The clearest cases of what I am calling pragmatic uses of pronouns are cases where a pronoun is used with no linguistic antecedent at all, as in (5), or where the antecedent occurs in an earlier sentence of a discourse, as in (6).

(5)   (On walking into a room) Why is *he* [pointing] here?

(6)   I couldn't reach Elliot last night. *He* is probably in Boston.

These are cases where the pronoun is being used to refer to a particular individual, and the determination of which individual the intended referent is requires making use of the linguistic and non-linguistic context. Ignoring some complicated cases that I will discuss later, we may say that at the level of purely linguistic description, such pronouns function like *free* variables which are not bound at all at the semantic level. A sentence containing one expresses a determinate proposition only relative to a particular choice of value for the variable, much as a sentence containing the word *now* expresses a determinate proposition only relative to a particular time of evaluation. Such choices depend on the context of use of the sentence, which is why I call this a *pragmatic* use of pronouns.

I believe that there are no absolute rules governing the choice of referent for pragmatic uses of pronouns, but that there are discoverable strategies and principles governing the relative likelihood or preference among choices. The other participants in this panel know much more than I do about what those principles and strategies are; I hope they would agree that the output of such principles is a probable or expected referent rather than an absolute referent for the pronoun. For example, in most contexts, the *probable* referent of the *he* in (6) is Elliot; but one can easily enough imagine a context where speaker and hearer are most interested in figuring out where Max is, and being unable to reach Elliot is a good clue to Max's being in Boston; then *he* may be intended and understood as referring to Max. What matters most seems to be the salience and relevance of a particular individual, and I see no reason to draw any theoretical line between cases where that salience comes from the linguistic context as opposed to the non-linguistic context.

Where I do want to draw a sharp line is between the bound variable use and the pragmatic use of pronouns. The bound variable use is best described at the level of syntactic form and semantic interpretation of single sentences, and the relevant question is not what the pronoun refers to, but what quantifier phrase is binding it. The pragmatic use is best described at the pragmatic level, where the full context of the sentence in use is considered; on the syntactic level, these pronouns are really no different from proper names, and at the semantic level, they can be viewed as free variables or as dummy names.

5.2   Structurally Ambiguous Pronouns

I have begun with the clearest examples of the distinction; if all uses of pronouns fell unambiguously into these two categories, I could stop here. All the rest would be a matter of improving the description of the syntactic constraints on bound variable anaphora and unravelling the processing mechanisms that we use to determine the referents of the pragmatic uses of pronouns. But the clear cases do not provide a set of necessary and sufficient conditions for telling the two kinds of pronouns apart. All we can conclude so far by way of conditions is the following:

    i.   A pronoun can function as a bound variable only if it is in the same sentence as its antecedent.[1]

   ii.   Any pronoun can be used pragmatically.[2]

If these are the only conditions, we would expect many occurrences of pronouns to be ambiguous as to which use they have, and indeed many are. The pronouns in (1) and (2) are ambiguous in this way, and the sentences have sharply different interpretations in the two cases. But now consider a sentence like (7):

(7)   *The prosecutor* believed that *he* would win the case.

This example can be analyzed either way; if the pronoun is analyzed as a bound variable, the sentence is interpreted as in (7a), and if the pronoun is treated pragmatically, we can represent it as in (7b).

(7a)   (The prosecutor: he_0) [He_0 believed that he_0 would win the case.]
(7b)   The prosecutor believed that he_5 would win the case.

On the pragmatic pronoun reading, the free variable he_5 will be interpreted as some salient individual determined by the context; and one likely choice will be the prosecutor. This looks at first as if we are predicting an ambiguity where there is none. And this is not just an isolated example, since the same situation will arise whenever we have an antecedent noun phrase that picks out a particular individual. But it turns out that there is striking evidence that this is a real structural ambiguity, and not just an artifact of the analysis. I believe that Keenan (1971) was the first to point this out; Sag (1976) and Williams (1977) discuss such cases extensively. The evidence comes from verb phrase deletion, and involves examples like the following:

(8)   *The prosecutor* believed that *he* would win the case, and so did *the defense attorney*.

The missing verb phrase can be understood in just two ways, corresponding to the two structures we have posited for the first clause. On each reading, sentence (8) predicates the same property of the defense attorney as it predicates of the prosecutor: either the property of being an x such that x believed that x would win the case (the bound variable reading), or the property of being an x such that x believes that he_5 (the prosecutor) would win in the case (the pragmatic pronoun reading).[3] Thus the examples of so-called "sloppy identity" (Ross 1967) of pronouns are really examples of strict semantic identity of predicates. This important generalization can be captured only by recognizing that apparently unambiguous sentences like (7) are in fact structurally ambiguous.

   Cases with proper names as antecedents to pronouns work just like (7) and (8); the unified treatment of all noun phrases, including proper names, as

quantifier phrases proposed by Montague (1973) is an important aid in permitting the treatment of pronouns advocated here.

Another major source of pronoun ambiguity is the systematic ambiguity of most plural noun phrases as between a "group" reading and an "individual" reading, as in (9).

(9)   Three men lifted the piano.

When the plural pronoun *they* is used as a pragmatic pronoun, it always refers to a group; but when it is used as a bound variable, it may be either a variable over individuals or a variable over groups. Thus we get two bound variable readings plus a pragmatic pronoun reading for (10).

(10)   *The Democrats* voted for *their* wives.

On the group-level bound variable reading, the Democrats as a group voted for their wives as a group. On the individual-level bound variable reading, each of the Democrats voted for his own wife. On the pragmatic pronoun reading, the Democrats[4] voted for some group's wives; that group might be the Democrats themselves, but might be some other group determined by the context. Again, the three readings lead to corresponding readings in sentences with verb-phrase deletion:

(11)   The Democrats voted for their wives before the Republicans did.

I will not enumerate the readings, but it can be seen that the positing of the three structures for the first clause plus the requirement that verb phrase deletion be interpreted as semantic identity of predication makes the correct predictions about the possible interpretations of the full sentence.

Yet another source of structural ambiguity is the fact that noun phrases may have other noun phrases embedded within them, and a pronoun may have either the whole noun phrase or a subpart as antecedent. Sentences (12a) and (12b) do not have this particular ambiguity because of the number difference, but (13) is ambiguous as between (13a) and (13b).

(12)a.   One of the prisoners believed that she could escape.
    b.   One of the prisoners believed that they could escape.[5]

(13)   Two of the prisoners believed that they could escape.
    (a)   *Two of the prisoners* believed that *they* could escape.
    (b)   Two of *the prisoners* believed that *they* could escape.

Each of these sentences is ambiguous between a bound variable use and a pragmatic use of the pronoun; and sentence (13a) permits either the individual-level bound variable reading (each of the two believed she could escape) or

the group-level reading (both believed that both could escape). However, (13b) on the bound variable reading must be a group-level pronoun, because the antecedent is in a partitive construction, which requires a group-denoting noun phrase. A fuller discussion of plural noun phrases and bound variable pronouns can be found in Bennett (1974), although Bennett does not specifically discuss the pragmatic uses of pronouns. No new principles of pronoun interpretation are needed for these cases beyond the important observation that *they* can function semantically as an individual-level pronoun, that is, just like a singular pronoun. The complexities of these examples result simply from the joint interaction of several individually simple phenomena: bound variable vs. pragmatic uses of pronouns, individual vs. group readings of plurals, and the possibility of either a whole noun phrase or a subpart of it serving as antecedent for a pronoun.

The examples discussed so far are summarized and extended in table 5.1. The column headed "Pragmatic pronoun" should be understood as follows: the given pronoun can be interpreted as referring to an individual or group determinable on the basis of the interpretation of the given "antecedent" as

Table 5.1

Antecedent	Bound variable pronoun	Pragmatic pronoun
every man	he	*he, OK they (group)
no man	he	*he, OK they (group)
the man	he	he
John	he	he
one man	he	he
more than one man	he	*he, OK they (group)
at most one man	he	[none]
three men	they (ind), they (group)	they (group)
one of the men	he	he
$\begin{Bmatrix} one \\ two \end{Bmatrix}$ of *the men*	they (group)	they (group)
two of the men	they (ind), they (group)	they (group)
no men	they (ind)	they (group)
John and Bill	they (ind), they (group)	they (group)
John or Bill	he	they (group)[a]

[a] The group in this case is the group of John *and* Bill. That group can be put into contextual salience by any mention of John and Bill separately, as in the examples below.

(i)   John saw Bill yesterday. They decided to go fishing.
(ii) I invited John, but not Bill. They both came anyway.
(iii) Ask John or Bill. They know where the keys are kept.

the relevant linguistic context. Thus, for example, while *every man* does not *refer* to the group of all man, it can promote that group into salience, as can *no man* and *no men*.

(14)   No students came to the party. They thought they weren't invited.[6]

5.3   Are There "*Pronouns of Laziness*"?

Both traditional grammar books and early transformational accounts such as Lees and Klima (1963) suggest a treatment of pronouns different from either of the two I have described. This is the view that a pronoun is a substitute for a linguistically identical noun phrase; (15b) would on this view be derived from (15a).

(15)a.   John spoke to Mary when John walked in. →
    b.   John spoke to Mary when he walked in.

But such a view requires that semantic interpretation operate on surface structure, since the application of the rule changes the meaning whenever the repeated noun phrase is anything other than a proper noun or a definite description.

(16)a.   John lost a watch and Bill found a watch →
    b.   John lost a watch and Bill found it.

Given that pragmatic pronouns must be generated directly anyway because of cases where there is no linguistic antecedent, there is then no work left for such a transformation to do; it simplifies neither the syntax nor the semantics. Hence it has been abandoned by linguists of just about every theoretical persuasion.
    But there are some cases that look as though they might be better handled via a syntactic substitution rule than by either the bound variable or the pragmatic treatment. One class was introduced by Geach (1962), who provides examples like (17):

(17)   Every man who owns a donkey beats it.

On the defensible assumption that *a donkey* should be analyzed here as an existential quantifier phrase having narrower scope than the *every*, this *it* cannot be analyzed as a bound variable (see Partee 1975a). But it also does not refer to any specific donkey, and so does not appear to be functioning as a pragmatic pronoun. Geach suggests that a sentence like (17) be analyzed in terms of (18):

(18)   Every man who owns a donkey beats the donkey he owns.

Thus the *it* is viewed as standing for a description recoverable in a complex way from the initial part of the sentence. Geach may or may not have called this an example of a "pronoun of laziness"; the term is his, but it has been used by him and others in a variety of ways. What all uses of the term have in common is the idea that some pronouns should be analyzed neither as bound variables nor as directly referential, but in terms of some syntactically definable relation to an antecedent noun phrase.

Another example for which a "pronoun of laziness" treatment has plausibility is (19), from Karttunen (1969):

(19)   The man who gives his paycheck to his wife is wiser than the man who gives it to his mistress.

This *it* is also not a bound variable nor directly referential; it seems to be a substitute for the expression *his paycheck*. In both Partee (1970) and Partee (1975b), I argued for the existence of a syntactic pronoun-of-laziness rule, intended to cover both these examples and those cases of what I am now calling pragmatic pronouns in which the antecedent is itself a directly referring expression such as a proper noun or a definite description. However, neither I nor anyone else that I know of ever succeeded in stating a version of the rule which covered all of these cases without generating clearly unacceptable results as well. Recent arguments by Terry Parsons (personal communication), Robin Cooper (1979), Gareth Evans (1977), Emmon Bach (personal communication), and others have convinced me that there is no way to make the notion of "pronoun of laziness" coherent without reducing it to one which covers only a small subclass of the pragmatic pronouns and hence does no useful work.

What, then, can we say about the paycheck sentences and the donkey sentences? Many lines of attack are being explored currently; one that I find particularly promising is proposed by Cooper (1979), who suggests a rather natural extension of the notion of pragmatic pronoun to handle them. Before describing his proposal, I need to fill in some background.

Russell's analysis of singular definite descriptions (Russell 1905) requires that there be a unique object satisfying the description in order for the expression to denote anything, and hence notoriously fails to account for the successful reference of a noun phrase like *the clock* in (20).

(20)   Did you wind the clock?

That the missing ingredient is pragmatic has long been recognized; Cooper (1979) proposes a mechanism that brings in pragmatics in a simple way that parallels the account of pragmatic pronouns given above (which is also basically Cooper's). He proposes for definite descriptions a semantic interpretation like Russell's but with the addition of a free property variable P: *the clock* then denotes (the property set[7] of) the unique individual x such that clock(x) and

P(x). At the semantic level, P is just a free variable; it is left to the pragmatic interpretation of the sentence in context to determine an appropriate choice for P. In a context where there is no salient distinguishing property, the singular definite description would indeed be inappropriate or uninterpretable. Cooper's treatment can be seen as a formalization of the informal gloss of *the* (by Katz and others) as "contextually definite".

  As a second background step toward Cooper's proposal, consider the interpretation of genitive phrases like that in (21).

(21) John's team lost again.

As is well known, John's team may be the team John owns, or plays for, or roots for, or collects trading cards of, or writes news stories about; there are virtually no limits on the relevant relation. I propose that such constructions be analyzed at the semantic level as definite descriptions containing a free relation variable R, whose value is to be determined at the pragmatic level, by looking for an appropriately salient and relevant relation in the linguistic or non-linguistic context. Thus *John's team* would be interpreted as (22):

(22) the x such that team (x) and R (John, x).

What is common to these analyses of pragmatic pronouns, definite descriptions, and genitive constructions is the use of semantic free variables that are pragmatically assigned particular values. Introducing the free variables allows a complete specification of the form of the interpretation to be given for each sentence at the semantic level, while providing an appropriate division of labor between semantics and pragmatics in the determination of the content.

  Cooper's proposal for the donkey and paycheck sentences is that pronouns can be analyzed not only as free variables, but alternatively as expressions composed of more than one free variable, utilizing free property or relation variables much as in the examples just discussed. The logical formalism is complex, but I will give it for completeness and then try to paraphrase it less formally. A singular pronoun (*he*, *she*, or *it*) may have any translation of the following form:

(23) $\lambda K\ \exists x\ [\forall y\ [[^\vee\pi]\ (y)\ \equiv\ y\ =\ x]\ \wedge\ K\ (x)]$, where π is a property-denoting expression containing only free variables and parentheses.

What this says is that e.g. *it* may be interpreted as (the property set of) the unique individual x which has property π. For the paycheck example, an appropriate π will be R (u), where R is a free relation variable and u is a free individual variable that will be bound by the second occurrence of *the man*. The second clause of (19) will then say "the man u such that u gives the x such that R (x, u) to u's mistress." The pragmatically appropriate R will be "being the paycheck of". The computational complexity of the analysis is justified,

I believe, by the fact that only very salient relations permit the kind of pronoun use evidenced by the paycheck example.

Cooper's analysis of the donkey sentences uses the identical device; for details see Cooper (1979).

The conclusion of this section is that there are no pronouns of laziness; the cases which seemed to require them can be handled by an extension of the notion of pragmatic pronouns. The extension is somewhat complex, but (a) it makes use of the same kind of property and relation variables that are needed for an account of definite noun phrases and genitive constructions, and (b) the examples it is needed for are intuitively complex and infrequent in occurrence.

5.4   Conclusion

There are many problems of pronouns and reference that I have not touched on. I have not discussed reflexive pronouns, first and second person pronouns, pronouns in modal contexts, the pro-common noun *one*, anaphoric determiners like *same*, *different*, or *other*, or any of a host of other topics crucial to a fuller account of the role of pronouns in reference. In some cases the problem is just lack of space and time, but in other cases there are still difficult open problems. I hope that some of what I have included is relatively unfamiliar and potentially useful for computational language processing endeavors, and I count on my fellow panelists to fill in some of the holes I have left.

Notes

1   There are apparent exceptions to even this weak a statement, but I believe they are best understood as involving elliptical sentences. Consider the following example (from David Kaplan, personal communication):

A: Could a woman become chairman of the Philosophy Department?
B: Yes, if she's qualified.

The *she* in the second sentence is not a pragmatic pronoun; but I think it is best treated as bound by an unexpressed antecedent within the second sentence, which is not as it stands a complete sentence, rather than as bound by an antecedent in the previous sentence.

2   There are exceptions to this statement, too, but they all involve idiomatic pronoun-containing expressions like "shrugged his shoulders" or "lost his cool". Reflexive pronouns are not included in this generalization; they are almost invariably bound variable pronouns, except for certain cases that seem to result from instability in the choice of nominative or accusative form. I will not go into any details about reflexive pronouns here.

3   On the pragmatic pronoun reading, the pronoun *he* can of course refer to someone other than the prosecutor; in that case the missing verb phrase will always be understood as involving reference to the same third person.

4   There is still an individual/group ambiguity for the subject in this case, but it does not affect the interpretation of the pronoun, so I will ignore it.

5   For simplicity I am ignoring the dialect that allows *they* with a singular antecedent; in that dialect (12b) is as ambiguous as (13).

6   Not every occurrence of a quantifier phrase with *no* has this effect, as the following example from Evans (1977) shows:

   (i)   *John owns no sheep and Harry vaccinates them.

The role of non-linguistic inference in interpreting pragmatic pronouns can be seen from the following linguistically similar examples.

   (ii)   John owns no sheep because Amherst taxes them.
   (iii)   John now owns no sheep because Harry poisoned them.

In (ii), *them* seems to be generic *sheep* rather than any group of sheep; in (iii) the most plausible interpretation seems to be the sheep that John once owned. Perhaps it would be more accurate to say that *no man* and *no men* never serve directly as antecedent to a pragmatic *they*, but sentences in which they occur do sometimes permit the inference of a suitable referent for a pragmatic *they*.

7   Montague (1973) treats all noun phrases as devoting property sets, and Cooper follows this practice. While that treatment seems essential for a unified account of noun phrases, I have omitted discussion of it here for simplicity.

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Chapter 6

Anaphora and Semantic Structure

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Emmon Bach and Barbara H. Partee

6.1 Pronouns and Variables

Suppose you had a language that was just like a predicate calculus except that the number of distinct variables was fixed at some small number. Suppose further that most of the time the elements acting as binders of the variables (quantifiers, abstraction operators, and the like) were either invisible in the language or not syntactically distinct from the singular terms and variables themselves. What you would have would be something like English.

Linguists and logicians alike, either informally or formally, have attempted to explicate the role of pronouns in natural language on the model of the predicate calculus. *If* you want to associate with sentences of a natural language a disambiguated language as part of the explanation of the semantics of the language (including a recursive characterization of truth and entailment) and *if* you want to use something like quantification theory of the standard sort as part of this task, then it's necessary to use an infinite set of variables at some level and move NPs around at some level so as to represent scope for quantification and other binding.[1]

(Author's note, 2003) This is one of a pair of related papers authored jointly with Emmon Bach. The two papers share a fragment which we worked out jointly, while concentrating on different issues in the prose parts. The other one is: Partee, Barbara H., and Emmon Bach, 1981: Quantification, pronouns and VP anaphora. In *Formal Methods in the Study of Language*, ed. J. Groenendijk, T. Janssen, and M. Stokhof, 445–81. Amsterdam: Mathematisch Centrum. Reprinted in: J. Groenendijk, T. Janssen, and M. Stokhof, eds., *Truth, Information and Interpretation: Selected Papers from the Third Amsterdam Colloquium*. Dordrecht: Foris, 99–130. In each case, the first author did most of the actual writing. This one is the more central of the two. In this edition I have unabbreviated some abbreviations and made a few other small changes at the suggestion of my copy-editor.

We can distinguish three major approaches to solving the disambiguation problem. If you overlook details, they are more like each other than different.

One approach, the Revised Extended Standard Theory (REST), takes "surface" structures (SS) which include nodes with no phonological content (traces, null anaphors) and marks nodes with indices.[2] Part of the indexing has been done before surface structure (maybe), some gets carried out by rules operating first on SS, then by successive operations on the results, until we get a disambiguated language (logical form: LF). The semantic interpretation (if there is an explicit one) is done on logical form. (See references to Chomsky, May, Higginbotham, Williams, Hellan.)

A second approach (Generative semantics: GS) is sort of the opposite of REST. It starts with a fully disambiguated language (which is presumably given an interpretation) and by a series of rules maps it into surface structures. (See Dowty, 1979, for an explication of various interpretations of Generative semantics.)

A third approach (call it EMG for Extended Montague Grammar) builds up surface structures directly but associates with each syntactic rule a semantic rule (usually via a translation into intensional logic).

We'll mainly be comparing the first and the third approaches. With regard to the issues we want to address here it turns out the first and second approaches are really quite equivalent. In both, there is a particular disambiguated language (Logical Form; Remote Structure or Semantic Representation) in which indexed variables are used and where scopal relations are overtly indicated in structural configurations. The relation between this level and surface structures of English sentences is expressed by rules, that introduce indexed variables for (REST), or remove indices from, pronouns or substitute pronouns for variables (GS), supply variables for gaps (delete variables to produce gaps), raise (lower) quantified noun phrases (NPs), create (destroy) syntactic structures like Ss, and require some track to be kept of intermediate stages (derivational constraints or traces with indices). We aren't here concerned with questions about the relative power or even the comparability of the two approaches. (See Cooper and Parsons, 1976, for a particularly explicit comparison of two approaches to quantification in English within two transformational theories reminiscent of the REST and Generative Semantic theories.)

To solve the problems of quantification in an ambiguous language, natural languages seem to make heavy use of two complementary devices or principles, which make natural languages sharply different from predicate calculus.

NON-COREFERENCE. In predicate calculus (PC) variables do two jobs: (1) they mark positions in what we might call argument structure for purposes of evaluating quantificational statements; (2) use of the same variable in an open sentence or within the scope of a single binder requires the same value on any assignment (truth-conditions of quantified statements are given on the basis of truth-on-an-assignment for the open formula in the scope of the quantifier). In striking contrast, use of the "same" pronoun in natural languages within a certain yet-to-be-defined "local" context requires that there be some assignments

that give different values to the two occurrences (by "same" we mean the obvious: *he* is the "same" as *him*). The terms *coreference* and *non-coreference* are unfortunate. Since most systems we'll consider here use a system of indexing (at some level), we'll use, in a theory-neutral way, terms like *co-indexing*. Typical facts to explain are sentences like the following (# means that the underlined items have to be non-coindexed or in the case of quantified noun phrases (QNPs) the pronoun in italics can't be interpreted as a variable bound by the QNP):

(1)   #*He* saw *him*.

(2)   #*Every woman* told *her* that she was OK.

Note that *she* can be, interpreted as bound by *every woman*. It's obviously necessary to have interpretations that would correspond to formulas with repeated uses of the same variable in local contexts; hence, natural languages make use of a second kind of device:

REFLEXIVES.   To get the kind of interpretation that would express the illicit interpretations of (1) and (2), English uses reflexive pronouns:

(3)   He saw himself.

(4)   Every woman told herself that she was OK.

Now (3) is unambiguously to be evaluated as would a formula SEE (x, x) and (4) (though still ambiguous as to *she*) must have a subpart like this: TELL (x, x, p).

Before launching into an attempt to describe a procedure for getting the right disambiguated expressions to relate to English sentences and then comparing the two approaches, let us emphasize some areas of actual or potential agreement.

   In both REST and EMG all noun phrases are (or can be) given a common type of interpretation as binding operators. In EMG, for example, *every woman* is interpreted as denoting the set of properties that every woman has and "quantifying in" to a lambda-abstracted sentence says that the property (of being an *x* such that *x* loves *x*, say) is in that property set. In REST, a rule of quantifier-raising replaces *every woman* by *x* and sticks a binder (Every *x*: *x* a woman) in front of the sentence. As far as we know, these are only notationally distinct ways of doing the exact same thing.

   (A difference: EMG usually takes over Montague's treatment of intensional locutions like *seek a unicorn* which come from direct generation and not quantifying in. We are not aware that this distinction has been treated in REST, but there's no reason in principle why REST couldn't incorporate the same treatment by making quantifier-raising optional; cf. Cooper and Parsons, 1976.)

Both systems associate variables with anaphoric elements like pronouns, null anaphors, or gaps.

6.2   Principles about Pronouns

It's easy to state a few vague general principles about pronouns in English:

(i)   Two occurrences of the "same" pronoun occurring in the same local context (e.g. immediate arguments of the same verb) must be non-coindexed.
(ii) To express a meaning that would be gotten by disobeying (i), use a reflexive.
(iii) Pronouns within certain constructions (e.g. VPs) under conditions of obligatory or optional control work just as if they were in a sentence formed from the constituent plus a pronoun appropriate to the controller.

We've already seen examples of (i) and (ii). Here are examples of (iii) for obligatory and then free control:

(5)   #I regard *him* as proud of *him*.

(6)   #*He* strikes me as proud of *him*.

(7)   #I gave *him* a book to read to *him*.

(8)   I bought a book from *him* to read to *him*.

According to (iii), these should be compared to:

(9)   #*He* is proud of *him*.

(10) #*He* read a book to *him*.

(11) I read a book to him.

To make the above principles do any work for us we have to say what is meant by the term *local context*. It's intended to cover the differences among sentences like these:

(12) #*He* loves *him*.

(13) *He* loves *his* mother.

(14) *He* persuade me to talk to *him*.

(15) *He* said that *he* was OK.

(16)   #*his* gift to *him*

(17)   #between *him* and *him*

Where can we state or implement principles like those given above? It can't be done in the semantics, in the strict sense, for sure. (This is probably too bold, so you can just take it as a challenge, if you want.) Try to state principle (i) semantically. In the semantics we have meanings and we have meaning structures. In a model-theory like Montague's these meanings (using the word non-technically) are things and functions from things to things (one kind of thing being a truth-value). So *see(x, y)* denotes (let us say) the thing (truth-value) that you get when you apply the function denoted, by *see(y)* to the thing $g(x)$ where g is an assignment of values to variables and *see(y)* is the function from things to truth-values that you get when you apply the function denoted by *see* to $g(y)$. Suppose we now try to say that $g(x) \neq g(y)$, necessarily. Well that's just wrong, in the first place: we can certainly say *he saw him* in situations where *he* and *him* denote the same individual (section 6.3 below). (That's why the term coreference is unfortunate; more on this in section 6.3.) But even if we could carry through some such semantic constraint it can't be stated purely in term of functions and arguments: given any sentence with two pronouns and any principle stated in terms of (say) being co-arguments of a function, there are always zillions of equivalent function/argument structures that will get around or be subject to any constraint we want to state.

Moreover, the principles governing coindexing can't be stated purely in terms of (unenriched) English surface structures. This is shown by every ambiguous sentence structure in which coindexing and reflexive possibilities are determined by (or determine) the interpretation:

(18)   An announcement about him/himself upset him.

(19)   Considering him/himself sick bothered him.

In (18) and (19), whether or not we use a reflexive and whether or not the pronouns can be coindexed depends on how we interpret the phrase in which the item is contained: if the understood "subject" is interpreted as coreferential with the pronoun after the main verb then the reflexive is required (and hence coindexing of a plain pronoun impossible), otherwise just the opposite (Who made the announcement? Who was doing the considering?).

Thus it appears that a theory of pronouns and other anaphoric elements must take into account something more than surface structure or interpretation alone.

The two approaches we are comparing make different assumptions about how to assign interpretations to natural language expressions. In REST, as in all transformational theories since *Aspects* (Chomsky 1965), the approach is *configurational*. That is, it's assumed that there is a level (or there are levels) of

syntactic representation which form the basis for interpretation. The concepts available for stating restrictions on coindexing are thus those that are definable on "geometrical" properties of phrase-markers (*precede*, various types of prominence relations such as *dominate*, *c-command*). It follows from this view that it is necessary to enrich purely syntactic structures with traces and other phonologically null anaphors as parts of phrase-markers. Moreover, it is in principle impossible to make reference to semantic relations among constituents that are not reducible to syntactic relations at some level of representation. In (some versions of) EMG, the approach is not configurational but follows a *rule-by-rule* procedure: every syntactic rule has associated with it a semantic rule. In a pure version of this theory, it is impossible to refer to geometrical notions, but the principles may make reference to semantic relations among constituents, for example, whether one constituent is interpreted as the argument of a function which is the interpretation of another.[3]

To see that these approaches are not simply notational variants, let's consider a specific example. Reinhart (1976, 1979) and others have used the notion *c-command* essentially in discussions of coreference, binding of pronouns-as-variables, and control. Keenan (1974) has proposed alternative accounts based on the function/argument relations among the interpretations of constituents. Because of the nature of English phrase structure it will often turn out that identical predictions will be made. For example, the subject of an English sentence, given usual notions about phrase structure, c-commands the rest of the sentence immediately dominating the subject. In this case, the syntax mirrors the function–argument structure. The subject is the argument of the remainder of the sentence.[4] So two principles could be stated:

(a)   A pronoun may not c-command its antecedent.
(b)   A pronoun may not be the argument of a function containing its antecedent.

(These are temporary illustrations only.) In this case, both accounts would rule out sentences like (20), on the intended interpretation:

(20)   *He* loves *John*.

A difference between the two types of accounts emerges in some sentences, however. Consider the problem of obligatory control in sentences like these:

(21)   I tried to go.

(22)   I persuaded John to go.

We could imagine two accounts (cf. Williams 1980).

(c)   A $\overline{\text{VP}}$ (or $\overline{\text{S}}$ with subject gap, depending on the analysis) must be control-
      led by the first NP that c-commands it.
(d)   A $\overline{\text{VP}}$ (or $\overline{\text{S}}$) must be controlled by the argument of the function in which
      it occurs.

Again, for the above sentences the predictions are exactly alike. But if we
accept the idea that there are prepositional objects for certain verbs in which
the entire prepositional phrase is given just an NP meaning, then there will be
a difference:

(23)   I depend on you to do the dishes.

Here, if *on you* is a prepositional phrase then *C* (incorrectly) predicts that the
subject is the controller, but *D* (correctly) predicts that *you* is the controller.
Hence, to maintain *C* the first type of theory must alter the structure (by a
readjustment or incorporation rule) or alter the definition of c-command. (We
will take up such examples below, section 6.5, and argue against a reanalysis
or two-structure approach.)

6.3   Coreference and Coindexing

We claimed above that the term "coreference" is misleading. We now want to
expand on this. A typical example of the use of the term is the following
(Reinhart 1979):

Two NPs *must* be interpreted as non-coreferential if one is in the domain of
the other and is not a pronoun.

A statement of this sort is, of course, OK if we all understand "coreferential"
as a technical term. We'll first spell out why the term can't be understood
literally, then say how we think it ought to be interpreted. Then, if you want,
you can go right back to using the term.
   To take a statement like Reinhart's literally would be to say something like
this:

In any sentence of *L* (English) in which an NP_1 (not a pronoun) is in the
syntactic domain of another NP_2, the individual denoted by NP_1 is distinct
from the individual denoted by NP_2.

The first difficulty with this idea is this: even if we adopt the view that
some NPs denote individuals (which we don't) not all NPs refer to or
denote individuals. Succinctly, how can you have coreference without
reference?

Suppose we take the view that NPs are interpreted as sets of properties of individuals. Could we say then that rules like the above are saying that these sets can't be identical? No, because then a sentence like *Everyone loves everyone* would be ruled out. The two NPs denote exactly the same set of properties in this sentence. Could we perhaps say that the individuals that the set of properties are sets of properties *of* must necessarily be distinct? That might make some sense for NPs like *John* or *Chicago* but isn't very helpful for NPs like *every woman* or *no donkey*. In such NPs there is no particular individual that is the "kernel" of the set of properties because the kernel is a variable bound by a quantifier.

Finally, suppose we could pin down some suitable explication of coreferentiality in term of distinctness of "referents". We believe that such an approach would be wrong if it is taken literally and unqualified. Consider Quintus the war-hero who is suffering from amnesia. He is discussing the war-hero with a friend. We report "He (= Quintus) admired him." (Cf. Castañeda 1967, 1968; Mitchell 1979).

Or consider the sentences: *Who is that guy over there*? *He's Joe Blow.* Reinhart's principle would lead us to say that *he* and *Joe Blow must* be interpreted as non-coreferential.

We realize that we have perhaps been being pedantic in belaboring this point. We just want to remind ourselves of Postal's original point. "Coreference" must be understood as *stipulated* coreference (or *intended* or *purported* or *presupposed*: McCawley 1968; Chomsky 1980; Postal 1971; Higginbotham 1980). Stipulated coreference *always* requires at least one referring NP. For these reasons, as we've said, we'll use the term "coindexed". Let's summarize the places where something like coindexing is used in the literature:

(i)   The same pronoun appears in several places in a sentence:

    (24)   *He* said that *he* was OK.

(ii)   A pronoun appears together with a referring NP:

    (25)   *John* said that *he* was OK.

(iii)   A pronoun appears together with a quantificational NP:

    (26)   *No woman* doubts that *she* is OK.

(iv)   A pronoun occurs in a relative clause:

    (27)   . . . the *woman* who said that *she* had found the answer

(v)   A reflexive or other obligatorily bound pronoun appears in a sentence:

(28)   *John* loves *himself*.

(29)   *Oscar* is out of *his* head.

(vi)   Various of the above situations occur in sentences with no overt NP to be coindexed with or in which the proper NP appears in a structural configuration removed from the immediate site for coindexing:

(30)   Saying that he was OK wasn't enough, it appeared.

(31)   Here's a book to read to yourself.

(32)   Aha! Here was a book to read to himself.

It is really only in situation (i) (in some sentences), and (ii) that it seems appropriate to talk about coreference. In every other case (except perhaps sentence (30)) coindexing a pronoun with some other expression is a shorthand way of saying that the pronoun in question is being interpreted as a bound variable and (we would claim) not bound directly by the NP in question but indirectly via lambda abstraction (or some equivalent device). We will now turn to a particular implementation of the constraints on binding and coreference in the framework of a particular version of EMG.

6.4   Spelling it Out: One Way

For concreteness, let's assume we are working out the details of an account of anaphora in a framework with the following features:[5]

1   A grammar is a direct recursive definition of sets of well-formed expressions of *English* (or perhaps labeled-bracketed English) and their interpretations (for convenience, at least, represented in an intensional logic of the same general sort as that of Montague's PTQ).
2   There are no transformations.
3   English expressions are associated with sets of interpretations, and a STORE mechanism of the sort developed by Cooper (1975) is used for wide-scope quantification, and the interpretation of *wh*-phrases, and reflexives.
4   The syntax is essentially context-free but makes use of syntactic and semantic features.
5   Derivations proceed bottom-up (this follows from (1)).
6   Pronouns are pronouns (this follows from (1)); they are interpreted as sets of properties of individuals that correspond to variables (in Montague's Intensional Logic (IL): $\lambda P^{\vee}P(x_i)$).[6]

Here's a sketch of how we are going to treat the problems laid out above within such a framework (see the Appendix for a fragment of English).

Pronouns are assigned arbitrary indexed variables in the translation into IL. Each time a new pronoun meaning is added to a translation, its index goes into two sets that are carried along in the derivation: one (Local Pronoun Store: LPST) amounts to a recursive definition of what we called above "local context"; the other (Super Pronoun Store: SPST) amounts to a recursive definition of what it means for a variable to be free in an expression. The indices are removed from these stores whenever binding takes place. Restrictions on coindexing make use of both LPST and SPST for "local" and "unbounded" restrictions. Such devices are necessary for theory-internal reasons also: the extensive use of lambda abstraction necessitates checking what variable meanings are free in arguments of lambda functions in order to avoid accidental binding of free variables. We assume here that any pronoun meaning that remains free in an expression is assigned a referent by context-assignment. (The question of whether the same set of pronoun meanings should be used both for bound variables and context-dependent interpretations is vexed and difficult, for discussion of the issues and references to literature, see Partee and Bach 1981.)

Here's an example of a derivation tree for a simple sentence:

(33)   **he sees him**, $see'(\hat{P}^{\vee}P(x_3))(\hat{P}^{\vee}P(x_2)) \longrightarrow see'_*({}^{\vee}x_2, {}^{\vee}x_3)$

    he, $\hat{P}^{\vee}P(x_2)$ **sees him**, $see'(\hat{P}^{\vee}P(x_3))$

        sees, see' **him**, $\hat{P}^{\vee}P(x_3)$
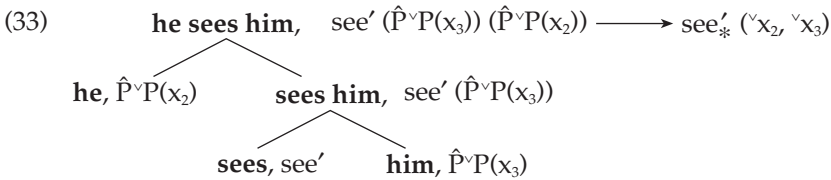
The system will block assigning an interpretation like *see'*$_*({}^{\vee}x_1, {}^{\vee}x_1)$ to the given sentence. We'll come back to how.

Reflexives are treated essentially as operators on two types of meanings: intransitive verb phrase (IVP) and transitive verb phrase (TVP) meanings. Whenever a reflexive is added in to a translation, an arbitrary new pronoun meaning is put into its place in the translation and a special pronoun meaning is put into STORE along with the index of the variable used in the pronoun meaning "left behind". Two special rules (IVP → IVP, TVP → TVP) allow the retrieval of the reflexive pronoun meaning from STORE and the creation of an appropriate meaning for the result, using lambda abstraction over the stored indexed variable. (For a precise statement of these rules, see the Appendix; for some discussion of the motivation for this approach to reflexives and reciprocals, see Bach forthcoming.*) Here's a simple example:

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*   Author's note (BHP) 2003: The planned paper was never completed.

(34)   **he sees himself**,   SELF1 ($\hat{x}_3$ see' ($\hat{P}^{\vee}P(x_3)$)) ($\hat{P}^{\vee}P(x_4)$) $\longrightarrow$ see'$_*$ ($^{\vee}x_4$, $^{\vee}x_4$)

   he $\hat{P}^{\vee}P(x_4)$ **sees himself**,

                 λR SELF1(R)   ($\hat{x}_3$ see' ($\hat{P}^{\vee}P(x_3)$)) $\longrightarrow$ SELF1 ($\hat{x}_3$ see' ($\hat{P}^{\vee}P(x_3)$))

              sees himself, $\langle$see' ($\hat{P}^{\vee}P(x_3)$), $\langle$SELF1, $x_3\rangle\rangle$

        sees, see'   **himself**, $\langle\hat{P}^{\vee}P(x_3)$, $\langle$SELF1, $x_3\rangle\rangle$
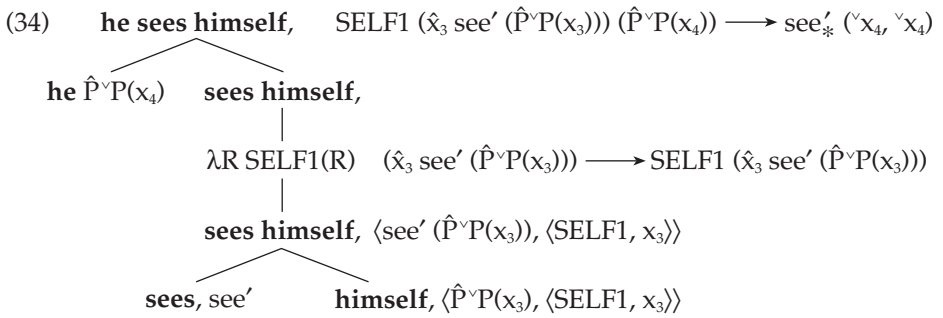
SELF1 may be thought of as a function which turns a two-place relation R into a one-place predicate *SELF1(R)* (which is true of an individual *x* just in case R holds between *x* and *x*). (Similarly, SELF2 for TVPs converts in an exactly parallel way a three-place relation into a two-place relation.)

   Quantification is handled by the same store mechanism. Whenever a quantified NP is put into a translation we have the option of putting a pronoun meaning in its place and storing a sequence consisting of the meaning of the quantified NP and the indexed variable chosen for the pronoun meaning. At various points (S, IVP, and perhaps others) we have the option of taking the sequence out of store, forming a lambda abstract over the stored variable and "quantifying in".

   WH-movement. WH-phrases are generated in place. The system generates phrases with gaps corresponding to the WH-phrases and stores an arbitrary pronoun meaning (for simple cases). The rules for combining WH-phrases with sentences with gaps make use of the stored pronoun meanings to derive the proper interpretation.[7]

   Are there any reasons beyond a desire for tidiness for preferring our treatment of reflexives over available alternatives? The principal alternatives fall into three families:

Family I.   Basically transformational treatments of reflexives – these go back ultimately to Lees and Klima (1963). In the Montague tradition (Bennett 1974; Thomason 1976; Partee 1976) transformations are defined on sentences containing pairs of identical variables (similar treatments are implied in some of the generative semantic literature: McCawley 1968). The main considerations here seem to be metatheoretical. If you do it that way you have to have a lot of deletion rules, since reflexives occur in structures with no overt controller or no local controller: sentences (30)–(32) above. In any event, there have to be some VP-meanings available for VP deletion/interpretation.

(35)   Everyone loves himself and John does too.

A possible counter-argument here would be that you need an independent Derived VP rule anyway (Partee 1975; Sag 1976; Williams 1977). In any case it

seems that any solution has to make use of some relatively powerful device (constraints on command-type relations), reference to derivational history (Thomason 1976), or special markers (Partee 1976; Bennett 1976).

Family II. Interpretive theories (Jackendoff 1972); current REST approaches (Chomsky 1980; Higginbotham 1980) which take Intermediate Structures (= Enriched Surface Structures) and do indexing, etc. Here we simply note that spelling out the interpretation of a structure like *Everyone$_i$ loves him$_i$self* requires going through something like the stages of our treatment above, so the arguments for or against this approach reduce to general considerations about the two main approaches we want to compare here. So we defer discussion to section 6.5.

Family III. Very close to our treatment are those proposed by Gazdar and others within basically similar kinds of frameworks. In these, no storage is used, but reflexives are assigned meanings using distinguished variables. The main difference we see (and we haven't seen any of these treatments worked out in detail) is that our treatment automatically allows reflexives and non-reflexives in the proper environments to be in effect coindexed:

(36)   Mary told *herself* that *she* was OK.

This is because a regular old pronoun meaning is left behind and it can be coindexed with *she*. For the same reasons the blocking of coindexing in local contexts blocks this assignment of meanings:

(37)   #Mary told *herself* about *her*.[8]

The notion *locally free* has to be defined for a particular grammar. Basically, it's like this:

(i)   If α is a pronoun and is assigned a meaning $\lambda P^\vee P(x_i)$, then $\lambda P^\vee P(x_i)$ is *locally free* in tr (α) (i.e. the translation of α into IL).
(ii)   If α is *locally free* in β then α is locally free in $^\wedge\beta$.
(iii)   If α is *locally free* in φ and β is locally free in ψ then α and β are locally free in $\varphi(\psi)$ unless $\varphi(\psi)$ is in ME_t, $ME_{F(NP)}$, . . .*

Similarly, *free* can be defined in the same way, but without the "unless clause" of (iii). (In (iii) the types of meaningful expressions mentioned are

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*   Author's note (BHP) 2003: The notation ME_t, which comes from Montague's work, means "meaningful expression (of IL in this case) of type t"; $ME_{F(NP)}$ means "meaningful expression of the type assigned to the syntactic category NP". F is the function that maps each Syntactic category of English onto a corresponding semantic type.

those corresponding to the categories S and NP; "..." is to be filled in by whatever other categories are needed to get non-coindexing to come out right, i.e. they correspond to the bounding or cyclic nodes used in definitions of k-command cf. below, section 6.5.)

(iv) If a pronoun meaning $\lambda P^\vee P(x_i)$ occurs within an expression headed by Qx_i (where $Q = \forall, \exists, \lambda$) then $\lambda P^\vee P(x_i)$ is *bound* in the expression (i.e. neither free nor locally free).

(We will add one more clause to this definition in section 6.5.)

6.5   Comparisons

We are now ready to take up in more detail the question raised in section 6.2: Are there any ways to choose between an account of restrictions on coindexing and coreference that is framed in geometrical terms and one which makes use of semantic relations among constituents? We'll take up five situations. In each case we'll compare an account based on the notions of *precedence*, *k-command*, or *c-command* to an account based on function/argument structure. Let's recall the definitions of *k-command* (Lasnik's *kommand*) and *c-command* (closely related to Klima's notion *in construction-with*; Klima 1964; Reinhart 1976).

Consider two constituents, *A* and *B*, neither of which dominates the other:

A k-commands B just in case the first cyclic branching node above *A* dominates a structure containing *B*.
A c-commands B just in case the first branching node above *A* dominates a structure containing *B*.

For present purposes we'll take the cyclic nodes to be just *NP* and *S* (in English).[9]

As far as function/argument structure (hereafter "functional structure" but please note the scare quotes: this isn't at all the functional structure of Bresnan) is concerned, we assume that the semantic structures associated with English are completely categorial and binary, that is, every constituent is assigned a translation in which the parts of the constitutent are interpreted either as arguments or as functions.

It's easy to see where the cheating points for each approach lie. In the geometrical approach, you assign the constituent structure in a way that makes things come out right. In the functional approach you assign the functional structure in such a way as to make things come out right. So for firm conclusions we need as many clear cases as possible and as much independent evidence as possible for the particular assignments made.

One more preliminary remark: we noted above that in many cases the two approaches will make the same predictions since constituent structure often

mirrors functional structure. But it's worth noting that the functional account has one little edge at the start: you don't need to say anything about branching versus non-branching.[10]

6.5.1   Case 1: Pronouns and pronouns

We'll split up the different cases somewhat differently from the way most discussions in the literature have done (reflecting a somewhat different assessment of what the facts are). Consider first the cases we started from.

(38)a.   #*He* saw *him*.
  b.   #I gave *him* to *him*.
  c.   *His* mother loves *him*.
  d.   *He* loves *his* mother.
  e.   *He* said that *he* was OK.
  f.   #*his* picture of *him*.

A geometrical principle that would cover these cases might be this:

  A.   Two pronouns that k-command each other cannot be coindexed.

The functional structures we assign to these examples are roughly these:

(38')a.   (see (him)) (he)
  b.   ((give-to (him)) (him)) (I)
  c.   (love (him)) (his (mother))
  d.   (love (his (mother))) (he)
  e.   (say (OK (he))) (he)
  f.   his (picture (him))

(where *a(b)* means the interpretation of *a* is a function taking the interpretation *b* as its argument: we omit all reference to intensional operators in this section). Here, a functional account would require a principle like (A'):

  A'.   A pronoun can't be coindexed with any pronoun meaning *locally free* in a constituent interpreted as a function taking it as argument. (Cf. section 6.4.)

Neither (A) nor (A') seems particularly explanatory or natural, and there doesn't seem to be any particular advantage of one over the other. (A) has counterexamples that require additional principles and something has to be done about these examples under (A') also (we'll take them up separately in section 6.5):

(39)   *He* persuaded me to vote for *him*.
       (cf. #*He* promised me to vote for *him*.)

(40)   I promised *him* to vote for *him*.
       (cf. #I persuaded *him* to vote for *him*.)

6.5.2   Case 2: Pronouns and referring NPs

If you take any English sentence with two pronouns in it that *can* be coindexed and replace one of them by a referring NP (e.g. a name or definite NP) you get one of two results:

 (i)   the substitution allows stipulated coreference in only one of the positions;
(ii)   the substitution allows stipulated coreference in either position:

(41)a.   *He* said that *he* was OK.
    b.   *John* said that *he* was OK.
    c.   #*He* said that *John* was OK.

(42)a.   *He* loves *his* mother.
    b.   *John* loves *his* mother.
    c.   #*He* loves *John's* mother.

(43)a.   The woman that *he* loved saw the woman that hated *him*.
    b.   The woman that *John* loved saw the woman that hated *him*.
    c.   The woman that *he* loved saw the woman that hated *John*.

(44)a.   *His* mother loves *him*.
    b.   *John's* mother loves *him*.
    c.   *His* mother loves *John*.

Here we can take Reinhart (1979) as a source for a geometrical principle:

   B.   An NP which is not a pronoun must be interpreted as non-coreferential with any pronoun that c-commands it.[11]

   For a functional account, we again have a model (Keenan 1974) which may be adapted for our present purposes:

   B′.   A pronoun can't be a stipulated coreferent to an NP that occurs in a constituent interpreted as a function with the pronoun as argument.

The two accounts give the same results for the examples above. In (41c) and (42c) *John* is c-commanded by the italicized pronoun and the pronoun is interpreted as an argument of the function which is the interpretation of the tensed verb phrase. Before looking at some examples where (B) and (B′) yield

different predictions, let's note that here, unlike case 1, there is a kind of natural explanation for (B′) that is lacking in (B) (as Keenan, 1974, notes). Keenan explains requirements like (B′) on the basis of a general principle about functions and arguments: the reference of an argument can't depend on the reference of its function.

One major class of crucial cases is presented by prepositional phrases. Consider a sentence like (45):

(45)   #I talked to *him* about *John*.

As we mentioned before, we treat some prepositions as semantically empty (i.e. as functions of type NP/NP with no change in meaning). These are the types of structures traditionally described as involving prepositional objects (see Bach 1979, 1980, for justification of such analyses). Here, (B′) predicts the # on (45), but since *him* doesn't c-command *John* (B) doesn't. For this explanation to work, we have to motivate the analysis of *talk to . . . about John* as a complex TVP (Bach 1979, 1980). (Among the motivations for this view are passivizability and the fact that the NP in the *to*-phrase can exert control over reciprocals and reflexives.)

On the other hand, when a PP is of a different type, that is, when the preposition is really a function from NP types to some other category (e.g. adverb) we expect congruence between the predictions of (B) and (B′). It's difficult to think of natural examples, but here are a few:

(46)   She sat near *him* to *John's* delight.
       (cf. #*he* sat near her to *John's* delight.)

(47)   I sat on *him* for *John's* benefit.
       (cf. #I rely on *him* for *John's* contribution.)

(48)   Near *him*, *John* saw a snake.

To preserve the c-command explanation it is necessary to reanalyze the PPs in question (or have double structures) for examples like (45). Since this move has been made for a number of different problems including control problems (cf. section 6.3 above) we want to take it up in a special section (6.5.6) after considering a wider range of cases.[12]

A second class of cases are those in which we associate verbs that apparently stand in the same syntactic environments with different semantic functional structures. Well-known examples are *strike* vs. *regard*, *promise* vs. *persuade* (cf. Bach 1979, 1980).

(49)   I strike *him* as *John's* best friend.

(50)   #I regard *him* as *John's* best friend.

We feel there is a considerable difference between (49) and (50). (Here it is possible that there is a syntactic difference since one might want to argue that *strike him* is a constituent, but we know of no firm evidence for this analysis.) The functional structure we assigned to *strike* is suggested by this picture: (strike (NP)) (as AP); for *regard*: (regard(as AP)) (NP). Note again that passive and reflexive/reciprocal facts bear this out.

(51)   *I strike him as proud of himself.

(52)   I regard him as proud of himself.

(53)   *He is struck by me as proud.

(54)   He is regarded by me as proud.

(We have more to say about such examples in section 6.5.5.)

6.5.3   Case 3: Pronouns and referring NPs in local contexts

Nothing we've said about stipulated coreference so far covers cases like these:

(55)   #*John* saw *him*.

(56)   #I gave *John* to *him*.

These are, of course, situations where a reflexive construction is available and perhaps that is all that needs to be said, along with a Gricean explanation for why stipulated coreference fails. If a principle is wanted, then (C) or (C') will do:

   C.   A pronoun can't be stipulated as coreferential with an NP that it k-commands.

   C'.   A pronoun locally free in a function can't be stipulated as coreferential with an NP that is its argument.

As in case 1, there is little to say about the choice between (C) and (C').

6.5.4   Case 4: Pronouns as bound variables

In this section we want to take up the conditions governing the interpretation of a pronoun as a variable bound by some quantified NP like *every horse*, *a woman*, *no stranger*. Here again we have a model in Reinhart's work (1977):

D. "Nonreferential indefinite NPs can have anaphoric relations only with NPs in their syntactic domain" [i.e. with NPs that they c-command (Reinhart's 26)].

Before proposing an alternative functional account, we want to discuss two things. First, since (D) gives only a necessary condition, we want to say something about cases that have to be ruled out to approach sufficiency. Second, we want to challenge the factual claims of Reinhart's proposal.

Both Reinhart and we presuppose that certain associations of quantified NPs (QNPs) with pronouns will be excluded by independently needed principles. In particular, QNPs can't bind pronouns that k-command them. For Reinhart this results from a combination of the non-coreference rules and the treatment of pronouns in "reflexivizable" contexts (1979, fn. 3). For us, this restriction falls out from our treatment of quantifying in. When an QNP is given a pronoun meaning plus a stored interpretation with an index, the same principles that govern case 1 (pronouns and pronouns) will act to block binding of pronouns locally free in the rest of the sentence. Sentence (57) can't have the indicated interpretation because the underlined part of the formula is ruled out:

(57) Every student sees her. Every student' $(\hat{x}_3 \underline{see' (x_3, x_3)})$

Further restrictions result from two factors: conditions on wide-scope quantification and a special restriction governing WH-moved elements, gaps, and wide-scope quantification (Jacobson's "left most constraint"). Discussion of these factors requires some attention to factual matters.

Reinhart (1979) maintains that quantified NPs can have scope only over elements in their syntactic domain. We believe that this is incorrect and agree with a position that is more in line with other writers (e.g. Higginbotham 1980; May 1977; among REST people, Cooper and most Montagovians). That is, quantified NPs can have semantic scope arbitrarily far "up" (but subject to various island constraints). But this is not to say that they can bind pronouns unrestrictedly. Part of the restrictions for Reinhart come from the non-coreference rule (adapted here for our purposes):

E. A pronoun can't be interpreted as a variable bound by a QNP that it c-commands.

If you assume a rule of Quantifier Raising (May 1977; Higginbotham 1980) we would need something like (F):

F. A pronoun can't be coindexed with a trace c-commanded by it.

((F) is preferable since it generalizes to all movement rules.)

Before considering a functional alternative to these conditions, we need to consider some apparent counter-examples. In (58) the QNP does not c-command the pronoun, yet it seems as if it can bind it:

(58)   Every Englishman's mother loves him.

We believe that such examples are not counter-examples to (D) (or similar conditions) but rather are to be treated on a par with Geach's famous donkey sentences or Karttunen's paycheck sentences:

(59)   Every man who owns a donkey beats it.

(60)   The woman who gives her paycheck to her husband is wiser than the woman who gives it to her lover.

(For a suggestion on how to treat these pronouns, see Cooper 1979, and note 6 below.)
   As it stands, our use of local pronoun conditions would automatically block (58) (see below, where we extend the definition of *locally free* to include variables in store) but allow (61) and (62):

(61)   *Every Englishman's* mother loves *his* wife.

(62)   *Every car's* owner regrets that he bought *it*.

We find these sentences marginal at best. But our main reasons for thinking that sentences like (58) are not to be treated as genuine bound-variable cases are the following. First, we have been unable to find any examples in which a possessive QNP *by itself* has wider scope than other NPs in a sentence. Of course, the NP as a whole can have wide scope, as in (63):

(63)   At least three professors read every candidate's thesis.

Second, in view of the widespread similarity between WH-movement and wide-scope quantification, it would be strange to be able to "quantify out" a possessive in view of the ungramaticality of sentences like (64):

(64)   *Whose did you see mother?

Finally, since NPs with possessives are definite, i.e. have a uniqueness condition or presupposition in their meaning, they are prime candidates for Cooper's suggested treatment, according to which *he* has a possible interpretation of "the unique x such that $\pi(x)$" where π is a metavariable for a property expression made up solely of variables of various types and brackets. Note that the second reason remains in force for any theory which treats wide-scope

quantification and WH-movement by the same devices and assumes they are subject to the same constraints. Thus, for such examples, Reinhart's principle (D) seems to stand up. Nevertheless, we believe that this is a spurious result. Rather, we propose (D′) as a semantic constraint:

> D′.   A QNP can bind only pronoun meanings within its semantic scope.

An example that speaks for (D′) and against (D) is the following:

(65)   Every student claimed that *one of his professors* was a genius in order to influence *her*.

We believe that this sentence has a reading of the sort indicated by the italicization and that it goes with assignment of scope to *one of his professors* outside of *claim* and inside *every student*. This reading is one which we get by storing the QNP and quantifying in (in May's system, then, the principle would read: A QNP can only bind pronouns which it c-commands).

(D′) must be taken in conjunction with a set of island constraints on quantifying out (in), among them perhaps the NP-constraint of Horn (1974) (see Cooper, 1979, for discussion of the difficulties involved). QNPs can freely escape from PPs and these provide the major set of difficulties, for Reinhart's principle (D) (for scope, but not pronoun binding, Reinhart (1979) makes a special provision for PPs).

A functional counterpart to (E) or (F) is the following:

> E′.   A pronoun which is interpreted as the argument of a function can't be bound by a quantifier which "came from" a position within the function.

Note that this means in essence that the pronoun meaning "left behind" for purposes of wide-scope quantification is always treated as if it were locally free until it is bound. So the most straightforward way to incorporate (E′) in our framework is to add another clause to the definition of *locally free* (cf. pp. 133–4):

(v)   If $\langle \alpha, x_i \rangle$ is in the translation of φ, then $\lambda P^{\vee}P(x_i)$ is locally free in φ.

There are independent reasons for this move that have nothing to do with pronominal binding. In any sentence with two or more QNPs that can both have wide scope we need to keep their "left-behind" pronoun meaning distinct.

The final thing that we have to think about in an account of binding is the question of the "left-most" constraint (Jacobson 1977). The data here are exceedingly difficult to interpret. In support of some such constraint are examples like these:

(66)   ?His mother loves every Englishman.

(67)   ?That he has flunked will surprise no student.

(68)   ?A dessert that he likes will delight every passenger.

Compare:

(69)   Every Englishman is loved by his mother.

(70)   It will surprise no student that he has flunked.

(71)   Every passenger will be delighted by a dessert that he likes.

On the other hand, the following examples (Reinhart 1977) speak against any such left-most constraint:

(72)   Near him, every soldier saw a snake.

(73)   In its early years, every organization suffers some setbacks.

Reinhart (1977) argues against an account based on precedence relations for such cases on the basis of examples like (72) and (73) and in favor of a principle like (D) above, comparing them to examples like the following:

(74)   Near him I saw every soldier's pack.

(75)   In its early years, members of every organization suffer.

If our discussion of the possessive phrases above is correct, then (74) and (75) simply reflect island constraints. We will not try to settle these issues here but simply note that if precedence is involved then some constraint will have to be placed on the syntactic operations of our theory. It's also worth noting that this is the only place where it seems as if we have to pay attention to whether or not a pronoun meaning is free in general (and not just locally free).[13]

6.5.5   Control and anaphora

In section 6.2, we stated a general principle governing anaphora in structures of control, i.e. predicatives of various kinds. We don't have space to go into all types here so we'll just consider three types:

(76)   I persuaded him to see him.

(77)   I went down town to see him.

(78)   I bought a book to send to him.

Sentence (76) illustrates a structure of obligatory control, (77) a free control situation, (78) a construction with one obligatorily controlled gap and free control of the subject position. It is characteristic of the free control cases that there exist parallel structures with overt lexical subjects (*in order for you to get a chance to see me*, *for you to give to your sister*) and that a pronominal subject acts as if it were locally free in the higher sentence (at least in *for–to* clauses). The possibilities for anaphora are precisely those that you would get if you put a pronoun appropriate to the obligatory or understood controller in subject position of a sentence with the predicative or in place of the gap in non-subject positions:

(79)   #*He* promised me to see *him*.   Cf. #*He* saw *him*.

(80)   I promised *him* to talk to *him*.   Cf. I talked to him.

(81)   #*He* is easy to explain to *him*.   Cf. #I explained *him* to *him*.

This fundamental insight was reflected in early treatments involving a rule of Equi-NP Deletion, more recently in conditions like Chomsky's (1973) Specified Subject Condition. Our treatment of these cases is modeled closely on that of REST but only in the semantics: we assign the infinitivals to the semantic category of sentence (type *t*) and give them a meaning which combines the VP type meaning with an arbitrary pronoun meaning in three different ways: for obligatory control, we require one of the two reflexive meanings to be put in store (reflecting Helke's 1971 treatment) depending on which type of control is exhibited; for the structure of free control we let the invisible subject be a free pronoun meaning. In this way the usual conditions will govern the anaphora possibilities.

6.5.6   Against reanalysis

At several places we've noted that the only difference between a syntactic condition of c-command and principles based on functional structure comes from the behavior of certain kinds of prepositional phrases. A number of grammarians (starting, we believe, with Bresnan 1972; see also Williams 1980; Hornstein and Weinberg 1981; Ross 1981) have proposed that such structures involve sequences of prepositions and NPs that are not PP constituents at all, either because of a readjustment rule of some kind or by a process of

incorporation of the preposition into the verb (or perhaps by having double structures to start with). We want to argue against this move on several counts.

In the first place, unless we can find independent motivation for such a move it robs the c-command principles of any predictive power. But in the case at hand there is evidence against the reanalysis. If the reanalysis were correct we should expect an interaction between interpretation and behavior under movements of the putative PP. But there isn't:

(82)   I rely mostly on you to come up with examples.

(83)   On you I rely most to come up with examples.

(84)   To him I talked about John.

6.6   Taking Stock

We can summarize our suggestions as follows:

(1)   Unbounded movement and interpretation is handled by assigning sets of interpretations to constituents; these include ordered pairs of binding operators and pronoun indices for the pronoun meanings left in place. For optional store (quantification) these pairs may be removed from store and binding of the relevant pronoun is accomplished at the level of S, VP (and perhaps elsewhere). For obligatory store (WH-gaps, reflexive meanings) the pairs must be removed from store at the relevant places.

(2)   A recursive definition of the notion *locally free* is given. All binary function/argument rules require that pronouns locally free be non-coindexed.

(3)   Wherever an interpretation involving two variables coindexed in the same local environment is required this comes about by the operation of the reflexive rules (plus certain special constructions we haven't talked about).

(4)   Stipulated coreference may hold between a referring expression (the antecedent) and an anaphor (typically a pronoun). Keenan's functional principle may be used to explain restrictions on stipulated anaphors (they can't be the argument of a function containing their antecedent).

(5)   In addition to the restrictions on binding of pronouns by quantified NPs that follow from considering any pronoun whose index is the index of a stored QNP to be locally free, either a stronger constraint than the one for stipulated coreference or a left-most constraint must be given.

(6)   The mechanisms used for reflexives, together with a semantic analysis of VPs (and other predicatives) as Ss are used for obligatory control. Free control is done on the basis of the presence of a free variable in the interpretation of the predicative.

(7)   The unified treatment of WH-movement, quantification, and reflexives makes it possible to allow (2) to cover many examples.

This isn't the place, nor have we the space, to make a detailed comparison to alternative treatments in REST and elsewhere. But we can make a few comparisons.

(a)   The basic definition of *locally free* does the job that is mostly done by such notions as k-command (and is neither more nor less *ad hoc*).
(b)   Wherever configurational theories state restrictions using the c-command, our theory uses the semantic relation of argument to function. This seems to come somewhat closer to getting things straight in a few situations where functional and structural relations diverge.
(c)   Both approaches make use of invisible variables for doing unbounded "movement" or interpretation. However, it follows from our treatment as it does not from trace theory that only the "original" site of the moved element is relevant for interpretation.

What can we say about the relative merits of thinking in a rule-by-rule way about the assignment of interpretations as opposed to an approach which goes from enriched surface structure to logical form? The main advantage that we can think of in our approach is that the statement of restrictions is entirely independent of the form of the syntactic operations that are used in a language (this is the source of the spin-off we get from treating prepositional objects as semantic term phrases). Thus, if there are languages which use case marking in lieu of order and phrase structure to express fundamental relations between nominal and verbal elements (as Hale et al. (1977) have claimed for Walbiri), our approach predicts that binding and coreference restrictions will be reflected in the rules and categories in ways that are similar to the ways in which our restrictions are reflected in properties of English phrase structures.

Appendix: A Partial Fragment of English

(I)   The objects generated by this grammar are 6-tuples (we omit for the most part (but see (R13), (R14), (R19)) reference to syntactic and semantic features and semantic types):

1   an expression of English;
2   its syntactic category;
3   its translation into IL;
4   a set of pairs (maybe empty) $\langle \alpha, i \rangle$ where α is an NP meaning, WH, SELF1, or SELF2 – this is like Cooper's STORE (1975);
5   a set of natural numbers – the indices of the pronoun meanings locally free in (3);
6   a set of natural numbers – the indices of pronoun meanings free in (3).

We define these functions on 6-tuples:

LPST(X) = the fifth member of X ("local pronoun index store")
SPST(X) = the sixth member of X ("super pronoun index store")
QST(X) = the fourth member of X ("Quantifier store")
$QST_I(X) = \{i | \langle \alpha, i \rangle \in QST(X)\}$
$QST_R(X) = \{i | \langle SELF1, i \rangle$ or $\langle SELF2, i \rangle \in QST(X)\}$

(II)   Excerpts from lexicon:

$\langle$*John*, N, $\lambda PP\{\hat{}j\}$,   Ø,   Ø,   Ø$\rangle$
Expr. Cat   tr   QST LPST SPST

$\langle$*he*, N, $\lambda PP\{x_i\}$,   Ø,   {i},   {i}$\rangle$
                  QST LPST SPST
(same for *him*, *she*, *her*, *it*; differentiated by features)

$\langle$*his*, Det, his'_i,   Ø,   {i},   {i}$\rangle$
                  QST LPST SPST
(where $his'_i = \lambda P \lambda Q \exists x [\forall y [[P\{y\} \wedge R(y, x_i]] \leftrightarrow x = y] \wedge Q\{y\}]$)
(same for *her*, *its*)

$\langle$*himself*, N, $\lambda PP\{x_i\}$, $\{\langle SELF1, i \rangle\}$, {i}, {i}$\rangle$
$\langle$*himself*, N, $\lambda PP\{x_i\}$, $\{\langle SELF2, i \rangle\}$, {i}, {i}$\rangle$
(same for *herself*, *itself*)
(where $SELF1 = \lambda R \lambda x [R(x)(\hat{P}P\{x\})]$, R of type $\langle\langle s, e \rangle, f(VP)\rangle$
        $SELF2 = \lambda R' \lambda x [R'(x)(\hat{P}P\{x\})]$, R' of type $\langle\langle s, e \rangle, f(TVP)\rangle$)

$\langle$*e*, N, $\lambda PP\{x_i\}$, $\{\langle WH, i \rangle\}$, {i}, {i}$\rangle$
(where *e* is phonologically null, WH semantically empty)

$\langle$*man*, CN, man', Ø, Ø, Ø$\rangle$
(etc.)

(III)   *Rules*

Here is an example of a rule in our format (due to unpublished work by Rick Saenz
and Ken Ross); we explain the notation just after the rule.

(R6)   S = NP VP $LPST(1) \cap LPST(2) = \emptyset$

            0' = 2' (^1') $QST_R(2) = \emptyset$

        QST(0) = QST(1) ∪ QST(2) $LPST(0) = QST_I(0)$

                                $SPST(0) = SPST(1) \cup SPST(2)$

Interpretation:* The numbers 0, 1, 2, refer to the S, the NP, and the VP respectively
(numbering mentioned categories from left to right); 0' means the translation of

*   Author's note 2003: Further discussion of the details of the technical aspects of the
fragment can be found in Partee and Bach (1981).

element 0 (the S in this case). The first two lines on the left are thus tantamount to the rules S4 and T4 of Montague's PTQ (Montague 1973). The QST statement says that the stored part of the meaning for the whole sentence is the union of the stores of its parts (the usual case). The statements on the right put conditions on the stores of the NP and the VP and define the contents of the stores of the S.

Simple unary rules

(R1) XP = X (NP = N, etc.) $\quad$ LPST(0) = LPST(1)
$\qquad$ 0′ = 1′ $\qquad\qquad\qquad$ SPST(0) = SPST(1)
$\quad$ QST(0) = QST(1)

(R2) $\quad$ S̄ = that S $\qquad\qquad$ LPST(0) = LPST(2)
$\qquad$ 0′ = 2′ $\qquad\qquad\qquad$ SPST(0) = SPST(1)
$\quad$ QST(0) = QST(2)

(R3) $\quad$ $\overline{\text{VP}}$ = to VP $\qquad\qquad$ LPST(0) = LPST(2)
$\qquad\quad$ [−tns] $\qquad\qquad$ SPST(0) = SPST(1)
$\qquad$ 0′ = 2′
$\quad$ QST(0) = QST(2)

(R4) $\quad$ PP = to NP $\qquad\qquad$ LPST(0) = LPST(2)
$\qquad$ [to] $\qquad\qquad\qquad$ SPST(0) = SPST(1)
$\qquad$ 0′ = 2′
$\quad$ QST(0) = QST(2)

Function–argument rules, NP and S

(R5) $\quad$ NP = DET CNP $\qquad$ LPST(1) ∩ LPST(2) = ∅
$\qquad$ 0′ = 1′ (^2′) $\qquad\qquad$ LPST(0) = QST$_I$(0)
$\quad$ QST(0) = QST(1) ∪ QST(2) $\quad$ SPST(0) = SPST(1) ∪ SPST(2)

(R6) $\quad$ S = NP VP $\qquad\qquad$ same as for R5, plus
$\qquad$ 0′ = 2′ (^1′) $\qquad\qquad$ QST$_R$(2) = ∅
$\quad$ QST(0) = QST(1) ∪ QST(2)

Function–argument rules, other than NP and S

(R7) $\quad$ VP = TVP NP $\qquad\quad$ LPST(1) ∩ LPST(2) = ∅ $\qquad$ (see, love)
$\qquad$ 0′ = 1′ (^2′) $\qquad\qquad$ LPST(0) = LPST(1) ∪ LPST(2)
$\quad$ QST(0) = QST(1) ∪ QST(2) $\quad$ SPST(0) = SPST(1) ∪ SPST(2)

(R8) $\quad$ TVP = TVP/PP PP $\qquad$ same conditions $\qquad\qquad$ (give, explain)
$\qquad\qquad$ [to] [to]
$\qquad$ 0′ = 1′ (^2′)
$\quad$ QST(0) = QST(1) ∪ QST(2)

(R9) $\quad$ TVP = TVP/NP NP $\qquad$ same $\qquad\qquad\qquad$ (give, envy)
$\qquad$ 0′ = 1′ (^2′)
$\quad$ QST(0) = QST(1) ∪ QST(2)

(R10)   TVP = TVP/$\bar{\text{S}}$ $\bar{\text{S}}$ same   (tell)
          $0' = 1'\ (^2')$
       QST(0) = QST(1) $\cup$ QST(2)

(R11)   VP = VP/$\bar{\text{S}}$ $\bar{\text{S}}$ same   (believe, assert)
          $0' = 1'\ (^2')$
       QST(0) = QST(1) $\cup$ QST(2)

(R12)   VP/INFS = (VP/INFS)/NP NP   same   (promise)
          $0' = 1'\ (^2')$
        QST(0) = QST(1) $\cup$ QST(2)

(R13)   VP = VP/INFS   INFS
                [SUBJ CONTROL] [SUBJ CONTROL]   same   (try)
          $0' = 1'\ (^2')$
       QST(0) = QST(1) $\cup$ QST(2)

(R14)   TVP = TVP/INFS   INFS
                 [OBJ CONTROL] [OBJ CONTROL]   same   (persuade, force)
          $0' = 1'\ (^2')$
       QST(0) = QST(1) $\cup$ QST(2)

(R15)   CNP = CNP   REL   same
          $0' = 2'\ (^1')$
       QST(0) = QST(1) $\cup$ QST(2)

"Transformation" RIGHTWRAP: [TVP/x x NP] $\Rightarrow$ [TVP/x NP x]

Rules involving variables: quantification, reflexives, and control

(R16)   ("Store NP")
          NP = NP   LPST(0) = QST$_1$(0) [= LPST(1) $\cup$ {i}]
          $0' = \lambda P\{x_i\}$ i = 0, 1, . . .   SPST(0) = SPST(1) $\cup$ {i}
       QST(0) = QST(1) $\cup$ {$\langle 1', i\rangle$}

(R17)   (Quantifying In)
          S = S $\langle \alpha, i\rangle \in$ QST(1), $\alpha \neq$ WH,SELF1,SELF2
          $0' = \alpha(\hat{x}_i\ 1')$ LPST(0) = QST$_1$(0)   [= LPST(1) $-$ {i}]
       QST(0) = QST(1) $-$ {$\langle \alpha, i\rangle$}   SPST(0) = SPST(1) $-$ {i}

(R18)   REL = that S   QST(2) = {$\langle$WH, i$\rangle$}
          $0' = \lambda P\lambda x_i[P\{x_i\} \wedge 2']$ LPST(0) = QST$_1$(0)
       QST(0) = QST(2) $-$ {$\langle$WH, i$\rangle$} [= $\emptyset$]   SPST(0) = SPST(2) $-$ {i}

(R19)   INFS = $\overline{\text{VP}}$ $\text{LPST}(1) \cap \{i\} = \emptyset$
             $0' = 1' (\lambda P \{x_i\})$ $\text{QST}_R(1) = \emptyset$
                                                                $\text{LPST}(0) = \text{QST}_I(0)$

   a. add [FREE CONTROL] to
        syn. features of INFS $\text{SPST}(0) = \text{SPST}(1) \cup \{i\}$
   b. add [SUBJ CONTROL]
   c. add [OBJ CONTROL]

$$\text{QST}(0) = \begin{cases} \text{(a) } \text{QST}(1) \\ \text{(b) } \text{QST}(1) \cup \{\langle \text{SELF1}, i\rangle\} \\ \text{(c) } \text{QST}(1) \cup \{\langle \text{SELF2}, i\rangle\} \end{cases}$$

(R20)   (Reflexive 1: Subject control)
            VP = VP $\langle \text{SELF1}, i\rangle \in \text{QST}(1)$
            $0' = \lambda \wp \, \wp \{^{\wedge}\text{SELF1} \, (\lambda x_i 1')\}$ $\text{LPST}(0) = \text{LPST}(1) - \{i\}$
         $\text{QST}(0) = \text{QST}(1) - \{\langle \text{SELF1}, i\rangle\}$ $\text{SPST}(0) = \text{SPST}(1) - \{i\}$

(R21)   (Reflexive 2: Object control) $<\text{SELF2}, i> \in \text{QST}(1)$
            TVP = TVP $\text{LPST}(0) = \text{LPST}(1) - \{i\}$
         $\lambda \wp_2 \lambda \wp_1 [\wp_2 \{\hat{y} \, \text{SELF2} \, (\lambda x_i 1')(y)(\wp_1)\}]$ $\text{SPST}(0) = \text{SPST}(1) - \{i\}$
         $\text{QST}(0) = \text{QST}(1) - \{\langle \text{SELF2}, i\rangle\}$

Constraint on well-formed outputs: $\text{QST} = \emptyset$

Notes

 1 Not everyone goes along with the *if*s: Cooper (1975) argues that a disambiguated language is unnecessary; Katz (1972) argues that scopal ambiguities are not part of semantics proper; Quine (1960) shows how to eliminate variables altogether by use of suitable operators.
 2 Note that "surface structure" has been redefined. Surface structures are really intermediate structures which are mapped on to both surface structures in the old sense and expressions in logical form.
 3 The term "geometrical" is taken from Ladusaw (1979); this work has influenced us greatly. Note that in PTQ (i.e. Paper 8 in Montague 1974), there is the further possibility of using what Hellan (1981) calls "operational" properties of analysis trees, which come close to being order-free geometrical properties.
 4 We adopt here the somewhat controversial position that subjects are arguments (as in Montague's "Universal Grammar" (Paper 7 in Montague 1974) rather than functions (as in PTQ). Cf. Keenan and Faltz (1978) for some justifications for this view.

5   We draw here on a framework originally proposed by Rick Saenz and Ken Ross, neither of whom is necessarily in agreement with the details of our use of it or the analysis of English presented. Similar frameworks have been proposed by Gazdar (1979).

6   We also assume that pronouns have alternative translations of the sort suggested by Cooper (1979) as definite descriptions involving free property variables or meta-variables over property expressions containing just free variables and brackets.

7   Our use of WH as an arbitrary gap-marker is done for ease of exposition only. In the Appendix we consider only *that*-relatives.

8   Actually, it is possible to do examples like the above with distinguished variable translations for reflexives, along with quantification or a derived verb-phrase rule. It's unclear to us at present whether there are any empirical differences between the two approaches. We should also note that all approaches that we know of share a problem: rules like reflexive or derived VP rules must be prevented from reapplying at the same level in such a way as to undo the effects of non-coindexing at a lower level (for discussion see Partee and Bach 1981).

9   We note that several wrinkles are added to Reinhart's definition of c-command: (1) *c-command* is extended to include higher structures labeled by the same category as the first branching node (so long as they are not separated by differently labeled nodes); (2) in discussion of quantification scope (but not in other places) Reinhart defines the notion of quantificational phrase or elements in such a way that an NP in a PP acts as if it c-commands what the PP c-commands.

10 It follows from the structure of interpretations that an element which has gone through several unary rules will always be either the function or the argument of the first binary rule that combines it with something. A good recent review of geometrical accounts of anaphora is Koster (1979).

11 Reinhart's principle is actually somewhat different, since it is stated in such a way as to require non-coreferentiality between a nonpronominal NP and *any* NP that c-commands it. Here we simply disagree about the status of examples like the following, starred by Reinhart: *Jill loves Jill's mother*; *Jill believes that Jill is OK*.

12 It must be admitted that the status of examples like (46) and (47) is far from clear, both with regard to the facts and with regard to the proper analysis of the constituents after the PP.

13 All of the questionable examples would be ruled out by a revision of (E') to read "a pronoun whose interpretation is free in the argument of a function . . .".

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Chapter 7

Compositionality

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7.1 The Principle and its Theory-relativity

7.1.1 Introduction

The compositionality principle, in its most general form, can be expressed as follows:

> The meaning of an expression is a function of the meanings of its parts and of the way they are syntactically combined.

The principle is usually attributed to Frege, and is often called "Frege's principle" (but cf. Janssen 1983 for some problems with this attribution). In its most general form, the principle is nearly uncontroversial; some version of it would appear to be an essential part of any account of how meanings are assigned to novel sentences.

But the principle can be made precise only in conjunction with an explicit theory of meaning and of syntax, together with a fuller specification of what is required by the relation "is a function of". If the syntax is sufficiently unconstrained and meanings are sufficiently rich, there seems no doubt that natural languages can be described compositionally. Challenges to the principle generally involve either explicit or implicit arguments to the effect that it conflicts with other well-motivated constraints on syntax and/or on the mapping from syntax to meaning. Ultimately the question of how strong a form of the principle can reasonably be maintained is a matter of overall theory comparison, so we cannot expect it to be settled very soon or easily.

I have several goals in this chapter. One is to emphasize how many versions of the principle there can be, since I think some arguments about it are clouded by assumptions that it is more clearcut than it is (or that compositionality equals Montague's theory of grammar). The second is to examine a number of

challenges to various forms of the principle from both broad and narrow perspectives, trying to sort out what real arguments there may be for doubting the principle, particularly Montague's strong version of it. And finally I want to explore some questions about context-dependency, ambiguity, and "invisible variables" that I don't know how to resolve but which have potentially important consequences for how strong a version of the compositionality principle we can reasonably expect to maintain.

7.1.2   Versions of the principle

Given the extreme theory-dependence of the compositionality principle and the diversity of existing (pieces of) theories, it would be hopeless to try to enumerate all its possible versions. In what follows, I will be focusing mainly on the following kinds of differences (not exhaustive): (1) in the nature of "meanings": model-theoretic objects or linguistic representations of some sort? Intensions? Functions from contexts (what are those? do they include assignments to free variables?) to intensions? (2) in assumptions about the syntax: must it be "independently motivated?" or is compositionality itself one of the constraints? Is the relevant part-whole relation "configurational" or "derivational" ("rule-by-rule")? (Cf. Bach 1976.) What kinds of abstractness and invisibilia are allowed? (3) in the construal of "is a function of": how locally must compositionality hold? What kinds of functions are allowed, and are there constraints on what kinds of functions interpret what kinds of syntactic combinations? (Cf. Partee 1979a, 1979b; Landman and Moerdijk 1983; Sag and Klein 1982.) Is compositionality necessarily purely "bottom-up"? Must the functions be single-valued, and if so, how are ambiguity and context-dependence allowed for? Does functionality preclude non-dispensable intermediate levels of representation?

   This is just a sample of the kinds of questions to which different answers yield different versions of the principle. In the following section we will review some of Montague's answers, and then turn to considering alternatives and challenges.

7.1.3   Montague's "universal grammar"

An explicit version of the compositionality principle which has fueled a lot of subsequent research is that embodied in Montague (1970) ("UG"; expositions can be found in Halvorsen and Ladusaw 1979, Link 1979, and Dowty, Wall, and Peters 1981, ch. 8.) A brief review will summarize what I will subsequently refer to as "Montague's strong version of the compositionality principle", or MCP.

   (1) Meanings can be anything you like, as long as they form an algebra homomorphic to the syntactic algebra. ("Intermediate levels" must therefore be in principle dispensable.[1]) For the more restricted notion of "Fregean

interpretations" (part of the "theory of reference" for Montague), meanings are functions from possible worlds *and context of use* to possible denotations based on the familiar typed domains with primitive types e and t. (2) The syntax is given as an algebraic characterization of a disambiguated language plus an "ambiguating relation", with no constraints on the substance of the syntactic operations. The compositionality principle is a fundamental constraint on grammar construction; Montague was not interested in syntax "except as a preliminary to semantics", and believed that syntactic evidence alone was unlikely to determine a unique syntax. (UG, the (in)famous footnote 2.) The relevant part–whole relation is given by the syntactic derivation in the syntax of the disambiguated language ("rule-by-rule interpretation"). "Parts" must be "immediate parts" (derivationally), but they need not be "visible parts" of the resulting expression – the syntactic operations can delete or replace things, and the ambiguating relation can effect further deletions after the derivation of an expression in the disambiguated language is complete. (3) "is a function of" is interpreted as the requirement of a homomorphism from the syntactic algebra to the semantic algebra. There are no further constraints on the nature of this function. Interpretation is purely "bottom-up". Ambiguity arises only via the ambiguating relation; there is no ambiguity within the disambiguated language. Context-dependence is treated entirely as indexicality and built into the notion of meanings as functions from possible worlds *and context of use*; there is no provision for dependence on context effects between parts of a single sentence.

Since the issue of compositionality *vis-à-vis* context-dependence is a major concern in this chapter, I will quote what Montague said about it in UG:

> Thus *meanings* are functions of two arguments – a possible world and a context of use. The second argument is introduced in order to permit a treatment, in the manner of [Montague (1968)], of such indexical locutions as demonstratives, first- and second-person singular pronouns, and free variables (which are treated in Section 6 below as a kind of demonstrative). *Senses* on the other hand . . . are functions of only one argument, regarded as a possible world. The intuitive distinction is this: meanings are those entities that serve as interpretations of expressions (and hence, if the interpretation of a compound is always to be a function of the interpretations of its components, cannot be identified with functions of possible worlds alone), while senses are those intensional entities that are sometimes *denoted* by expressions. No such distinction was necessary in [Frege (1892)], because there consideration of indexical locutions was deliberately avoided.   (UG, p. 228)

It is clear from this passage that Montague took compositionality as a guiding principle in determining what sorts of things meanings should be and not as an independently falsifiable claim. Janssen (1983) gives a number of detailed illustrations of how *prima facie* challenges to the compositionality principle can be met by suitably enriching the entities that are to serve as meanings, following the methodological principle articulated by Montague in the passage just quoted.

7.1.4   Theoretical alternatives

In some approaches to semantics, meanings are identified with expressions of some sort – "semantic representations" (Katz and Fodor 1963; Katz 1972; Jackendoff 1972) or "logical forms".[2] The compositionality principle can still be formulated for such systems, but it then becomes a much more syntactic notion, basically a constraint on the translation rules which map syntactic representations on to semantic ones. It is difficult to compare such systems straightforwardly with model-theoretic semantics, although one can probably say that Jackendoff's theory was less locally compositional (given that some parts of semantic interpretation were to be determined at deep structure, others at surface structure) than that of Fodor and Katz (an early model of "rule-by-rule" interpretation). It seems to me that one of the biggest open issues in semantics is the status of a possible linguistic level of semantic representation of some sort; Montague's theory allows such a level but requires that it be in principle dispensable, but one serious alternative is to posit an intermediate level of representation such that its own semantics is compositional (which might justify calling it "logical form") while the rules mapping syntactic representations on to it are not compositional or only weakly so – or vice versa.[3]

Even within the tradition of Montague grammar not all analyses have adhered to MCP. Cooper (1975) proposed the mechanism now known as "Cooper storage" as a means of generating multiple interpretations, differing with respect to quantifier scope, corresponding to a single syntactic structure; Bach and Partee (1980), extending Cooper's mechanism still further, suggested that a limited weakening of the compositionality constraint was a reasonable tradeoff for the strong syntactic constraints of a phrase structure grammar obeying the well-formedness constraint (Partee 1979a). Landman and Moerdijk (1983) have shown how results corresponding to those of Bach and Partee can be achieved in a system which preserves MCP but reinstates quantifying-in rules in the syntax; one of the major points at issue is the need for a level of translation or "logical form", particularly with respect to the indexing of pronouns – if quantifier scope and pronoun indexing are not represented in the syntax, then it appears that an additional level is needed where they are represented. It appears then that MCP is closely bound up with the possibility (and desirability) of giving a direct model-theoretic interpretation for natural languages.[4] This is a crucial issue, but one for which I have no resolution to offer. It will recur at various points below, and is likely to be a major issue for some time to come.

7.2   Broad Challenges to Montague's Version of Compositionality

In addition to the fact that not all current theoretical approaches to syntax and semantics are as strictly compositional as Montague's, there have been a number

of explicit challenges to MCP. In this section I will discuss some which involve challenges to Montague's whole framework.

Chomsky's skepticism towards the compositionality principle, expressed in Chomsky (1975) and elsewhere, seems to stem from two convictions: the "autonomy of syntax" thesis and the idea that the organization of grammar is best viewed as involving a number of relatively independent subsystems, each with its own principles and constraints, which interact to jointly constrain the final output – a view of grammar very different from Montague's, which when extended to phonology as in Bach and Wheeler (1981) presents a grammar as a simultaneous recursive definition of well-formed, phonologically and semantically interpreted, expressions of the language – starting from the smallest units and building up larger ones with phonological, syntactic, and semantic rules working hand in hand to construct and interpret complex expressions compositionally from their parts. Filters, for example, play a large role in Chomsky's theories but have virtually no place in Montague's: given the requirement of a homomorphism from the syntax to the semantics, if an expression is generated by the syntax, it must be interpretable by the semantics.[5] The "autonomy of syntax" thesis is a complex issue which I have discussed elsewhere (Partee 1975b); at the level of description, Montague's theory does include an autonomous syntax. But if the thesis is taken to assert that the syntax of a language should be learnable in isolation from the semantics, then while Montague's theory takes no direct stand on the question, MCP makes such a thesis quite implausible. In a compositionally organized grammar any information about either syntax or semantics would provide some evidence about the other, and an optimal learning mechanism would presumably exploit all available evidence. These tenets of Chomsky's are, like the compositionality principle itself, too global to be straightforwardly evaluated; and the resulting theories differ in too many ways for grammars constructed within them to be directly comparable. As Landman and Moerdijk (1983) point out, Chomsky's particular arguments against compositionality (as in Chomsky 1975) consist of non-compositional analyses of certain phenomena, and while such cases can provide valuable challenges (which may reasonably sway opinions if unmet), they neither settle the issue nor provide an alternative account of what the limits are on the relation of semantics to syntax.

Bresnan's Lexical-functional Grammar (Bresnan 1978; Kaplan and Bresnan 1982) provides challenges to compositionality which are in a sense more interesting because the theories are more nearly comparable. From the perspective of Montague grammar, her arguments for the level of functional structure can be seen as arguments against direct model-theoretic interpretation of syntactic structure and for the value of an intermediate level of representation. Halvorsen (1983) has provided rules for mapping Bresnan's functional structures onto formulas of intensional logic, making the system model-theoretically interpretable; but since the functional structures are apparently not homomorphically related to either the syntactic algebra or the model-theoretic interpretation, the resulting system violates MCP.

Of particular interest is Bresnan's treatment of idioms and dummy *there*, and their interaction with passives, Raising structures, and the like. On her treatment, an NP which is part of an idiom, such as *tabs* in *keep tabs on*, has no meaning of its own; only the complete idiom has a meaning. Within the Montague framework the fact that such "meaningless" elements appear as NPs presents a problem, since they then should have NP-type meanings, at least if they are independently generated in their surface positions. It is possible to maintain compositionality for such cases by providing special meanings for the "meaningless" pieces (see Sag 1982; Sag and Klein 1982). But one should also consider the possibility that a less compositional but more natural treatment (analogous to Bresnan's) might be achieved in a Montague grammar with a non-dispensable level of translation containing "dummy constants" with no fixed interpretations of their own but subject to meaning postulates specifying the meanings of the relevant larger units that contain them.

Another sort of challenge to MCP concerns "bottom-up" vs. "top-down" interpretations; this is discussed in Hintikka (1980) (as "inside-out" vs. "outside-in") and arises also in connection with recent work of Kamp (1981) and Heim (1982) as well as some of the proposals of Barwise and Perry. Kamp and Heim both provide explicit treatments of syntax as well as semantics, so I will focus on where their theories depart from Montague's. Simplifying considerably and selecting a single feature for comparison, both of their theories (let me call them jointly in this respect the K–H theory) introduce an intermediate level of representation ("discourse representations" (Kamp) or "file cards" (Heim)) such that occurrences of certain kinds of noun phrases in the syntactic structure affect global properties of the intermediate representations. Indefinite noun phrases, for instance, are interpreted "in the long run" as existentially quantified, but what the scope of the existential quantifier is is not determined locally, "bottom-up" but by properties of the larger configuration in which the corresponding variable ("discourse referent") appears at the intermediate level; the scope may end up over a whole discourse, and in the case of the treatment of "donkey-sentences", the operation of the rules for determining the truth-conditions for intermediate representations do not yield a standard "scope" interpretation at all (although they are well-defined). In the K–H theory, *every* and *if* are more alike than *every* and *a*; not only does this depart from Montague's category-to-type correspondences, but the *if* in effect introduces an "unselective" or variably polyadic universal quantifier which binds everything which occurs within a certain configuration at the intermediate level; what this configuration will be is not a simple function of the syntactic structure, but depends as well on what sorts of noun phrases occur within the *if*-clause (*a*-type or *every*-type). The fact that these treatments do not conform to MCP does not prove, of course, that no MCP-compatible treatment is possible; but the novel solution to the *donkey*-sentence problem provided in the new frameworks does not appear to be expressible in a pure Montague grammar and it poses a serious challenge to the thesis of direct compositional model-theoretic interpretability, since it seems (to me at least) to be superior to any of the

many analyses of *donkey*-sentences proposed within Montague's (or any other) framework.[6]

7.3   Context–dependence, Ambiguity, and Challenges to Local, Deterministic Compositionality

In addition to challenges to compositionality which concern Montague's whole framework, there have also been many challenges directed more specifically at the combination of strict rule-by-rule ("bottom-up") compositionality with particular views about the optimal syntactic treatment of various constructions.

7.3.1   Cases which can be treated as ambiguity resolution by selection

7.3.1.1 *Generic vs. non-generic interpretation of NPs*   Before the work of Carlson (1980) it was frequently held that "genericness" was a property of whole sentences, and that the interpretation of a noun phrase as generic or not might be dependent on the interpretation of other parts of the sentence, as would seem to be the case for *the horse* in sentence (1)–(3) below. In (1) we must interpret *the horse* generically, in (2) non-generically, and (3) is ambiguous since either a whole species or an individual can grow stronger. But in the light of Carlson's work we can see this straightforwardly as ambiguity resolution by selection, i.e. as a result of the incompatibility of an individual-level subject with a kind-level predicate or vice versa.

(1)   The horse is widespread

(2)   The horse is in the barn

(3)   The horse is growing stronger

The noun phrase *the horse* can be viewed as having two interpretations;[7] the fact that a sentence can contain a mixture of generic and non-generic NPs, as in one interpretation of (4), shows that genericness cannot be reasonably regarded as a sentence-wide property, and the ambiguity of (3) and (4) shows that the posited NP ambiguity is indeed attested.

(4)   The teacher was explaining the diesel engine

This case illustrates a general methodological point: apparent counterexamples to bottom-up compositionality that are claimed to involve determination of meaning of parts by other parts (where the latter are not subparts of the former) can often be analyzed as cases of local ambiguity, with incompatibilities between certain local choices reducing the ambiguity of the containing whole. The next two cases are similar.

7.3.1.2 *Dependent plurals* Chomsky (1975) offered an argument against bottom-up compositionality on the basis of examples like (5) and (6), where the number of the subject seems to affect the interpretation of the plural object *wheels*.

(5)   This unicycle has wheels

(6)   Unicycles have wheels

De Mey (1981 and elsewhere) has done extensive study of the phenomenon of "dependent plurals" exhibited in (6), and his work supports the view that there are distinct interpretations of bare plurals involved in the two sentences; the "dependent" one, as its name suggests, can only occur within the scope of an appropriate quantifier phrase such as a plural noun phrase or frequency adverb. Again a compositional approach invoking ambiguity resolution seems to be leading to success, and I know of no comparably successful "top-down" analysis along the lines originally suggested by Chomsky.[8]

7.3.1.3 *Any* While the behavior of the word *any* has been a puzzle for linguists regardless of theoretical persuasion for years, it seemed to pose a particular problem for the compositionality principle because of its apparent sentence-internal context-sensitivity. Sentence (8) has two meanings, only one of which appears to come from sentence (7). (That this is not just a scope effect can be seen by substituting "nearly anyone" for "anyone" in (7) and (8); only one reading remains in (8).) And sentence (9) seems to have no coherent meaning on its own, but occurs as part of sentence (10), which is fine (and unambiguous).

(7)   Anyone can solve that problem

(8)   If anyone can solve that problem, I suppose John can

(9)   #Anyone got the answer right

(10)   If anyone got the answer right, I suppose John did

While important mysteries and controversies about *any* remain, great progress has been made in the last few years through the work of Fauconnier (1975), Ladusaw (1979), and Carlson (1981). At this point it appears that there are strong arguments for two distinct *any*s, 'affective' *any* and 'free-choice' *any*, with distinct (though overlapping) constraints on the contexts in which their semantic contributions "make sense"; the constraints on affective *any* can be described elegantly in model-theoretic terms (Ladusaw 1979), while those on free-choice *any* are less clearly understood and may be partly pragmatic. The examples in (7)–(10) can therefore be justifiably viewed as involving an

ambiguous *any*, with one or both readings eliminated by incompatibility with the surrounding context.

7.3.2 Further challenges to strictly "bottom-up" compositionality

7.3.2.1 *Keenan's functional principle* Keenan (1974) enunciates the interesting claim that the (form and) interpretation of a function word may depend on the (form and) interpretation of its argument but not vice versa, and uses the principle to help explain a wide range of phenomena. Intuitively the claim seems correct; where function-argument structure is uncontroversial,[9] we find many examples of the sort Keenan discusses. In adjective-noun constructions, where the adjective is generally agreed to be the function word, we find the contrast noted by Quine (1960) between *red apple* (red on the outside) and *pink grapefruit* (pink on the inside), and between the different colors denoted by *red* in *red apple* and *red hair*; Keenan points out cases like *flat tire*, *flat beer*, *flat note*, etc. The interpretation of the nouns in these constructions stays constant, while that of the adjective appears to shift in a context-sensitive way. Even more extreme cases are prepositions and versatile minimal-content verbs like *make*, *do*, and *take*.

But there is a natural explanation of the phenomenon consistent with MCP. As Keenan notes, mathematical functions are often defined disjunctively in the manner illustrated in (11), where the P_i are mutually exclusive properties of possible arguments of the function f.

(11)
$$f(x) = \begin{cases} \ldots \text{ if } P_1 (x) \\ \ldots \text{ if } P_2 (x) \\ \ldots \\ \ldots \text{ otherwise} \end{cases}$$

What the function *does* to its argument depends on the argument, all right, but that's inherent in the notion of a function. The interpretation of the function symbol *f* in such a case does *not* vary with the argument; it is given by the whole of (11). Similarly we could imagine a description of the meaning of an adjective like *flat* or of a preposition like *to* displayed in a form like (11); that would show how the value obtained by applying the function to its argument varies with the argument, but would not show that the function word has different meanings with different arguments. Dependence of a function on its argument in this sense is perfectly compatible with the independent interpretability of function-expressions and argument-expressions required by compositionality.

7.3.2.2 *Things "in the wrong place"* I will close this subsection with two examples that pose problems for a compositional semantics combined with a highly constrained "surfacy" syntax.

Bolinger (1967) noted the problem raised for compositionality by sentences like (12), where *occasional* appears within the NP but has the effect of a frequency adverbial.

(12)   An occasional sailor walked by

(Cases like this, it should be noted, are a problem for any theory, since abandoning compositionality does not immediately lead to an alternative account of how the sentence does get its interpretation.) Stump (1981a) provides a compositional treatment which seems as elegant as the facts allow; it requires an additional *a(n)*, but the restricted distribution of such constructions supports the analysis.

   If direct generation of surface structures by context-free rules is pushed to the limit, phonology and morphology pose some serious problems for compositionality. Consider phrase (13).

(13)   The king of England's daughter

Phonologically, *'s* is part of the word *England's*, and *England's can* occur as a syntactic and semantic constituent; but in (13) it does not – the suffix belongs with the whole NP *the king of England*. Similar examples abound in other languages; see Carlson (1983), Bach (1983), and Landman and Moerdijk (1983) for a discussion of a number of such cases and their implications for compositionality.

All the authors mentioned above call attention to the importance of a theory of explicit feature-percolation mechanisms that allow features on higher-level phrasal nodes to have their semantic effect take place at that level but their "instantiation" realized in such various ways as affixes on words within the phrase, word order effects, intonation contours, etc. These works suggest that such constructions pose no great problems for local rule-by-rule compositionality unless one tries in addition to constrain the syntax to pure context-free phrase structure rules "all the way down" to the level of inflectional morphology. It will be important for further research to try to determine more precisely the constraints on the additional mechanisms needed for such cases; the works cited are important steps in this direction.

7.3.3   Challenges to the determinacy thesis

What Hintikka (1980) calls the determinacy thesis is the thesis that it is *only* the meanings of the parts and their syntactic mode of combination that matter. There are a number of cases that cast doubt on it.

7.3.3.1   *Constructions with variable "extra meanings"*   Frege in "On Sense and Reference" claimed that non-restrictive relative clause constructions often ended

up with components of meaning that could not be traced to any of their parts nor to the construction itself – added meanings such as "because", "in spite of", etc., as in his well-known example (16).

(16)   Napoleon, who recognized the danger to his right flank, himself led his
          guards against the enemy position

In hindsight it is quite easy to see this as a typical case of Gricean conversational implicature; the "added meaning", easily cancellable by an explicit addition to the sentence, can be generated by the maxim of relevance and need not be considered part of the literal meaning of the sentence.

An intricate case of apparent extra meaning neither directly attributable to overt expressions nor easily explained away by Gricean means is the analysis of free adjuncts and absolutes in Stump (1981b). Examples of free adjunct constructions are (14) and (15) (Stump's (26a) and (26b), p. 70).

(14)   Being a master of disguise, Bill would fool anyone

(15)   Wearing his new outfit, Bill would fool anyone

(Free absolutes are similar but with overt subjects in the preposed phrase; the difference between absolutes and adjuncts is irrelevant to the present discussion.) In (14) the adjunct is understood as outside the scope of the *would* in the main clause, in (15) as inside. (Cases like (15) show that a uniform "and" meaning plus Gricean implicature could not explain the full range and distribution of available readings.)

Stump reduces the bewildering array of apparent semantic indeterminacy of such cases to basically just two discrete constructions, one of which makes the adjunct an argument to a propositional relation expressed overtly in the main clause, the other of which introduces a free higher-order variable over such relations (relations like *because*, *although*, *after*). Stump shows that the different scope possibilities are determined by whether the predicate in the adjunct phrase is "stage-level" or "individual-level" in the sense of Carlson (1980). In the case of (14), the syntactic construction introduces a free variable over propositional relations (plus an operator making the relation factive for both arguments); the choice of a particular value is argued not to be a matter of grammar *per se* (although there are possibly conventional "unmarked cases" and something like "attendant circumstances" is common to most of the normal choices), but depends heavily on inferences that can be drawn from the content of the adjunct and the main clause – this part of the account does have a Gricean flavor.[10] In the case of (15), the adjunct serves as an argument to a propositional relation introduced in the interpretation of the main clause (in connection with *would*; other main clause elements besides modals that can introduce such variables are frequency adverbs and the generic simple present).

Is a compositional semantics which introduces free variables still compositional? Montague, in the passage cited earlier, clearly allowed the possibility:

he took meanings to be functions from both possible worlds and contexts of use (to denotations of appropriate types), with the idea that contexts of use could supply the values for free variables as well as for straightforward indexicals like *I* and *this*. In the case of interpreting non-anaphoric third person pronouns as (expressions containing) free variables, it seems reasonable to think of the context as supplying a value – if a speaker uses a non-anaphoric *he* or *she*, he or she must be able to presuppose that the hearer is already able to identify an appropriate referent, typically someone perceptually salient or mentally salient as a result of past conversation or of shared interests. But are Stump's variables the same kind of case? When we hear (14), even in isolation, we will all probably interpret the propositional relation variable as *because*; the only context we need is the sentence itself. (And having just had a *because* in prior discourse probably would make it only marginally more likely that a subsequent sentence with a free adjunct would be understood to express a *because* relation.)

I can see two ways of evaluating this situation, and I expect the preference for one view or the other will be strongly influenced by one's antecedent attitude toward the compositionality principle.

One possible conclusion is that while Stump's analysis is technically compatible with MCP, it nevertheless provides an argument against it. On Stump's analysis, a sentence like (14) has no truth conditions at all without a value for the free variable over propositional relations; the relevant relation is an essential part of the assertion.[11] But the understood value, most likely *because* in the case of (14), is not determined by any antecedently available context in the manner of indexicals, but from inferences drawn from the content of the two parts of the construction (plus context, including general knowledge). So it would appear that a crucial part of the truth-conditional meaning of the free-adjunct plus main-clause construction is *not* determined directly from the meanings of the immediate parts plus the rule by which they are combined, nor directly by the context, but by carrying out inferences from the content of the parts plus other premises available in the context in order to arrive at a most plausible relevant value for the free variable.

The other possible response is that Stump's analysis is perfectly compositional, and that the interpretation of the crucial variable is not as different from pronoun interpretation as it seems. Prior context does not by itself always determine a most likely referent for a *he* or *she*; the content of the sentence in which it occurs may be instrumental in choosing among a number of potentially available values. Consider a situation in which one spouse comes home at the end of a day, not having seen the other spouse since morning, and opens a conversation with one of (16a–d).

(16)a. Did she get her report card today?
   b. She still won't give me a raise
   c. Did she call and say when she's arriving?
   d. Oh, I see she brought my banjo back

It is not hard to imagine a situation in which any of (16a–d) could be understood unambiguously by the second spouse, with a different value for *she* in each case. Between frequent conversational partners there will generally be a large but finite number of "she's" potentially salient without immediate perceptual or linguistic context, and the rest of the content of an isolated sentence may make one of those the unique most relevant value for the pronoun in that sentence, just as sentence content contributes to ambiguity resolution. All we need to assume to see the Stump cases this way is that there are only a finite number of potential values for the proposition-relation variable. This assumption may be disputable, but I see no argument against it in Stump's work, and the traditional grammarians he cites who studied the construction all attributed to it a discrete number of semantic roles, ranging from three to eight, with fairly high agreement as to what the possibilities were. If it is indeed the case that English speakers share a limited inventory of available values for the relation variable, then it is fair to say that the context (or background knowledge) does provide the salient values (namely at most all of the possible values), and the role of inference is one of selection or disambiguation, just as in the case of pronouns discussed above.[12]

7.3.3.2 *Compounds* Compounds like *milk truck*, *fire engine*, *pony cart* seem notoriously non-compositional. But if we assume that compounding is a lexical process, and follow Dowty (1979) in regarding lexical rules as rules for extending the language by adding new basic expressions, then a natural approach is to assume that the compounding rule involves a free variable, as indicated in (17), where "BCN" stands for "basic common noun".

(17)a. $[\text{BCN}_1 \ \text{BCN}_2]_{\text{BCN}}$
   b. $\lambda x[\text{BCN}'_2(x) \wedge {}^{\vee}\Re({}^{\wedge}\text{BCN}'_1)(x)]$

On this approach the interpretation of a novel compound would contain a free variable, whose possible values would depend on context and plausibility. As in the case of other lexical rules, frequent use could lead to a particular compound's entering the lexicon with a fixed relation in place of the variable $\Re$, and subsequent semantic shift could lead to a compound's coming to have a meaning in conflict with the predictions of the rule (e.g. a *bookworm* is normally not a worm but a person; an *ashtray* is not a tray).

   Moortgat (1983) investigates the semantics of "synthetic compounds" like *price increase*, *mountain climber*, *tax evasion* in Dutch and German; he offers an interesting lexical-rule analysis in which the first noun is interpreted as a generalized quantifier (by introducing a free variable over an appropriate sub-class of determiner meanings) which is quantified into a free argument position contained in the interpretation of the head noun. This suggests a dualism in the interpretation of compounds similar to the dualism in Stump's analysis of adjuncts: if the head of the construction is interpreted as a relation (or contains a free "argument-variable"), the non-head constituent is interpreted

as its argument; otherwise, a free context-dependent higher-order relation variable is added as part of the interpretation of the construction. There are differences between Stump's and Moortgat's proposals which are glossed over in this formulation of the parallels between them, but the similarity is striking, and extends also to the interpretation of genitives discussed briefly in the following section.

7.3.3.3   *Genitives*   The analysis of genitives in English poses a challenge to MCP when we consider a range of cases as in (18)–(20).

(18)a.   John's team
   b.   That team is John's

(19)a.   John's brother
   b.   (*)That brother is John's

(20)a.   John's favorite movie
   b.   (*)That favorite movie is John's

Without going into details,[13] we can formulate the basic problem as follows. One can provide a compositional analysis of these examples by making a syntactic and semantic distinction between one-place common noun phrases (CNs) and relational, or "transitive" common noun phrases (TCNs). When a genitive determiner combines with a TCN, as in (19a) and (20a), the genitive is interpreted as an argument of the TCN function; when it combines with a simple CN, as in (18a), the interpretation rule introduces a free relation variable, to be evaluated as a contextually salient relevant relation. The "free relation" interpretation is the only one available for predicative genitives, which accounts for the contrast between (18b) and (19b), (20b). The disadvantage of such an analysis is that it increases lexical and syntactic ambiguity considerably; ordinary CN/CN adjectives must all be given TCN/TCN homonyms, most relational nouns are only optionally so (*portrait*, *teacher*, etc.), and the genitive construction itself would have to be split into two separate constructions accidentally looking alike in a great many languages.[14] As far as I can see, the only possible syntactic argument for multiplying categories and constructions in this way is the deviance of examples like (19b) and (20b), deviance which could, I believe, just as easily be regarded as purely semantic. It would seem that there is a tradeoff relation here between compositionality and syntactic ambiguity; the genitive construction could be treated as syntactically uniform and the TCN category eliminated if the semantic interpretation rule were allowed to be stated in such a way that its outcome would be ambiguous if the genitive was in construction with a common noun phrase that was optionally relational.[15]

   I have only scratched the surface of the complexities of the genitive construction here, and have not touched at all on the similar problems that arise

with the main verb *have*[16] (as in *John has a sister* vs. *John has a car*). I intend to explore these issues further in a subsequent paper. One conclusion seems firm: the interpretation of genitive constructions at least sometimes introduces a free higher-order variable as "semantic glue" between its parts, just as in one of Stump's two subcases of free adjunct constructions and in one of Moortgat's rules for lexical compounds. And in all three cases, the meaning of the whole is not determinate without a value for the variable, nor need there be a most salient value for the variable "already" in the context. These analyses satisfy MCP, but this use of free variables may be pinpointing places at which compositionality as it is commonly understood is indeed best viewed as not fully deterministic. The further open problem that remains for all three of these construction types (adjuncts, compounds, and genitives) is either to unify what have been treated as pairs of constructions with and without a free higher-order variable, or to explain why and predict when such constructions should occur in homonymous pairs.

7.4   Implicit Arguments and Invisible Variables

7.4.1   Issues

Predicates of various categories are sometimes understood as having implicitly on some level more arguments than appear on the surface. The analysis of such cases raises both descriptive and theoretical problems that bear on the compositionality thesis.

7.4.2   At what level(s) are implicit arguments present?

The principle of compositionality would be most easily satisfied if implicit arguments were present at both a syntactic and semantic level or at neither. The first option requires syntactic deletion rules (as in early transformational treatments of subjectless imperatives and agentless passives), which have been steadily losing favor on grounds of both descriptive and theoretical arguments. The second option, not representing the "understood" arguments in either the syntax or the semantics in any overt way, is exemplified by Montague's treatment of infinitives as (subjectless) VPs on both the syntactic and semantic level, contrasting with treatments like those of Bresnan (1982) and Gazdar (1982), which treat infinitives as VPs syntactically but provide an explicit subject argument for them in the semantics. The latter typifies a third option, representing understood arguments in the semantics but not in the syntax; this alternative, while it may be carried out compositionally, suggests a mismatch between syntax and semantics which one would not want to impute to a natural language without good reason. The reasons for doing so often turn on the apparent interaction of the "missing" argument with other elements in the

sentence, as with the involvement of the understood subject of controlled infinitives with the distribution of reflexive and non-reflexive pronouns.[17]

We then have three possible answers to the question of where to represent understood arguments: (a) in both the syntax and the semantics; (b) in the semantics but not in the syntax; and (c) in neither. As option (a) recedes in attractiveness, it becomes important to articulate principles concerning (b) and (c) and the choice between them. If (b) is to continue as an available option, the natural questions to raise concern constraints on the introduction of semantic constituents that do not correspond directly to syntactic ones. Do they enter only via the lexicon, only via the interpretation of syntactic rules, or in both ways? One example of a general principle of this sort was proposed by Gazdar (1982): a parenthesized constituent in a phrase structure rule, if not chosen, is always to be interpreted as an existentially quantified variable of the appropriate type.[18]

As for option (c), representing understood arguments in neither the syntax nor the semantics, this would seem the most attractive for combining a tightly constrained syntax with a compositional semantics limited to a constrained inventory of kinds of interpretation rules.[19] What is needed on this approach are (i) an account of the basis for intuitions that there *is* an understood argument – presumably to be derivable from a substantive theory of lexical meaning –, and (ii) a means for explaining the apparent interaction of implicit arguments with explicit parts of the interpretation, e.g. if the implicit argument acts like a bindable variable (see cases in section 7.4.3 below).

Among the kinds of interpretations that have been proposed in the literature for implicit arguments, the three that I want to focus on are (i) existentially quantified variables (7.4.3), (ii) deictics or indexicals[20] (7.4.4), and (iii) bindable variables (7.4.5).

7.4.3   Existential quantifier vs. indexical or free variable

How should we represent the "understood agent" in (21)?

(21)   John was killed

Intuitively it has generally been agreed to be an existentially quantified variable; arguments have emerged which reinforce this view and show that furthermore the existential quantifier has maximally narrow scope relative to any other scope-bearing elements in the sentence (Partee 1975a; Dowty 1979; Fodor and Fodor 1980; Dowty 1982b). Crucial test cases include sentences with quantifiers or negation like (22) and (23):

(22)   Three of John's books have been reviewed

(23)   John wasn't killed

Only a narrow-scope existential gives the right truth conditions for such sentences; even if the identity of the agent may be clear from the context of an utterance of (21), (22) and (23) show that a uniform interpretation of the passive agent cannot be deictic, nor can it be a free variable left to be bound existentially by general convention at the highest sentence or discourse level.[21]

Similar arguments show a difference in the implicit arguments of relational common nouns like *father* and *enemy* when they are used as simple one-place predicates. Compare (24a–c) with (25a–c).

(24) a. John is a father
   b. John isn't a father
   c. Every man in this room is a father

(25) a. John is an enemy
   b. John isn't an enemy
   c. Every man in this room is an enemy

In (25), we understood *enemy* as enemy of some particular contextually determined person or group, often "me" or "us" (but other values could be made more salient by context), even in the presence of negation or quantifiers. Sentence (25b), for instance, does not require that there be no one John is an enemy of. In (24), however, the facts support a narrow-scope existential, as with the agentless passives. Similar contrasts with verbs have been noted, as with the contrast between *eat* (existential) and *notice* (deictic) in (26) and (27).

(26) John hasn't eaten

(27) John hasn't noticed

Interaction with other scope-bearing elements appears then to provide a fairly clear test for choosing between an existential interpretation and an indexical or variable interpretation. We turn now to the problem of distinguishing between the latter two.

7.4.4   Free variable vs. indexical

The notions "indexical" and "variable" are both highly theory-dependent notions, so it is not surprising that their application to natural language phenomena is often a matter of dispute. The paradigm indexicals are the "pure indexicals" like *I*, *here*, and *now*, whose interpretation seems best described as a function from context of utterance to a particular semantic value (see Kaplan 1977; but see also Klein 1978 for an indication of how complex the relevant parameters of context may be). Are they more like variables or more like

constants? Or do we need to rethink the foundations on which that dichotomy is based?[22] The paradigm cases where variables are invoked to explicate natural language phenomena are cases describable in terms of variable binding, cases which involve something like "coreference" between terms which are not in fact "referential" in any straightforward sense, typified by cases of pronouns with quantificational antecedents like (28a,b).

(28)a.   Every man believed that he would win
     b.   No man believed that he would lose

In these sentences, the pronoun *he* seems to act like a bound variable and the antecedent quantifier like a variable-binder. The paradigm indexicals *I*, *here*, and *now* do not act like variables in that sense; *I* has no bound-variable uses (in English[23]), and neither does *here*, even in contexts where it could mean "place where I am", as in (29) and (30).

(29)   (#)   In every city I am in, I try to interview someone who has lived here
             all his life

(30)   (#)   Wherever I am, John is here too

In this respect the paradigm indexicals seem clearly more like constants than like variables; *I*, *here*, and *now* always get a *particular* value from the context of the whole utterance,[24] and are unaffected by sentence-internal quantifiers or operators.

   Janssen (1981) explicitly advocates treating indexicals as constants and limiting the introduction of free variables to the translation of explicitly variable syntactic elements (like Montague's he_0, etc.); he offers both descriptive and formal arguments against viewing a variable-assignment index as part of a context of utterance.

   However, there are other expressions in English that seem to share properties of indexicals and variables; the "demonstrative" *there* contrasts with the "indexical" *here* precisely in the fact that it can both receive a particular value from the utterance context, as in (31), and be used as a bound variable, as in (32).[25]

(31)   You should be sitting there

(32)   In every city I am in, I try to interview someone who has lived there all
       his life.

Similar contrasts can be seen between *I* and *he*, between *now* and *then*, and even between *I* and *we*: a bound-variable use of *we* is illustrated in (33).

(33)   Everyone I play duets with seems relieved when we stop

There seem to be at least as many elements that show this dual nature as there are "pure indexicals", and probably more. This is one reason for the attraction of Montague's suggestion that contexts might be taken to include a variable assignment, so that such elements could be uniformly interpreted as variables; they may then end up either as bound variables or remain free within the sentence and receive a value from the particular variable-assignment associated with the context.

When we consider the interpretation of implicit arguments in this light, we find that those which act like variables or indexicals rather than like existentially quantified terms generally follow the pattern of *he*, *there*, and *then* rather than that of *I*, *here*, and *now*. Thus alongside the "indexical" interpretation of the implicit arguments of *enemy* and *notice* in (25) and (27) (section 7.4.3), we find corresponding bound variable interpretations in (34) and (35) below.

(34)   Every man faced an enemy

(35)   Every man who shaves off his beard expects at least his wife to notice.

In fact, I don't know of any cases of implicit arguments which can be interpreted *only* as bound variables or *only* as indexicals, which seems to me a further argument against frameworks which force a sharp dichotomy between the two.[26]

7.4.5   The indexical/variable problem and the "lexical source" option

In section 7.4.2 we raised the question at what level, if any, implicit arguments are to be represented explicitly, and if they are represented explicitly in the semantics, how they get there. In this section I want to point out some theoretical difficulties that appear to stand in the way of what seems to me an intuitively plausible approach to the range of phenomena considered above.

First of all let us suppose that some "missing arguments" and "invisible variables" enter the semantic interpretation explicitly via the interpretation of syntactic rules. We expect these to be regular and productive, and to share properties with the interpretation of syntactically realized constituents within and across languages. (I don't expect to find simple necessary and sufficient conditions for separating syntactic from lexical cases; cf. the continuing debate about the treatment of agentless passives, and the general discussions in Dowty 1982a, 1982b.)

Many other cases seem lexically governed, and for these we still have two options that both seem worth pursuing. One is to represent them explicitly in the semantics – e.g. translate the intransitive *notice* into (say) intensional logic

as if it were *notice it*$_i$ (a family of translations, probably having to include "Cooper pronouns" if we stay within Montague's framework; cf. note 23). On this option one would be claiming that *notice* is always semantically transitive even when syntactically intransitive (and there may be reasons for doing so; I don't want to try to settle this issue here, but just try to clarify the options). The other option for the lexically governed cases is not to represent the missing arguments explicitly at all – e.g. translate intransitive *notice* as a single non-logical constant *notice*$'_2$ (distinct from *notice*$'_1$, the translation of transitive *notice*), and give a lexical account that makes the implicit argument *part of* the meaning of that predicate (e.g. via explicit definition or meaning postulates).

Now here is the problem. In Montague's framework and related ones, even those enriched to handle context-dependency by making meanings functions from contexts as well as indices (cf. Lewis 1980), predicate constants are interpreted very differently from variables, so that it is impossible to interpret a predicate constant as having a variable as *part of* its meaning. (In PTQ, for instance, predicate constants are interpreted by the function F which is part of the interpretation $\mathscr{A}$, variables by the entirely separate variable-assignment g; all formal semantic systems descended from the Tarskian tradition have a similar dichotomy, as far as I am aware.) If this is so, then the second option of the previous paragraph is not even a real option, and the first option makes the intermediate level of translation indispensable – in neither case can we give a direct model-theoretic interpretation of an intransitive *notice* that lets its "missing argument" be a bindable variable (or a context-dependent one, for that matter, if indexicals are either assimilated to variables or treated as a third class of items distinct from both variables and ordinary constants).

This is too big a problem to try to resolve here. In current frameworks, it seems that variables have to be introduced explicitly in order to be bound and that this cannot be done lexically in systems which do not recognize a separate level of logical form. But I am not happy with that assumption, and would rather see a modification of the framework that allows the interpretation of lexical items to be sensitive to context *and* variable-assignments, with "pure constants", "pure indexicals", and "pure variables" as distinguished purebreds, but also with room for hybrids (which I expect we will find plenty of once we begin to look for them).[27]

Let me try to summarize the main point of this section with respect to the compositionality principle. It seems that many "implicitly understood" arguments share the versatility of third-person pronouns and words like *there* and *then* in being able to function as demonstratives, "donkey-pronouns", and bound variables; in at least the latter two roles they can interact with variable-binders overt in the sentence, and given the formal properties of frameworks like Montague's, this requires that they be represented explicitly in the semantic interpretation. But this requires either a mismatch between syntax and semantics (albeit one which does not violate strict compositionality in the

cases where they can be argued to be introduced via the interpretation of syntactic rules) or, in the case of introduction via particular lexical predicates, the non-dispensability of an intermediate level of translation, which does violate MCP. Since many of these cases clearly seem to be lexical, it appears that MCP is not compatible with the traditional sharp dichotomy between constants and variables. And my guess is that we'd be better off descriptively as well without the sharp dichotomy, but I do not have a revised framework to offer here.

7.5   Concluding Remarks

In this chapter I have touched on a wide range of issues surrounding the principle of compositionality. This has by no means been an exhaustive survey, since compositionality is almost as broad a topic as the question of how semantics relates to syntax. I have reviewed a number of cases where apparent challenges to compositionality have been successfully met by compositional analyses that are elegant and insightful; I've also discussed cases where what seems to me the best available account violates at least MCP. And I've raised cases for which I don't think there is any completely satisfactory solution so far, and for which I suspect that either the compositionality principle or some other basic aspects of Montague-like frameworks may need to be revised.

   As for possible weakenings of MCP, there are at least two directions that seem to have serious support and plausibility, and which have recurred several times in the discussion above. One has to do with intermediate levels of representation and the other with determinacy and the role of context. Many alternatives to Montague grammar and some variants of it include one or more levels of intermediate semantic representation, sometimes disambiguated, sometimes not. It is consistent with many of the advantages that have been claimed for Montague grammar to have intermediate levels which are not dispensable, although such theories do not conform to the formally elegant constraints of Montague's "Universal Grammar". Certainly the demands for explicitness, rigor, and accountability for truth-conditions and entailment relations are not automatically violated by making the mapping from syntax to model-theoretic interpretation[28] less direct; but of course such proposals will be judged in part on their inclusion of equally general principles and constraints governing the nature of such intermediate levels and the mappings between them. The large number of plausible analyses that do conform to MCP provide at the least a yardstick for evaluating alternatives.

   The other direction of weakening MCP involves very global questions about how much should be accounted for by grammar. The many cases of tradeoffs between context-dependency and ambiguity resolution discussed above seem to show pretty clearly that from the perspective of a "user" of

a grammar, there may not be much difference between grammars which leave some aspects of interpretation locally underdetermined (requiring some "construction" of appropriate meaning that fits the context) and grammars that are formally strictly compositional but posit greater syntactic ambiguity and/or introduce more free variables or invisible indexicals (requiring "selection" of appropriate readings and/or values of variables that fit the context). The advantage of maintaining compositionality in such cases may be only in a greater explicitness in marking what needs to be filled in and what choices are to be selected among; on either approach one needs a supplementary theory to explain how context is used by the hearer to construct or select appropriate choices (and analogously exploited by the speaker), and a theory encompassing both grammar and its use in context might also include general principles governing the distribution of "invisible" context-dependent elements that could render their explicit inclusion within the statement of the grammar superfluous.

None of these uncertainties about the long-run tenability of a strict compositionality principle reflect on its value as a working hypothesis. I take the fruitfulness of trying to work within highly constrained theories as well established, and the compositionality constraint as one of the driving forces in recent progress in semantics. But as I have tried to emphasize, there are in principle many versions of it, and the tighter a constraint one makes it, the more chances there are that it will come into conflict with other constraints. My main goal in these pages has been to try to bring together and put into perspective a wide range of arguments and problems where it would seem that either MCP is too strong or something else has to be modified – in some cases (like those discussed in section 7.3.1) all that may be needed is a better analysis of some puzzling construction; in some (as suggested for some of the cases in 7.3.2 and 7.3.3) we may be led to a different way of looking at such issues as the relation between ambiguity and sentence-internal context-dependence; while in other cases, it seems that attention to the principle can help us to uncover important problems that may require substantial modification of currently available theoretical frameworks.

Acknowledgments

Notes

1 Janssen (1983) contains an excellent discussion of the homomorphism requirement and the constraints it places on the use of intermediate levels of translation such as Montague's IL. The central constraint is that for any translation rule "$F_i(\alpha, \beta)$ translates as $G_K(\alpha', \beta')$", the operation G_K on expressions must be such that for semantically equivalent input expressions it yields semantically equivalent results. Hence the only properties of expressions in the intermediate level that can play a role in compositional translation rules are those which are also properties of the corresponding meanings.

2 The phrase "logical form" raises such a host of questions that it would require a separate paper to even begin to sort out the different things that are meant by it in different discussions. On some of its uses, its closest analog in Montague's framework is the level of disambiguated language (derivation trees in PTQ), in others it seems more parallel to the translation into intensional logic. But in the latter case difficulties begin as soon as one talks of "*the* translation" or "*the* logical form" of a sentence, given the multitude of logically equivalent expressions; see, for instance, the criticism of Keenan and Faltz (1978) by Landman and Moerdijk (1983), who point out the problematic nature of trying to impose constraints directly on the relation between the syntactic form of a sentence and "the" translation of that sentence into a logical representation. It is even more difficult to make comparisons between model-theoretic semantics and approaches in which a "logical form" or "semantic representation" is the final output of semantic interpretation, as David Lewis (1970) emphasized in his discussion of "markerese".

3 One thing that most notions of "logical form" have in common is that logical forms are unambiguous; but there are beginning to appear proposals which allow for ambiguous logical forms, for instance with respect to quantifier scope and/or the place of prepositional phrase attachment for sentence-final prepositional phrases. (See, for example, Schubert and Pelletier 1982.) In such cases it may be that compositionality is maintained in the translation procedure but not in the model-theoretic interpretation of the logic, rather than (as more commonly) the other way around.

4 Explicit arguments against direct model-theoretic interpretation and for the inclusion of an intermediate level that is *not* simply a translation into a logical language can be found in the work of Kamp (1981) and Heim (1982), which is discussed in the following section.

5 Of course the semantic interpretation may show the expression to be a tautology, a contradiction, or in some other way ill-suited to any useful communicative purpose, and in such ways an intuition of anomalousness may be explained at a semantic or pragmatic rather than syntactic level. Similarly meaning postulates may indirectly effect a sort of semantic filtering; and a theory of presuppositions, especially if it involves a three-valued logic, will declare some sentences syntactically well-formed but semantically (or at least pragmatically) anomalous. So the issue of filtering is not completely clearcut; but there is nothing available in a compositional theory comparable to Chomsky's very general syntactic rule "move α" with its radical overgeneration plus filters at the level of "logical form" ruling out whole classes of resulting (non-)sentences. See Landman and Moerdijk (1983) for related comparisons.

 6 See Heim (1982) for a critical review of previous proposals for the treatment of *donkey*-sentence pronouns.

 7 Whether the ambiguity (between kind-level and individual-level) is to be pinned on the determiner *the*, or on the common noun, or introduced constructionally is controversial; all that is crucial here is the recognition that the noun phrase as a whole is indeed ambiguous.

 8 Partee (1975) argues against Chomsky's proposal on the grounds of the ambiguity of sentences with multiple plurals like "The boys gave the girls nickels", for which a sentence-level "plurality" feature is clearly not sufficient to determine the range of possible interpretations.

 9 Although there are many cases were nearly everyone who invokes function-argument structure at all agrees on which constituent in a given construction is the function and which the argument, there have been few *general* criteria offered besides Keenan's for determining which is which. See Ballmer (1980, 1982) for some grounds for skepticism toward the idea that the answer is in general determinate.

10 Note that if nothing is known about the propositional relation except that it is factive, the minimal choice would seem to be *and*, since conjunction is implied by all "two-sided factive" propositional relations. The main difference between an overt conjunction and an adjunct construction appears to be the differential degree of "assertedness" of the two parts, as with non-restrictive adverbials.

11 Note that if one could defend the view of Quirk et al. (1972) that the literal interpretation of the relation is just *and*, this argument would not apply; nor would it apply if the relation, however determined, were not part of the truth-conditional content.

12 I have focused here on one particular and potentially controversial aspect of Stump's work because of its bearing on the issue of compositionality; these remarks have oversimplified some parts and completely neglected many other parts of this rich and tightly argued analysis, which is for the most part perfectly compositional.

13 The first draft of this paper had a longer section on genitives, but since the paper was too long and I was not really satisfied with the analysis presented there, it seemed better to defer fuller discussion of genitives to a separate paper (in progress). [Author's note 2003: The deleted section on genitives was eventually published as an appendix to Janssen (1997) and appears here as chapter 8. The author's more recent work on genitives, joint with Vladimir Borschev, is represented here by chapter 15.]

14 The positing of a near-universal ambiguity would certainly need strong argument, but it is not necessarily indefensible. An example of a serious attempt to provide an explanation for a possible universal ambiguity of a single negative morpheme can be found in Seuren (1985).

15 McConnell-Ginet (1982) offers an interestingly innovative solution to the problem of variable polyadicity in verbs in connection with the analysis of adverbs; since all of the arguments of "relational" nouns are expressed by PPs, the problem of the proper treatment of relational nouns is similar to that of distinguishing "oblique" arguments of verbs from modifiers, to which McConnell-Ginet's proposals are directly relevant.

16 See Wierzbicka (1982) for a detailed discussion of the kinds of relations *have* typically expresses and the factors that govern the choice among more specific interpretations.

17 This is what led Bach and Partee (1980) to add subject variables in the inter-
pretation of infinitives; Landman and Moerdijk (1983) treat the same phenomena
without semantic subjects but with quantifying-in rules in the syntax.

18 I am not sure whether the principle is correct; Dowty (1982b) argues that deictic
interpretation of understood arguments is even more productive than existential
interpretation, and treats both kinds lexically rather than syntactically. But it is
principles of this sort which need to be found.

19 Chierchia (1984) is developing an approach of this sort, which includes an account
of control phenomena and their interaction with passives, etc., without represent-
ing "missing subjects" overtly in either the syntax or the semantics.

20 I am using the terms *deictic* and *indexical* interchangeably for expressions whose
interpretation is supposed to be supplied by the context.

21 Ivan Sag in a talk once proposed the last-mentioned treatment as a general alternat-
ive to Gazdar's uniform treatment of optionally missing arguments as existentials;
the argument against that possibility given here does not apply to the variable-like
treatments of existentials of Kamp (1981) and Heim (1982). A number of the issues
raised below might be viewed very differently in their systems, but I cannot try to
discuss their frameworks in detail here.

22 Terry Parsons in lectures in 1972 suggested that virtually every content word of a
natural language may be context-dependent to some degree; the idea that some
words have constant intensions and others are indexical may be just a simplifying
fiction.

23 This is not universal; Emmon Bach (personal communication) has pointed out that
the first-person pronoun can be used in Amharic in embedded sentences in ways
suggestive of Castañeda's "he*"; verb agreement distinguishes the anaphoric from
the indexical "I".

24 But *here* and *now* can "shift" in *style indirect libre* as discussed in Banfield (1973),
while *I* cannot. And *here* at least can sometimes be anaphoric, but none of these can
ever be a bound variable (see von Stechow 1982; Klein 1978).

25 The desire to find a basis for a unified treatment of elements which can function
as demonstratives, definite anaphors, and bound variables is one of the central
concerns of Cooper (1979), Kamp (1981), and von Stechow (1982). (There is a great
deal of variability in the use of the terms "indexical", "deictic", and "demonstrat-
ive", not to mention "anaphor", reflecting both different historical traditions and
different points of view about what sorts of classifications yield the best general-
izations. My use of scare quotes in the text signals an attempt to refer to fairly
common classifications without presupposing their appropriateness.)

26 Matters are still more complicated; neither the *we* in (33) nor the implicit argu-
ment of *notice* in (35) is a *simple* bound variable, in that neither is understood
as "co-indexed" with an antecedent that appears directly as a constituent in the
sentence. They rather seem to manifest properties of "donkey-sentence-pronouns"
as discussed in Cooper (1979), Heim (1982), and Dowty (1982b). Compare also the
indirect relation between the implicit bound "country" arguments in (i) below and
the "unselective" quantifier *always*:

(i) The capital is not always the largest city

(I think I got this kind of example from discussions with Greg Carlson and/or
Irene Heim.)

27 I think this issue is directly relevant to (i) the treatment of nouns like *price*, *temperature*, and *president*, for which Montague's technique of invoking individual concepts is probably not satisfactory; (ii) the various phenomena for which Skolem functions have been invoked by a number of recent writers (iii) the interpretation of the adjective *local*, discussed by Jonathan Mitchell in unpublished work (University of Massachusetts); (iv) the parallels drawn by Barwise and Perry between "discourse situations", "resource situations", and "subject-matter situations", making it easier to impose similar structure on context and content domains. See Schiebe (1982) for what appears to be a step in the suggested direction.

28 And even the inclusion of model-theoretic interpretation as an indispensable part of semantic interpretation is not sacrosanct, if proposed alternatives can be shown to move us forward and not backward.

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Chapter 8

Genitives: A Case Study

8.1   Introduction

In this appendix we will consider a difficult case for compositionality: the variety of meanings of genitives. It will turn out that the problems can be solved compositionally by methods discussed before. The aim of this section is to illustrate that this is not the end of the story. Designing a compositional solution for a given phenomenon may implicate decisions that have consequences in other parts of the grammar, and these consequences have to be taken into account as well. It is possible that the new insights give an improvement of the grammar as a whole, but it may also be the case the system becomes unnecessarily complicated. If certain decisions can be given no other argumentation than to preserve compositionality, then we may have chosen the wrong solution, or we may be working with a too narrow conception of compositionality.

8.2   The Problem

Here are some initial data:

(1)a.   John's team.
   b.   A team of John's.
   c.   That team is John's.

(2)a.   John's brother.
   b.   A brother of John's.
   c.   *That brother is John's.

(3)a.   John's favorite movie.
   b.   A favorite movie of John's.
   c.   *That favorite movie is John's.

Informally, we can give a unified description of the interpretation of the genitive phrase *John's* that applies to all these cases if we say that the genitive always expresses one argument of a relation (in intensional logic, something like $^{\vee}R(j)$). But the relation can come from any of the three sources:

1   The context. In (1), the most salient relevant relation might be "plays for", "owns", "has bet on", "writes about for the local newspaper", or any of an essentially open range of possibilities (henceforth the "free R" reading).
2   An inherently relational noun, like *brother* in (2).
3   A relational adjective, like *favorite* in (3).

I'll refer to the last two cases as the "inherent R" readings.

   Compositionality asks for a uniform semantics of the genitive construction in syntax. Since not all examples contain a relational noun or adjective, the best hope for a unified analysis would clearly seem to be to try to assimilate all cases to the "free R case". This is in fact the strategy carried out by Hellan (1980). Simplifying his approach, we may say that he points out that an inherently relational noun can be presumed to make its associated relation salient in the context (while still being analyzed as a simple *CN* syntactically and a one-place predicate semantically).

   Maybe this approach works for the given examples, but serious problems emerge if we consider the contrasts between *NP*-internal and predicative uses of genitives. In addition to the contrast among the (a) and (b) cases in (1)–(3) above, an interesting pattern of interpretations can be found in (Stockwell, Schachter and Partee 1973). They give the following examples (the section on genitives was primarily done by Schachter and Frank Heny):

(4)a.   John's portrait. (*ambiguous*)
   b.   (i)   A portrait of John's. (*free R only*)
      (ii) A portrait of John. (*inherent R only*)
   c.   That portrait is John's. (*free R only*)

What emerges from these examples is that while predicative genitives (the (c) cases in (1)–(4)) are easily interpreted in terms of a free relation variable which can get its value from the context, they do not seem able to pick up a relation inherent within the subject-*NP* as a value for that variable. The postnominal genitive and non-genitive *of*-complements in (4b) seem to offer a

minimal contrast which is neutralized in the prenominal genitive (4a), providing further evidence that the 'free R'' and the "inherent R" readings should be represented distinctly at some level within the grammar.

A caveat should be added concerning the predicative genitives. In some cases they appear to get an inherent relational reading, as in:

(5)   I knew there were three grandmothers behind the curtain, but I didn't know one of them was mine.

We can understand *mine* in (5) as *my grandmother*, but I believe the complicating factor is a result of the phenomenon described in transformational terms as *one*(*s*) – deletion (Stockwell, Schachter and Partee 1973). It seems that whenever a genuinely t/e-type genitive appears, it must be interpreted with a free R variable. In the present section the full-*NP* reading of bare genitives (of which (5) is an example) are omitted from further consideration.

8.3   A Compositional Analysis

Above we have seen that the genitive construction seems to have two basic meanings. A strategy described in previous sections can be applied here: eliminating the ambiguity by introducing new parts. This is done by enriching the syntax to include a category *TCN* of "transitive common noun phrases", thus making the inherently relational nature overt in their syntactic category and semantic type. The basic idea is that there are two basic genitive constructions, a predicative one with a free R variable (context-dependent), and an adnominal one which applies to transitive common nouns and fills in an argument place, yielding an ordinary one-place *CN* as result. The predicative one also has a postnominal counterpart, but of category *CN/CN*, and both have determiner counterparts of categories *NP/TCN* and *NP/CN* respectively.

Below a grammar for the genitive is presented; this grammar will be extended in the next section. Details of the analysis not immediately relevant to the genitive issue are not to be taken too seriously.

1   **Predicative genitives** (1c)–(4c)

- Syntax: $[NPs]_{t/e}$.
- Semantics: $\lambda x[{}^{\vee}R_i(NP')(x)]$ or equivalently ${}^{\vee}R_i(NP')$.
- Notes: The R_i in this interpretation is free; if context dependency should rather be treated by special constants, this would be one of those.

2   **Postnominal genitives** (1b)–(4b)

(a)   **Free R type**

- Syntax: $[of\ NPs]_{CN/CN}$.
- Semantics: $\lambda P\lambda x[{}^{\vee}P(x) \wedge {}^{\vee}R_i(NP')(x)]$
  or in the notation of Partee and Rooth (1983): $\lambda P[{}^{\vee}P \cap {}^{\vee}R_i(NP')]$.

- Notes: This is exactly parallel to the conversion of t/e adjectives to *CN/CN* adjectives.

(b) **Inherent R type**

- Syntax: $[of\ NPs]_{CN/TCN_{[+gen]}}$.
- Semantics: $\lambda R\lambda x[{}^{\vee}R_i(NP')(x)]$.
- Notes: The symbol $TCN_{[+gen]}$ is used to mark the subcategory of relational nouns which can take postnominal *of* + genitive (*brother*, *employee*, *enemy*, but not *portrait*, *description*, *height*); some relational nouns take *of* + accusative, some can take both. The data are messy; "heaviness" of the *NP* plays a role. Note that the agentive "by John" reading of (4b) counts as a free R reading; only the "of John" reading is blocked in (4b) and (4c).

3 **Prenominal genitives** (1a)–(4a)

(a) **free R type**

- Syntax: $[NPs]_{NP/CN}$.
- Semantics: Tantamount roughly to the *the* + $[of\ NPs]_{CN/CN}$, but see Notes below. Using Montague's treatment of *the*, this is:

$$\lambda Q\lambda P[NP'(^{\wedge}\lambda z[\exists x[\forall y[[{}^{\vee}Q(y) \wedge {}^{\vee}R_i(y)(z)] \leftrightarrow y = x] \wedge {}^{\vee}P(x)]])].$$

- Notes: A quantifier in a prenominal genitive always has wide scope, while those in postnominal genitives seem to be ambiguous. The uniqueness condition this analysis imputes to *John's brother* is disputable, especially when the whole noun phrase occurs in predicate position.

(b) **Inherent R type**

- Syntax: $[NPs]_{NP/TCN}$.
- Semantics: Similarly tantamount to the *the* + $[of\ NPs]_{CN/TCN}$:

$$\lambda R\lambda P[NP'(^{\wedge}\lambda z[\exists x[\forall y[{}^{\vee}R(z)(y) \leftrightarrow y = x] \wedge {}^{\vee}P(x)]])].$$

- Notes: The order of the arguments of R are reversed in the two determiners; this reflects the intuitive difference in natural paraphrases using, e.g., *owns* for the free R in *John's team* and (*is a*) *sister of* for *John's sister*. But this difference is not predicted or explained here, and to be fully consistent the arguments in the two other 'free R' genitives should be reversed as well.

8.4   Consequences for Adjectives

In the previous section a compositional analysis is given for the genitive construction by distinguishing two types of common nouns. But having more types of common nouns, implicates more types of prenominal adjectives, viz. *CN/CN*, *TCN/TCN* and *TCN/CN*. We consider examples of adjectives of the new types.

1　*TCN/CN*: *favorite₁*, as in *John's favorite movie.*

- Syntax: [*favorite*]$_{TCN/CN}$.
- Semantics: Lexical; roughly

  favorite$'_1$ = λP[λy[λx[$^\vee$P(x) and y likes x best out of $^\vee$P]]].

2　*TCN/CN*: *favorite₂*, as in *John's favorite brother.*

- Syntax: [*favorite*]$_{TCN/TCN}$, probably derivable by lexical rule from *favorite₁*.
- Semantics: lexical, but derivative; roughly

  favorite$'_2$ = λR[λy[λx[$^\vee$R(y)(x) ∧ *favorite*$'_1$($^\wedge$($^\vee$R(y)))(x)]]].

This analysis of inherently relational adjectives creates non-basic *TCN*s which act just like basic *TCN*s with respect to genitives. Once these categories are admitted, it appears that a number of traditionally *CN/CN* adjectives like *new* also fit here as well; we can distinguish four separate (but related) *new*s as follows:

1　[*new₁*]$_{t/e}$ "hasn't existed long" (*a new movie*).
2　[*new₂*]$_{CN/CN}$ "hasn't been a *CN* long" (*a new movie star*).
3　[*new₃*]$_{TCN/TCN}$ "hasn't been a *TCN*-of long" (*my new friend*).
4　[*new₄*]$_{TCN/CN}$ "hasn't been in the (free) R_i-relation too long" (*John's new car is an old car*).

New₄ is definable in terms of *new₃* and a free *R* as is shown in:

(6)　*new*$'_4$ = λP[λy[λx[$^\vee$P(x) ∧ *new*$'_3$R(y)(x)]]].

Note the difference between [*favorite*]$_{TCN/CN}$ with an "inherent" *R* built into its meaning, and [*new*]$_{TCN/CN}$ which introduces a 'free *R*', which in turn acts as "inherent" for the genitive.

Thus the analysis of genitives has stimulated a more refined analysis of adjectives. The above treatment gives a reasonable account of the data: the distribution of 'inherent' and 'free' *R* readings is explained by treating the 'inherent *R*' genitive as something which must be in construction with a *TCN*, which can only happen within the *NP*, while the 'free *R*' genitive is basically a predicate. The fact that *TCN*s can almost always be used as plain *CN*s would be attributed to the existence of highly productive lexical rules which "detransitivize" *TCN*s, interpreting the missing argument as existentially quantified or as an indexical or variable.

8.5　Doubts about the Introduction of TCNs

Although the grammar from the previous two sections deals with the phenomena, and gives interesting insights, there can be serious reservations

about introducing the category *TCN* into the syntax along with the associated distinctions in the categories of adjectives and determiners. The distinction between transitive and intransitive verbs has clear syntactic and morphological as well semantic motivation in many languages, while with nouns the motivation is almost entirely semantic. I believe that the analysis given above incorporates ingredients of a good explanation, but puts too much of it in the syntax.

Besides these general considerations, there are also phenomena which raise doubts. Consequences emerge when we consider what explanation to give of the semantics of *have* in sentences like (7)–(9).

(7) John has a car.

(8) John has a sister.

(9) John has three sisters and two brothers.

We could account for (7) and (8) by positing two *have*s, one ordinary transitive verb (IV/*NP*) *have*₁ interpreted as a free variable *R* (with typical values such as 'own', but highly context-dependent), plus a *have*₂ of category IV/*TCN* interpreted as in:

(10) $have'_2 = \lambda R \lambda x [\exists y R(x)(y)]$.

This requires us to treat *a sister* in (8) as not an *NP*, but a *TCN*, and similarly for even more complex indefinite noun phrases, as in (9). We could defend such a departure from apparent surface syntax, with arguments about the inadequacy of Montague's treatment of predicate nominals as ordinary *NP*s and with appeals to the diversity and interrelatedness across languages of constructions expressing possession, existence, and location, justifying the singling out of *have* for special treatment along with *be*. But putting this in terms of categorial distinctions in the syntax would predict the impossibility of sentences like:

(11) John has piles of money and no living relatives.

(12) John has a tutor, a textbook, and a set of papers.

(13) John has a good job, a nice house, a beautiful wife, clever children, and plenty of money (and an ulcer).

Conjoinability is a very strong test of sameness of syntactic and semantic category, and in this case it supports the traditional assumption that these are all *NP*s, and not a mixture of *NP*s and *TCN*s. This suggests that the interaction of the interpretation of *have* with relational nouns should not be dealt with by

multiplying syntactic categories. And while the conjunction test does not give similarly clear evidence in the genitive construction, I expect that if we can find a way to treat the *have* data without *TCN*s in the syntax, we will be able to extend it to a treatment of the genitives (probably still recognizing two genitives, but without invoking *TCN*s to explain the difference).

8.6   Genitives and Compositionality

There are several points at which the problems raised by the genitive construction relate to general issues concerning compositionality

1   If we were not committed to local and deterministic compositionality, we could extract a uniform core meaning that all the genitives described above share: [*NP*s] means $^\vee R(NP')$. And we could, I think, describe general principles that dictate what more must be "filled in" for the postnominal and determiner uses, and whether the variable is to be left free or bound by a λR operator. This approach would couple a uniform interpretation of the genitive with a not totally implausible interpretation strategy that could be caricatured as "try to understand" (according to Bach a term originating from Philip Gough). Arguments for such an interpretation strategy for semantically open-ended expressions are given in Partee (1988).

2   Montague's strategy for maintaining uniformity in the face of apparent diversity might be characterized as "generalize to the worst case". I don't think that will work for the analysis of the genitives, since trying to assimilate all genitives to the "free R" case gives the wrong result for the distribution of "inherent" readings. The only way I can see to give a *uniform* treatment of all genitives in English is to leave part of the meaning out of the grammar as sketched in paragraph 1) above. Perhaps a type-shifting along the lines of Partee (1987) could be explored.

3   If we do maintain the compositionality principle by building in the kind of multiple categorization described above, we simplify the process of determining semantic information from syntactic form, but complicate the task of parsing and ambiguity resolution, since we have simultaneously increased lexical and syntactic ambiguity.

4   The motivation for the introduction of *TCN*s was a desire to make explicit the role of the implicit second argument of relational nouns in the interpretation of genitives. In quantificational genitives like *every woman's husband* and in similar cases with *have*, the implicit argument becomes a bound variable (for other examples of this phenomenon, see section 4 in Partee 1984). This seems to give an obstacle to a treatment which would absorb these implicit arguments into meanings of the predicates, namely the absence of any way to describe "variable binding" phenomena without an overt variable to bind. Since syntactic evidence goes rather strongly against introducing transitive common nouns, this adds to the motivation

for seeking an alternative that would allow variable-like meanings as parts of predicate meanings, as argued in Partee (1989).

5 Although most of the above points suggest that the given treatment is not completely satisfactory, one aspect should be mentioned. For the compositional solution it is clear that it deals with the phenomena, how it would work out in a grammar, and how it would interact with other rules. For the suggested alternatives (interpretation strategy, partially unspecified meanings, new variable mechanisms) this is unclear.

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Chapter 9

Ambiguous Pseudoclefts with Unambiguous *Be*

9.1   Introduction

Ambiguous pseudoclefts such as (1), analyzed most thoroughly in Higgins (1973), have appeared to provide evidence for two verbs *be*, a "*be* of predication" and a "*be* of identity".

(1)   What John is is unusual.

On one reading, an a "predicational" pseudocleft, (1) predicates the property of being unusual of the referent of "what John is". For instance, (1) would be true on this reading if John is a skydiver and being a skydiver is unusual. On the other reading, as a "specificational" pseudocleft, (1) identifies the property of being unusual as the referent of "what John is"; on this reading, (1) differs only in matters of focus and presupposition from the simple sentence, "John is unusual." Representing these two readings as in (1′a–b) below, one can see that it is indeed plausible to attribute the difference to two different *be*s, a *be* of predication leading to (1′a) and a *be* of identity leading to (1′b).

(1′)a.   unusual (what John is)
    b.   what John is = unusual

Such a distinction between two *be*s has often been implicitly or explicitly assumed for sentences such as (2a–b), commonly represented as having semantic structures (2′a–b).

(2)a.   Cicero is mortal.
   b.   Cicero is Tully.

(2′)a. mortal(Cicero)

   b. Cicero = Tully

A further notable difference between the two types of pseudoclefts, also discussed by Higgins (1973), is that the specificational but not the predicational pseudocleft displays the behavior Higgins calls "syntactic connectedness": anaphoric and control relations hold across the copula in specificational pseudoclefts in violation of normal configurational constraints. Sentence (3), unambiguously specificational, illustrates this syntactic connectedness. Sentence (4), without it, is unambiguously predicational if the *him* is read as coreferential with *John*.

(3) What John is is a nuisance to himself.

(4) What John is is a nuisance to him.

In this chapter I will argue that an alternative account can be constructed on the basis of a proposal by Williams (1983) for a uniform *be*, coupled with the theory of nominalization of Chierchia (1984) and the type-shifting principles of Partee (1986). On this account, the ambiguity of (1) is a direct consequence of the different roles that can be played by the two arguments (each unambiguous up to type-shifting) of (unambiguous) *be*. In the sections that follow, I will describe and discuss the principles that contribute to the explanation of the ambiguity and suggest the beginnings of an explanation of the correlated phenomenon of syntactic connectedness.

9.2   The Uniform *Be* Theory

Williams (1983) suggests that stative *be* is unambiguous and always has one referential and one predicative argument (types e and $\langle e, t \rangle$ in Montague grammar terms), and that what is unusual about it is that its two arguments may appear in either order.[1] The semantics of such a *be* we can take to be an instruction to *predicate* the $\langle e, t \rangle$ argument of the e argument.

A natural generalization which is suggested by the syntactic heterogeneity of copular sentences is that *be* takes arguments of types X, $\langle X, t \rangle$, for any type X. Note the variety (syntactic and semantic) in the following, for instance.

(5)a. To love is to exult.

   b. To love is to exalt.

   c. From A to B is 600 miles.

   d. 600 miles is from A to B.

   e. Because he was out of money wasn't his only reason.

   f. Outside from one point of view may be inside from another.

   g. Electronically is usually fastest.

Under this perspective, the various predicates in (6) would all be analyzed semantically as $\langle e, t \rangle$

(6)
$$
\text{John is} \begin{cases} \text{tall} \\ \text{in the room} \\ \text{a professor} \\ \text{Mr Smith} \\ \text{mayor of Cambridge} \end{cases}
$$

    e $\langle e, t \rangle$

One question immediately faced by such a proposal is how one can treat apparent identity sentences like "John in Mr Smith" as instances of predication. It is here that the account draws on type-shifting principles (Partee 1986) that are independently needed to account for the full range of NP meanings, to which we now turn.

9.3   Type-shifting Principles

In this section I briefly summarize the approach to type-shifting proposed in Partee (1986). I retain from Montague's approach the requirement of a systematic category-to-type correspondence, but weaken it to allow each category to correspond to a family of types rather than just a single type.[2] For an extensional sublanguage I propose basic NP types e ("referential"), $\langle e, t \rangle$ ("predicative"), and $\langle \langle e, t \rangle, t \rangle$ ("quantificational"). While this last, the type of generalized quantifier, is the most complex, it is also the most general; I argue that all NPs have meanings of this type, while only some have meanings of types e and/or $\langle e, t \rangle$.

   One wants of course an explanation of the range of meanings any given expression can have; type-shifting principles of various kinds are offered as a part of such an explanation. Among the type-shifting principles proposed there are some very general ones which are derivable directly from the type-theory, others which are quite general but depend on the algebraic structure of particular domains (such as the Boolean structure of the $\langle \langle e, t \rangle, t \rangle$ and $\langle e, t \rangle$ domains), others which require the imposition of additional structure on the domain of entities or other domains, and still others which are language-particular rules. In all cases, the idea is to try to identify "natural" mappings that can be claimed to represent significant generalizations, seeking formally characterizable criteria of "naturalness" that correlate well with empirical evidence of generality.

   Figure 9.1 gives a schematic representation of a number of type-shifting principles and their interrelations. In the figure, the ovals represent the three model-theoretic domains D_e (the domain of entities), $D_{\langle e, t \rangle}$ (the domain of sets of entities), $D_{\langle \langle e, t \rangle, t \rangle}$ (the domain of generalized quantifiers, or sets of sets of entities) labelled by their types, and the arrows represent mappings between
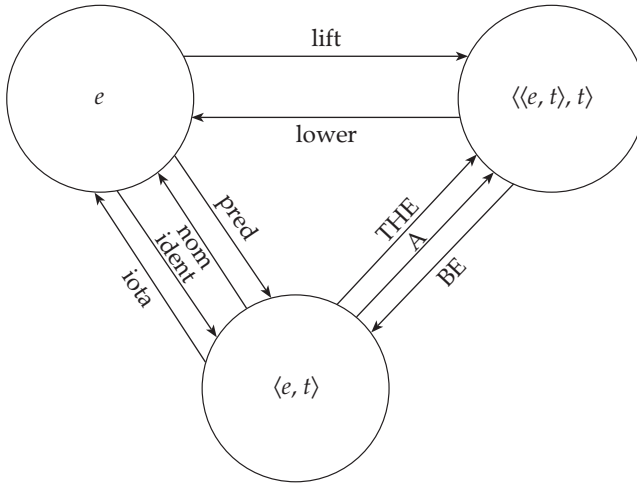
Figure 9.1

them, operations which map objects in one domain on to corresponding objects in another domain. The operations involved are defined and briefly described in (7); I will say a little more about some of them subsequently.

(7)a.   *lift*(j) = λP[P(j)]   : maps John to the set of John's properties

  b.   *lower*(λP[P(j)]) = j   : (partial); maps a principal filter on to its generator

  c.   *ident*(j) = λx[x = j]   : maps John on to the property of being John.

  d.   *iota*(P) = ιx[P(x)]   : (partial); maps a property P on to the unique entity that has P, if there is such an entity.

  e.   *nom*(P) = $^\cap$P (Chierchia 1984) : maps a (predicative) property on to its individual correlate; e.g. blue$_{ADJ}$ → blue$_N$

  f.   *pred*(x) = $^\cup$x (Chierchia)   : inverse of *nom*.

  g.   "A" (man') = λP∃x[man'(x) & P(x)] = MG(a man')'

  h.   "BE" ((a man')') = man'

The operation *lift* comes from Partee and Rooth (1983), where we argued against Montague's strategy of assigning to all members of a given syntactic category the "highest" type needed for any of them. We proposed there that each lexical item be lexically assigned the *simplest* type adequate to capture its meaning, *e* for a proper name, for instance, with higher-type meanings for the same expression derived by general type-lifting rules, but only when necessary in order to combine meanings by compositional rules. For example, *John* would have to be "lifted" from j to λPP(j) to interpret the conjunction "John and every woman," since *every woman* is only interpretable as type ⟨⟨e, t⟩, t⟩.

Many of the mappings come in pairs which are inverses. For example, the operator *lift* has an inverse *lower*; whereas *lift* is total and injective ("in to"), *lower* is partial and surjective ("on to"), mapping any principal ultrafilter on to its generator. I will have little to say about *lower* here.

Of more direct significance for the discussion of unambiguous *be* are the next four operations (7c–f), which effect shifts between referential and predicative readings of NPs. Take first the pair *ident* and *iota*, which are inverses. *Ident* is the total, injective operation mapping any element on to its singleton set; *iota* is its partial surjective inverse, mapping any singleton set on to its member. (In a more adequate system we would want versions of these operations and the next two involving *properties* as the interpretation of predicates, rather than sets, and I will freely use property terminology hereafter.) Note that *ident* gives a way to get predicative readings for normally referential expressions such as proper names, and hence a way to reanalyze identity statements like "John is Mr Smith" as having one e argument and one $\langle e, t \rangle$ argument (though of course one wants further evidence for such an analysis).

Iota is one plausible interpretation for the definite article, and we will invoke it as well in the referential reading of free relatives.

The other pair of mappings between e and $\langle e, t \rangle$, *nom* and *pred*, are extensional misrepresentations of the operators "∩" and "∪" from Chierchia (1984).[3] *Nom* maps properties on to their entity-correlates if these exist (the Russell property, for instance, will be acceptable as a predicate but will not have any entity-correlate); this is the operation which on Chierchia's analysis is involved in nominalizing the common noun *dog* to form the bare plural *dogs* and the adjective *blue* to the proper noun *blue*, and in formation of infinitives and gerunds from verb phrases. It is "almost" total, applying to all "ordinary" properties at least, and injective. Its inverse, *pred*, applies to those entities which are entity-correlates of properties, and returns the corresponding property. *Pred* is partial and "almost" surjective. Where defined, *nom* and *pred* are inverses. We will make crucial use of these operators in our analysis of pseudoclefts.

The mappings "THE", "A", and "BE" are discussed in Partee (1986). "THE" and "A" do not play any role in the analysis of pseudoclefts and I will not say anything about them here; "BE" will be mentioned shortly.

The three pairs of operators (7a–b), (7c–d), and (7e–f) illustrate the heterogeneity of type-shifting principles I alluded to at the beginning of this section: *lift* is a matter of simple combinatorics that falls directly out of the type theory, and would have an analogue between types a and $\langle \langle a, b \rangle, b \rangle$ for any a and b. *Lower* is not independently definable in combinatoric terms since it does not apply to the whole of the higher domain, but is definable as the inverse of *lift* or independently in terms of generators of ultrafilters. *Ident* and *iota* are not merely combinatorial but are still "formal" in so far as they do not depend on any particular assumptions about the domain D_e. *Nom* and *pred* are more "substantive" in that they depend on the inclusion of properties or property-correlates among the entities.

There is also room for considerable diversity in how natural languages make use of such type-shifting principles, encoding them with lexical items (*iota* might be a candidate meaning for the definite article), via lexical rules (*nom* or *pred* for the rule relating *blue* as adjective to *blue* as proper noun, depending on which one takes as basic), syntactic rules (*nom* for the formation of bare plurals), or not encoding them at all (e.g. if *lift* is universal for proper nouns). I will return to these linguistic issues at various points below. I should note here that *lower* is not necessarily part of the grammar of English at all, but is useful in the metatheory for predicting which NPs have *e*-type readings from their generalized quantifier interpretations.

With the introduction of such type-shifting principles we can give an account of *be* much closer to that of Williams (1983) than to that of Montague's PTQ (Montague 1973). Recall that Montague analyzed predicate nominals as generalized quantifiers, as he analyzed all NPs, and analyzed English *be* as a transitive verb, specifically as the "BE"-operator of (7h) above: a function that maps generalized quantifiers on to one-place predicates, representable in slightly non-standard notation as $\lambda \wp \lambda x[\{x\} \in \wp]$. While Montague achieved a uniform interpretation of *be* with all NPs, this *be* would not be identifiable with the *be* that occurs with things that are clearly of type $\langle e, t \rangle$, such as predicative adjectives.

We thus are able to achieve a more uniform interpretation of *be* if, following Williams (1983), we analyze predicate nominals, like other predicates, as being one-place predicates of type $\langle e, t \rangle$. Apparent occurrences of generalized quantifiers or referential expressions in predicate positions where an $\langle e, t \rangle$ interpretation is required can be subjected to syncategorematic type-shifting operators, akin to the automatic mass–count meaning shifts that occur when a normally mass noun is used in the plural or a normally count noun is used with a mass determiner like *much* or *little*. Thus while the type-shifting perspective increases diversity of interpretation in some respects, it permits greater uniformity in others.

9.4   Quantifying into and Relativizing out of Pred NP Position

A further essential ingredient of the account of the pseudocleft construction is a theory of the syntax and semantics of quantification in to and relativization out of predicate NP position. Our starting point is the observation by Ross (1969) that English *that* can be, among other things, a pro-form with an adjective as its antecedent, as in (8).

(8)   They said Mary was beautiful, and she is that.

It has also been noted in the literature that the use of *that* and *what* in positions where if they were referential they would have to be denoting unambiguously

animate entities is diagnostic of a predicate-type use. This is illustrated in (9a–b), from Williams (1983).

(9)a.   What did John become? A doctor.
   b.   #What did John talk to? A doctor.

The contrasts in the examples (10a–b), due to Roger Higgins, may be explainable if we can defend the following assumptions: (i) *that*, unlike *he*, cannot be used referentially to refer to (something intended to be picked out as) a human, so in (10b) it is predicative, or $\langle e, t \rangle$; (ii) *the mayor of Cambridge* has both e and $\langle e, t \rangle$ readings, but *mayor of Cambridge* can only be $\langle e, t \rangle$ (Partee 1986); (iii) as discussed in section 9.2, *be* takes one e argument and one $\langle e, t \rangle$ argument, in either order.

(10)a.   He is $\begin{cases} \text{mayor of Cambridge.} \\ \text{the mayor of Cambridge.} \end{cases}$

   b.   That is $\begin{cases} \text{*mayor of Cambridge.} \\ \text{the mayor of Cambridge.} \end{cases}$

The first alternative in (10b) would be out on these assumptions by virtue of having two $\langle e, t \rangle$ arguments. Of the assumptions above, the most controversial is probably that the *that* in (10b) is predicative; it certainly doesn't seem to play the same sort of semantic role as it does in the Ross example, (8) above.

In any case, I will posit a pro-form *that*$_i$ analogous to Montague's e-type proform *he*$_i$ to play a pivotal role in the rules of predicate quantification and relativization. For reasons elaborated in Partee (1986), I take the basic interpretation of *that*$_i$ to be as an e-type variable x_i restricted to range over (entity-correlates of) *properties*, the same sorts of things denoted by e-type expressions like *this color*, or nominalized *blue*, as handled in Chierchia (1984). Such "attribute expressions" can be predicativized by a rule whose semantic part invokes Chierchia's "*pred*" operator of (7f); in the case of *that*$_i$, this gives us a predicate expression whose interpretation is $^{\cup}x_i$. I assume that the predicativization rule creates a complex but non-island structure $[_{Pred}[_{NP}\text{that}_i]]$ of type $\langle e, t \rangle$, containing within it the e-type $[_{NP}\text{that}_i]$ in a position accessible to quantification and relativization.

The analysis tree in (12) shows a derivation for (11), from which it will be a short step to a derivation of the free relative *what John is*.

(11)   John is that$_i$: $^{\cup}x_i(j)$

(12)   Derivation of (11): $[_S \text{John is } [_{Pred}[_{NP}\text{that}_i]]]_t$: $^{\cup}x_i(j)$

$[_{NP}\text{John}]_e$: j $[_{Pred}[_{NP}\text{that}_i]]_{\langle e, t \rangle}$ $^{\cup}x_i$

$[_{NP}\text{that}_i]_e$: x_i

From (11), the free relative rule can relativize on the inner, *e*-type variable; the semantics of the free relative can be given to a first approximation by the iota operator. The result is (13), another property-denoting *e*-type expression.

(13) $[_{NP}$What John is$]_e$: $\iota x[^{\cup}x(j)]$

The interpretation of (13) can be paraphrased as "the property x such that John has x."

   We may note in passing that this treatment of *that* can be similarly employed to get a derivation of property-quantification sentences such as (14).

(14)   John is everything his mother wanted him to be.

The badness of (15) is evidence that the only way to get quantification into Pred position in English is in fact via these property-denoting NPs.

(15)   *John is every student in my class.

9.5   The Pseudoclefts

We finally have all the ingredients for deriving the ambiguous pseudocleft (1) in two ways. (I believe these derivations can be seen as formalizing the analysis proposed by Williams 1983.)

9.5.1   Predicational

On this reading, the derivation is quite straightforward; *What John is* occurs just as it is generated in (13), of type *e*, and *unusual* has its most basic interpretation, as an $\langle e, t \rangle$ predicate. The derivation is in (16).

(16) $[_S[_{NP}$What John is$]_e$ is $[_{ADJ}$unusual$]_{\langle e, t \rangle}]_t$: unusual'$(\iota x \, (^{\cup}x(j)))$

$[_{NP}$What John is$]_e$: $\iota x(^{\cup}x(j))$ $[_{ADJ}$unusual$]_{\langle e, t \rangle}$: unusual'
(as in (13), from (12))

This corresponds to our earlier paraphrase of this reading: the property John has in unusual.

9.5.2   Specificational

As suggested by Williams, we treat the specificational pseudocleft as involving a reversal of the referential and predicative roles of the two parts, with *what*

John is as the $\langle e, t \rangle$ predicate and *unusual* being used referentially (type e). We now have principles for accomplishing this. First of all, we can nominalize *unusual* using the nominalization operation (7e) of Chierchia (1984); the result semantically is $\cap$ unusual', of type e. (Still in need of explanation is the generalization that among arguments of *be*, such nominalizations do not require any overt morphological markings; why is the form here *unusual* rather than *unusualness*?)

We can predicativize the free relative *what John is* via the operation *ident* posited above. This gives us the semantic result in (17), which can be simplified, modulo a uniqueness presupposition, to the form given in (18).

(17) $\lambda y[y = \iota x[^{\cup}x(j)]]$ (type $\langle e, t \rangle$)

(18) $\lambda y[^{\cup}y(j)]$ (type $\langle e, t \rangle$)

We can approximately paraphrase (18) as "the property of being the property that John has".

In both derivations, the *be* just instructs us to predicate its $\langle e, t \rangle$ argument of its e argument. In this case, the combination gives us (19a), which is logically equivalent to (19b). (Or, if we started from (17) without simplifying to (18), we could get (19c), equivalent to (19a) and (19b) modulo the same uniqueness preposition.)

(19)a. $\lambda y[^{\cup}y(j)]$ $(^{\cap}$unusual')
    b.   unusual'(j)
    c. $^{\cap}$unusual' $= \iota x[^{\cup}x(j)]$

Sentence (19a) might be paraphrased as "the property of being unusual has the property of being the property that John has"; (19b), of course, just says "John is unusual".

We are now in a position to suggest an account of the "syntactic connectedness" facts illustrated by (3) and (4), repeated below.

(3)   What John is is a nuisance to himself.

(4)   What John is is a nuisance to him.

It is evident that the antecedent does not c-command the reflexive in (3) any more than it does in (4). But there have been independent proposals for considering semantic function–argument structure, with a relation we can call *f-command*, as the structure relevant to control, including control of reflexives (see Keenan 1974; Bach and Partee 1980). In rough terms, on this approach it is principally *arguments* that control the *functions* that apply to them (e-type subjects controlling $\langle e, t \rangle$ predicates that apply to them are just one subcase of this). Now the interpretation of (3) as a specificational pseudocleft would be as in (19b), with the complex predicate *a nuisance to himself* in place of *unusual*;

and in (19b), (John) is the normal position to semantically control that predicate. Conversely, in the predicational pseudocleft reading, whose derivation in shown in (16), *John* is not in any such semantic control position.

This account of syntactic connectedness is still incomplete, however, since I am appealing to the function–argument structure of the expression in (19b), which does not correspond to the direct compositional interpretation of the sentence, but rather reflects the result of applying several lambda-conversions (and possibly finessing away a uniqueness presupposition, if that belongs in the semantics to begin with). We would certainly overgenerate reflexives if we licensed them by appropriate f-command relations in any semantic structure logically equivalent to the directly compositional one. Perhaps the constraint is that the only logically equivalent structures that count are those that result from lambda-conversion alone; but even if that works, one would want to understand why.

The overall analysis also leaves open many questions about just how the syntax works. Among these are questions about the permutability of the two arguments of *be*, a full account of which will undoubtedly require attention to topic–focus structure, and the question of what licenses the proposed zero-morphology of *unusual* on the specification reading of (1). I believe that both of these questions are related to the special flexibility of *be* toward the syntactic categories of its arguments, illustrated in (5a–g) above. Nevertheless, this flexibility does not lead to total ambiguity; for instance, (20) below is unambiguously a specificational pseudocleft.

(20)   Unusual is what John is.

I don't have any solution to these problems and would not want to venture a guess without looking at a broader range of issues together, including both the aforementioned issues of topic–focus structure and the kinds of phenomena mentioned in the next section.

9.6   Polymorphic Types and *Be*

Montague's type system is a system of *fixed types*: all types are built up from e and t by specified recursive rules. Some type systems also allow *polymorphic types*, which permit variable types as well as fixed types both as basic types and in the recursive specification of complex types. English *be* is a good candidate for a genuinely polymorphic natural language expression, since its flexibility toward the syntactic categories of its two arguments is matched by a corresponding semantic flexibility. In terms of polymorphic types, we could propose that *be* requires a pair of arguments of type X and $\langle X, t \rangle$ for any X; i.e. any types, as long as one is interpretable as a predicate over the other. This would also enable us to link the above suggested account of syntactic connectedness to phenomena such as the preservation of opacity across the copula noted by Halvorsen (1978), as in (21).

(21)   What John is looking for is a unicorn.

An extension of this account to cover the range of pseudoclefts including (21) and those in (22) would require not only a polymorphic *be* of this sort, but a similarly generalized treatment of *that* and *what*; but facts of anaphora, WH-questions, quantification and demonstratives for categories other than simple NPs will probably require such extension anyway.

(22)a.   What John became was a movie star.
   b.   What John did was walk home.
   c.   What John was doing was walking home.
   d.   Where we thought he'd end up was in Detroit.
   e.   (?)How I could have done it would've been by tying them together first.

The examples in (22) are all specificational pseudoclefts; there are also predicational ones of most of these types, as in (23), and ambiguous ones as in (24).

(23)a.   What John did was stupid.
   b.   What John was looking for was expensive.
   c.   Where he lives is quite arid.

(24)a.   What John was doing was making Sara laugh.
   b.   Where he lives is on the other side of the ocean.

Examples (22a,b) relate to the problematic *do it* construction that English (at least) seems to use in place of pro-VPs; a quantificational instance of the same construction occurs in (25).

(25)   John did everything except walk on his hands.

It might be worthwhile exploring potential parallels between the analysis of quantification and relativization into predicates proposed above and a similar analysis for VPs that might be stated in terms of a complex pro-VP with the internal structure pictured in (26).

(26) $[_{VP}do\ [_{NP}it_i]]$

9.7   Conclusion

Although the account offered here covers a rather narrow set of data and leaves a number of questions open, it nevertheless suggests, if correct, that there is very good reason for the long-standing difficulty of finding an adequate

account of the behavior of the pseudocleft construction. What looked at first as though it must involve two different verbs *be* turns out on this account, following Williams (1983), to involve a single *be*, but one whose syntactic subcategorization and semantic typing has a flexibility that is perhaps unique in the language. The account also crucially depends upon the theory of nominalization of Chierchia (1984) which in turn goes beyond the bounds of familiar logics like Montague's intensional logic and underscores the need for serious attention to "property theory" as a possible replacement for set theory in the foundations of semantics for natural languages. A third crucial aspect of the account is its reliance on type-shifting principles available in universal grammar and in particular grammars. These are all rather new developments with potentially far-reaching consequences for many parts of the grammar. In so far as their joint interaction offers a simple and convincing explanation for the pseudocleft ambiguity, the principles involved receive further support; and one can hope that in turn, further exploration of the pseudocleft construction in this light, and particularly the phenomena of syntactic connectedness, will add to our understanding of the broader issues of property theory, type-shifting, and the special kind of polymorphism exhibited by *be* in English and copular verbs across languages generally.

Acknowledgments

Notes

1 Both Williams (1983) and this paper leave open the question of what principles determine the possibilities and preferences of word order in particular cases. It appears that syntactic, semantic, and pragmatic factors are all involved. Two "default" semantic preferences which sometimes conflict appear to be a preference for the *e* argument as subject and a preference for a definite NP to be subject if the other argument is an indefinite.

2 See Partee (1986) for possible ways to reformulate this proposal to preserve Montague's homomorphism requirement. More generally, the presentation in this section is a rather streamlined and emboldened version of the proposals presented more carefully there.

3 This is one point at which the intended treatment goes beyond the bounds of a purely extensional fragment. In this chapter I systematically misrepresent properties as sets, hoping that the differences between them will not affect the main lines of the proposed treatment.

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Chapter 10

Noun Phrase Interpretation and Type-shifting Principles

10.1 Introduction

The goal of this paper is to attempt a resolution of the apparent conflict between two approaches to noun phrase (NP) interpretation, one being Montague's uniform treatment of NPs as generalized quantifiers and the other, argued for by a variety of authors both before and after Montague, distinguishing among referring, predicative, and quantificational NPs (or uses of NPs). I believe that the most important insights of both sides are basically correct and mutually compatible. To try to show this, I will draw on and extend the idea of general type-shifting principles, argued for in Partee and Rooth (1983), together with the idea of type-driven translation developed by Klein and Sag (1985). I will draw heavily throughout on the many recent studies of model-theoretic properties of various generalized quantifiers and determiners, especially the work of Barwise and Cooper and of van Benthem. I believe that these tools can take us a good way toward explaining the diversity of NP interpretations on the basis of general principles relating syntax to semantics plus particular semantic properties of individual determiners, nouns, and NP-taking predicates.

I will retain from Montague's approach the requirement of a systematic category-to-type correspondence, but allow each category to correspond to a family of types rather than just a single type.[1] For an extensional sublanguage I propose basic NP types e ("referential"), $\langle e, t \rangle$ ("predicative"), and $\langle \langle e, t \rangle, t \rangle$ ("quantificational"). While this last, the type of generalized quantifiers, is the most complex, it is also the most general; we can argue that all NPs have meanings of this type, while only some have meanings of types e and/or $\langle e, t \rangle$. Part of our task will be to see to what extent we can find general principles for predicting from the generalized quantifier interpretation of a given NP what possible e-type and/or $\langle e, t \rangle$-type interpretations it will have. This enterprise turns out to shed new light on some old puzzles, such as the

semantics of singular definite NPs like *the king*, which turn out to be interpretable in all three types but with slightly different presuppositional requirements in each.

Opening up the issue of type-shifting principles and attempting to investigate them systematically also turns out to suggest a new perspective on the copula *be* and on the determiners *a* and *the*; I will suggest that this perspective may offer some help in explaining why certain semantic "functors" may be encoded either lexically or grammatically or not explicitly marked at all in different natural languages.

In sections 10.2 and 10.3 below I review a variety of proposals for interpreting various kinds of NPs and some of the evidence for the claim that there are NP interpretations of all three types mentioned above. The main proposals for type-shifting principles are the subject of section 10.4. Section 10.5 deals with the "Williams puzzle" introduced at the end of section 10.3; the proposed solution exemplifies the possibility of highly language specific type-shifting rules in contrast to the more general principles described in section 10.4. The paper concludes with a brief sketch of some possible implications of the perspective advanced here for the treatment of English *be* in section 10.6.

10.2 Alternative Treatments of NPs: Some Examples

I begin by reviewing alternative interpretations for a number of different kinds of NPs, contrasting Montague's treatment with others that can be found in the literature. These are summarized in table 10.1; comments follow.

Consider first the first three NPs in the table, *John*, *he$_n$*, and *every man*. One of Montague's best-known contributions to semantics was to show how these and other NPs could be given a uniform semantic type, by taking the type of all NPs to be $\langle\langle e, t\rangle, t\rangle$.[2] The fruitfulness of this idea is well-attested by now, and there are independent reasons for wanting to analyze at least some occurrences of proper names as generalized quantifiers, for instance when they occur in conjunctions like *John and every woman* and perhaps when they occur as antecedents of "bound variable pronouns".[3] But otherwise it would be more natural to treat proper names and singular pronouns as individual constants and variables respectively; this is indeed the more traditional view. Partee and Rooth (1983), in a discussion which focuses mainly on type assignments to extensional and intensional verbs, argue for a modification of Montague's strategy of assigning to all members of a given syntactic category the "highest" type needed for any of them. We proposed there that (i) each basic expression is lexically assigned the *simplest* type adequate to capture its meaning; (ii) there are general type-lifting rules that provide additional higher-type meanings for expressions, so that the uniform higher-type meanings Montague posited for a given syntactic category will indeed be *among* the available meanings for all expressions of that category; and (iii) there is a general processing strategy of trying lowest types first, using higher types

Table 10.1 MG Treatment of NPs and alternatives

NP	Translation		Type
(1) John	MG: $\lambda P[P(j)]$		$\langle\langle e, t\rangle, t\rangle$
	j		e
(2) he_n	MG: $\lambda P[P(x_n)]$		$\langle\langle e, t\rangle, t\rangle$
	x_n		e
(3) every man	MG: $\lambda P[\forall x[man'(x) \rightarrow P(x)]]$		$\langle\langle e, t\rangle, t\rangle$
(4) the man	MG: $\lambda P[\exists x[\forall y(man'(y) \leftrightarrow y = x] \& P(x)]]$		$\langle\langle e, t\rangle, t\rangle$
	(i)	$\iota x[man'(x)]$	e
	(ii)	$\lambda x[man'(x) \& \forall y[man'(y) \rightarrow y = x]]$	$\langle e, t\rangle$
(5) a man	MG: $\lambda P[\exists x[man'(x) \& P(x)]]$		$\langle\langle e, t\rangle, t\rangle$
	(i)	man'	$\langle e, t\rangle$
	(ii)	Kamp–Heim: x_i	e
		cond: $man'(x_i)$, x_i "new"	
(6) dogs	(i)	Chierchia: $^\cap dog'$	e
	(ii)	Carlson, in effect: $\lambda P[P(^\cap dog')]$	$\langle\langle e, t\rangle, t\rangle$
	(iii)	dog'	$\langle e, t\rangle$

only when they are required in order to combine meanings by available compositional rules. (For example, *John* would have to be "lifted" from j to $\lambda P[P(j)]$ to interpret the conjunction *John and every woman*.) According to that proposal, *John* and he_n would have basic interpretations of type *e*, and the interpretations Montague assigned to them would be predictably available by way of a general "lifting" rule. *Every man*, however, would have only the generalized quantifier-type interpretation. This dual treatment of proper names and pronouns is one piece of the more general picture we will develop here.

In the case of definite descriptions like *the man*, there are of course many issues of pragmatics to worry about that affect the question of what belongs to the semantic content of such expressions. What I want to do is consider several possible interpretations of different types and see whether they can be related by means of general type-shifting principles; if so, that might relieve us of the burden of trying to decide which is the "right" interpretation – perhaps they all are. One alternative to Montague's generalized quantifier interpretation of *the man* is the iota-operator analysis given in (4i), of type *e*. The iota-operator combines with an open sentence to give an entity-denoting expression, denoting the unique satisfier of that open sentence if there is just one, and failing to denote otherwise. (This interpretation could also be "lifted" to a generalized quantifier interpretation different from Montague's, agreeing with that given by Barwise and Cooper (1981).) Less familiar but at least implicit in some discussions is the possibility of a predicative reading for definites,

as given in (4ii), which picks out the singleton set of (or the property of being) the unique man if there is just one and the empty set (or empty property) otherwise.

For indefinites, there again seem to be plausible interpretations of all three types: Montague's generalized quantifier interpretation incorporating an existential quantifier; an $\langle e, t \rangle$ interpretation equivalent to the bare common noun interpretation (the traditional translation of indefinites in predicate positions); and the treatment suggested in recent work of Kamp and Heim, which is not adequately represented by the rough translation into intensional logic given in (5ii) but which can, I think, fairly be said to treat indefinites as e-type variables accompanied by conditions on assignments to those variables.[4]

Bare plurals like *dogs*, in (6), were not treated at all by Montague; Carlson (1980) proposed that they be treated as proper names of kinds, and Chierchia (1982a, b, 1984) provides an enrichment of intensional logic including a nominalization operator mapping properties on to property-correlates in the domain of entities, treating the bare plural as one such nominalization.[5] Carlson's $\langle\langle e, t \rangle, t \rangle$ interpretation can then be reanalyzed in retrospect as in (6ii), as bearing the same relation to Chierchia's nominalized property $^{\cap}dog'$ as Montague's translation of ordinary proper names bears to their translation as individual constants. The simple $\langle e, t \rangle$ translation in (6iii) remains a plausible interpretation for bare plurals in predicate positions.

10.3   Evidence for Multiple Types for NPs

So far I have just enumerated a number of cases where interpretations of differing types have been proposed for various NPs, without giving many arguments that a single NP may in fact have multiple interpretations. And indeed I do not intend to try to settle the question of how many distinct interpretations any given NP has and just what they are, although I will make some suggestions. In this section I will review some evidence for the plausibility of the claim that there are NP interpretations of at least types e and $\langle e, t \rangle$ as well as $\langle\langle e, t \rangle, t \rangle$, and in what follows I will try to show how interpretations of these types can be systematically related to one another.

10.3.1   Evidence for type e

The claim that proper names are basically of type e and only derivatively of type $\langle\langle e, t \rangle, t \rangle$ hardly needs defense, and there is almost as much tradition (though more controversy) behind the treatment of singular definite descriptions as entity-denoting expressions. However, there seemed to be no harm and considerable gain in uniformity in following Montague's practice of treating these NPs always as $\langle\langle e, t \rangle, t \rangle$, until attention was turned to the relation between formal semantics and discourse anaphora by the work of Kamp (1981)

and Heim (1982). As illustrated in examples (1) and (2), not only proper names and definites license discourse anaphora, but indefinites as well; other more clearly "quantificational" NPs do not.

(1)   John/the man/a man walked in. He looked tired.

(2)   Every man/no man/more than one man walked in. *He looked tired.

The generalization seems to be that while any singular NP can bind a singular pronoun in its (c-command or f-command)[6] domain, only an *e*-type NP can license a singular discourse pronoun. The analysis of indefinites is particularly crucial to the need for invoking type *e* in the generalization, since if it were only proper names and definite descriptions which licensed discourse anaphora, one could couch the generalization in terms of the retrievability of a unique individual from the standard Montagovian generalized quantifier interpretation (an ultrafilter in those cases).

10.3.2   Evidence for type ⟨*e, t*⟩

Certain verbs appear to take ⟨*e, t*⟩ arguments; some allow only adjective phrase complements (*turn introverted*, **turn an introvert*), while others, like *become* and *consider*, allow both AP and NP complements. Particularly strong evidence for these NPs being of type ⟨*e, t*⟩ comes from their conjoinability with APs in such positions, since I assume that true constituent conjunction requires identical types and I have seen no evidence for treating adjective phrases as either type *e* or ⟨⟨*e, t*⟩, *t*⟩.

(3)   Mary considers John competent in semantics and an authority on unicorns.

Although not all verbs that seem to take ⟨*e, t*⟩ complements allow exactly the same range of NPs in such complement positions (see Reed (1982)), I will for simplicity take occurrence with *consider* as diagnostic for "predicative NPs", i.e. NPs that can have an ⟨*e, t*⟩ interpretation.

(4)   Mary considers that an island / two islands / many islands / the prettiest island / the harbor / *every island / *most islands / *this island / *?Schiermonnikoog / Utopia.

   In general, the possibility of an NP having a predicative interpretation appears to be predictable from the model-theoretic properties of its interpretation as a generalized quantifier; in fact we will argue below that *all* NPs in principle have an ⟨*e, t*⟩ interpretation, but some of them (like *every island, most islands*) yield unsatisfiable or otherwise degenerate predicates.
   Williams (1983) notes that sentences like (5) provide counterexamples to

(5)   This house has been *every color*.

the above claim. We will take up such examples in section 10.5, arguing that in
these cases the possibility of an $\langle e, t \rangle$ reading results from a language-specific
and quite idiosyncratic property of the head noun of the construction, which
affects the syntactic as well as the semantic properties of the resulting phrase.

10.4   Type-shifting: General Principles and Particular Rules

10.4.1   A general picture

While I aim to uncover considerable systematicity in the phenomenon of type-
shifting, I do not want to suggest that there is a single uniform and universal
set of type-shifting principles. There are some very general principles which
are derivable directly from the type theory, others which are quite general
but which depend on the algebraic structure of particular domains (such as
the $\langle \langle e, t \rangle, t \rangle$ domain), others which require the imposition of additional struc-
ture on the domain of entities or other domains, and still others which seem
to be language-particular rules. (Note that lexical rules of the sort discussed
by Dowty (1978, 1979) usually involve a change of type; those which employ
zero morphology may be thought of as a species of language-particular type-
shifting rules.) Even the most general type-shifting principles, such as the
"lifting" operation that maps j (type e) on to $\lambda P[P(j)]$ (type $\langle \langle e, t \rangle, t \rangle$), need not
be universal, but I would expect such a principle to be universally available at
"low cost" or "no cost" for any language that has NPs of type $\langle \langle e, t \rangle, t \rangle$ at all.[7]
Conversely, there might be type-shifting rules which are not of any formal
generality but which are universal or at least very commonly employed
because their substantive content has some high cognitive naturalness (such
as perhaps the rule which turns proper names into common nouns denoting
a salient characteristic, as in "He's a real Einstein"). The general picture I
will sketch below will focus on formally definable type-shifting principles
which I believe are linguistically exploited in English and at least potentially
universal; I believe this perspective might be helpful for studying semantic
universals and typology, but I have not carried out any serious cross-linguistic
study.

   In figure 10.1, the circles represent the three model-theoretic domains D_e,
$D_{\langle e, t \rangle}$, and $D_{\langle \langle e, t \rangle, t \rangle}$, labelled by their types, and the arrows represent mappings
between them, operations which map objects in one domain on to correspond-
ing objects in another domain. I will say more about some of them below;
others will be discussed in subsequent sections.

   I should note here that while my focus in this paper is on type-shifting
operations that can map NP-meanings onto other meanings for those same
NPs, the same operations can of course be involved in rules which relate
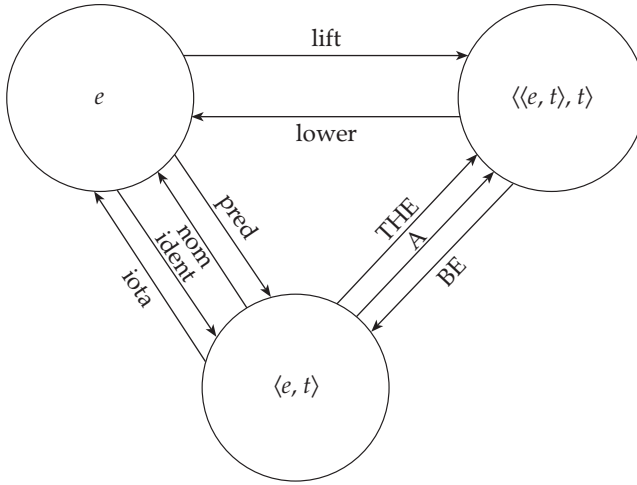
Figure 10.1

Notes:

lift:	$j \to \lambda P[P(j)]$	total; injective
lower:	maps a principal ultrafilter on to its generator;	partial; surjective
	$lower(lift(j)) = j$	
ident	$j \to \lambda x[x = j]$	total; injective
iota:	$P \to \iota x[P(x)]$	partial; surjective
	$iota(ident(j)) = j$	
nom:	$P \to {}^{\cap} P$ (Chierchia)	almost total; injective
pred:	$x \to {}^{\cup} x$ (Chierchia)	partial; surjective
	$pred(nom(P)) = P$	

expressions in distinct syntactic categories as well. In particular, I consider $\langle e, t \rangle$ a "marked" type for full NPs in English (as opposed to the "unmarked types" e and $\langle \langle e, t \rangle, t \rangle$); it is the "unmarked" type for common noun phrases and verb phrases, and one of the possible types for adjective phrases and prepositional phrases, so we should not be surprised if the type-shifting operations mapping to or from type $\langle e, t \rangle$ show up even more in rules relating NPs to expressions of other categories than in rules providing multiple meanings for single NPs. On the other hand, not all languages make as clear a syntactic distinction between NPs and CNs as English does, and the naturalness of some of these type-shifting operations may help to account for that fact.

Many of the mappings come in pairs which are inverses. For example, the operation *lift*, which has been mentioned before, has an inverse *lower*. *Lift* maps any entity *a* on to the principal ultrafilter generated by *a*; in IL terms, it maps (the denotation of) j on to (the denotation of) $\lambda P[P(j)]$; in set-theoretic terms, it maps *a* on to $\lambda X[a \in X]$. *Lift* is total and injective ("into"). Its inverse, *lower*, is partial and surjective ("onto"), mapping any principal ultrafilter

onto its generator. So *lower*(*lift*(*a*)) = *a*, and if *lower* ($\wp$) is defined, *lift*(*lower* ($\wp$)) = $\wp$.[8]

The pair *ident* and *iota* are similarly inverses. *Ident* is the total, injective operation mapping any element onto its singleton set; in IL terms, it maps j onto λx[x = j]. *Iota* is its partial surjective inverse, mapping any singleton set onto its member; in IL, augmented by the iota operator, it maps P onto ιx[P(x)]. (In an intensional system, we would want in addition or instead a version of *ident* mapping an entity onto the *property* of being that entity, and a version of *iota* mapping a property onto the unique individual having that property, if there is indeed just one, and undefined otherwise. In either case we would have *iota*(*ident*(*a*)) = *a* and, when defined, *ident*(*iota*(P)) = P.)

The other pair of mappings between *e* and ⟨*e*, *t*⟩, *nom* and *pred*, are extensional misrepresentations of the operators "∩" and "∪" from Chierchia (1984).[9] *Nom* maps properties onto their entity-correlates if these exist (the Russell property, for instance, will be acceptable as a predicate but will not have any entity-correlate); this is the operation which on Chierchia's analysis is involved in nominalizing the common noun *dog* to form the bare plural *dogs* and the adjective *blue* to the proper noun *blue*, and in the formation of infinitives and gerunds from verb phrases. It is "almost" total, applying to all "ordinary" properties at least, and injective. Its inverse, *pred*, applies to those entities which are entity-correlates of properties, and returns the corresponding property. *Pred* is partial and "almost" surjective. Where defined, *nom* and *pred* are inverses. We will make use of these operators in our analysis of the Williams counterexample.

These three pairs of operators illustrate the heterogeneity of type-shifting principles I alluded to at the beginning of this section: *lift* is a matter of simple combinatorics that falls directly out of the type theory, and would have an analogue between types *a* and ⟨⟨*a*, *b*⟩, *b*⟩ for any *a* and *b*. *Lower* is not independently definable in combinatoric terms since it does not apply to the whole of the higher domain, but is definable as the inverse of *lift* or independently in terms of generators of ultrafilters. *Ident* and *iota* are not merely combinatorial but are still "formal" insofar as they do not depend on any particular assumptions about the domain D_e. *Nom* and *pred* are more "substantive" in that they depend on the inclusion of properties or property-correlates among the entities.

There is also room for considerable diversity in how natural languages make use of such type-shifting principles, encoding them with lexical items (*iota* might be a candidate meaning for the definite article), via lexical rules (*nom* or *pred* for the rule relating *blue* as adjective to *blue* as proper noun, depending on which one takes as basic), syntactic rules (*nom* for the formation of bare plurals), or not encoding them at all (e.g. if *lift* is universal for proper nouns.) I will return to these linguistic issues at various points below. I should note here that *lower* is not necessarily part of the grammar of English at all, but is useful in the metatheory for predicting which NPs have *e*-type readings from their generalized quantifier interpretations.

10.4.2   Sample application: *the king* in all three types

By the criteria presented in section 10.2, singular definite descriptions like *the king* can occur in all three types.[10] Figure 10.2 shows mappings that could provide a possible account of this distribution and of the slight differences in meaning and presupposition that accompany the three uses. (The reader can fill in the caveats needed here about the wealth of research these suggestions need to be tested against and integrated with, etc.) Solid lines indicate total functions, dotted lines partial ones.

  Four of these mappings were described in the previous section: *lift*, *lower*, *ident*, and *iota*. *THE* is the total function which maps any set Q onto the generalized quantifier given by Montague's syncategorematic interpretation rule for the introduction of *the* (see entry (4) in table 10.1). In subsequent work in Montague grammar, this operation is usually assigned as the meaning of the determiner *the* itself; it is expressed in IL as $\lambda Q\lambda P[\exists x[\forall y[Q(y) \leftrightarrow y = x]$ & $P(x)]$; in languages lacking an overt definite article, one would have to look for grounds for choosing between a syncategorematic treatment and the positing of a zero definite article. Since *THE* is a total function, there are no presuppositions required for the use of definite descriptions as generalized quantifiers.[11] If there is a unique king, *THE(king')* denotes the set of all his properties; otherwise it denotes the empty set of properties, so that any sentence in which *THE(king')* has maximal scope comes out simply false. *Iota(king')*, on the other hand, is defined iff there is one and only one king; if we assume that *e* is the unmarked type for subject position,[12] and the preferred type for arguments of extensional verbs generally, this would help to explain the strong but not absolute preference for taking existence and uniqueness as
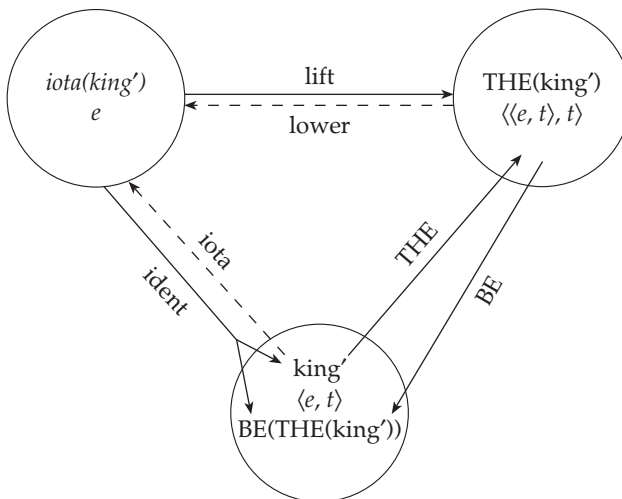
Figure 10.2

presuppositions rather than as part of the content in subject and other argument positions.

So far, we have a contrast between an *e*-type meaning *iota(king')* and an $\langle\langle e, t\rangle, t\rangle$ meaning, *THE(king')*, traceable to two alternative meanings for *the*, namely *iota* and *THE*. These are related to each other by the fact that whenever *iota* is defined, i.e. whenever there is one and only one king, *lift(iota(king'))* = *THE(king')* and *lower(THE(king'))* = *iota(king')*, and furthermore whenever *iota* is not defined, *THE(king')* is vacuous in that it denotes the empty set of properties. *(THE(king')* will generally have a non-vacuous intension, of course, which is presumably why it is useful to have a presuppositionless version of definite descriptions.)

Now what about a possible predicative ($\langle e, t\rangle$) reading for *the king*? Suppose we start with the $\langle\langle e, t\rangle, t\rangle$ reading *THE(king')*. We know that one way of getting from a denotation of type $\langle\langle e, t\rangle, t\rangle$ to one of type $\langle e, t\rangle$ is to apply the function denoted by Montague's PTQ translation of English *be*, $\lambda\wp\lambda x[\wp(\lambda y[y = x])]$. This is the function called BE in the figure; I will say more to argue for its "naturalness" in the next section. For now let me just present the suggestion that we treat this operator not as the meaning of the word *be* but as a type-shifting functor that we apply to the generalized quantifier meaning of an NP whenever we find the NP in an $\langle e, t\rangle$ position.[13] The English *be* itself, I will suggest (following Williams (1983)), subcategorizes semantically for an *e* argument and an $\langle e, t\rangle$ argument, and has as its meaning "apply predicate", i.e. $\lambda P\lambda x[P(x)]$. This pair of proposals gives the same result as Montague's for phrases like *be the king, be a man, be John*, but distributes the meaning among the parts differently, in such a way that we now have a predicative reading for NPs in positions other than after *be* (which Montague's treatment did not provide), and we can now have the same *be* occurring with NPs and with predicates of other syntactic categories. I think this is an important advantage and will say more about it in later sections; let's return now to the implications of this proposal for the predicative reading of *the king*, which can be defined as *BE(THE(king'))*.

In IL terms, *BE(THE(King'))* works out to be $\lambda x[king'(x) \ \& \ \forall y[king'(y) \rightarrow y = x]]$, or equivalently, $\lambda x[\exists y(king'(x) \leftrightarrow x = y)]$. This gives the singleton set of the unique king if there is one, the empty set otherwise. Since both *BE* and *THE* are total functions, this is always available as a possible $\langle e, t\rangle$ reading of *the king*; no presuppositions are required. Note that if there is *at most* one king, *king'* = *BE(THE(king'))*, i.e. this predicative reading of *the king* is the same as the common noun *king* in that case, since both pick out the empty set if there is no king and a singleton set if there is exactly one king. The fact that the common noun and the predicative definite description agree modulo this "at most one" presupposition may help explain why in English the definite article is sometimes but not always optional in predicative constructions, as illustrated in (6).

(6)a.   John is {the president / president}
   b.   John is {the teacher / *teacher}

It appears that the definite article is optional in such constructions just in case the presupposition that there is at most one such-and-such in any context is virtually built into the language, so that the conditions for the equivalence of predictive *the president* and *president* can generally be taken for granted. While this somewhat functional account may help to explain the contrast between (6a) and (6b), it cannot be taken as a predictive explanation, since as we will see in the next section, predicative *in*definites like *a man* are always fully equivalent to the common noun, so it would seem even more natural for a language to omit redundant indefinite articles, as in French, than redundant definite articles.

The double-headed arrow on the *ident* mapping reflects the fact that for *iota* to be defined there must be one and only one king, hence *king′ = BE(THE(king′)) = ident(iota(king′))*. In fact, when *iota* is defined, the diagram is fully commutative: *king′ = BE(THE(king′)) = ident(iota(king′)) = ident(lower(THE(king′))) = BE(lift(iota(king′)))*, etc. This property of the mappings lends some formal support to the idea that there is a unity among the three meanings of *the king* in spite of the difference in type. There are of course alternatives that should be considered; the diagram would also be commutative if we replace the total function *THE* by a partial function identical to the composition *lift · iota*, so that there would be the same presuppositions for the meanings in every type, and no reading of *the king* lacking those presuppositions. I tend to believe there *is* a presuppositionless reading, but I doubt that clear arguments can be found within a purely extensional sublanguage.

10.4.3   A and BE as "natural" type-shifting functors

When we consider possible functions mapping from $\langle e, t \rangle$ to $\langle \langle e, t \rangle, t \rangle$, the obvious candidates are all the determiners, since that is exactly their type. Natural language data suggest that *a* (and plural *some*) and *the* are particularly natural, since they are often not expressed by a separate word or morpheme but by constructional features, or not expressed at all. Sometimes definites are marked but indefinites unmarked. Determiners like *every*, *many*, *most*, and numerals are always expressed by a word or morpheme, as far as I know. Sometimes an indefinite article is overt in referential positions, unexpressed in predicative positions. Can we find formal backing for the intuition that what *a* and *the* denote in English are particularly "natural" type-shifting functors? We have already done this to some extent for *the*; here we will consider *a*, and also strengthen the case for the naturalness of the functor *BE* introduced in the previous section.

Let *A* be the categorematic version of Montague's treatment of *a/an*: in IL terms, $\lambda Q[\lambda P[\exists x[Q(x) \& P(x)]]]$. We will focus first on the naturalness of *BE*,[14] then argue that *A* is natural in part by virtue of being an inverse of *BE*.

Fact 1:   *BE* is a homomorphism from $\langle \langle e, t \rangle, t \rangle$ to $\langle e, t \rangle$
viewed as Boolean structures, i.e.:

$$BE(\wp_1 \sqcap \wp_2) = BE(\wp_1) \sqcap BE(\wp_2)$$
$$BE(\wp_1 \sqcup \wp_2) = BE(\wp_1) \sqcup BE(\wp_2)$$
$$BE(\neg \wp_1) = \neg BE(\wp_1)$$

Fact 2: *BE* is the unique homomorphism that makes figure 10.3 commute. (There are other homomorphisms, and other functors that make the diagram commute, but no others that do both.)[15]

What exactly does *BE* do? Perhaps more perspicuous than Montague's IL formulation is its expression in set-theoretical terms: $\lambda \wp[\lambda x[\{x\} \in \wp]]$. That is, it applies to a generalized quantifier, finds all the singletons therein, and collects their elements into a set. The commutativity of figure 10.3 is then straightforward, since a generalized quantifier obtained by applying *lift* to an entity *a* will contain just one singleton, $\{a\}$. And as Keenan and Faltz (1978, 1985) showed, the full $\langle\langle e, t\rangle, t\rangle$ domain can be generated by applying Boolean operations to generalized quantifiers of that special sort (the "individual sublimations", in the terms of Dowty, Wall and Peters (1981).) So *BE* does indeed seem to be a particularly nice, structure-preserving mapping from $\langle\langle e, t\rangle, t\rangle$ to $\langle e, t\rangle$.

The semantic naturalness of the *BE* operator is of course independent of whether we take it to be the meaning of English *be*, analyzed as a transitive verb taking $\langle\langle e, t\rangle, t\rangle$ objects as in PTQ, or, as I proposed above, treat it as a (potentially universal) operator that is always available to turn an $\langle\langle e, t\rangle, t\rangle$ meaning into an $\langle e, t\rangle$ meaning. The choice between the analyses will depend heavily on syntactic considerations. In either case, *BE* is a total function, so we still have to explain why some NPs don't occur naturally after *be* or in other predicative positions. The explanation is that although *BE* is total, and preserves important structure of the $\langle\langle e, t\rangle, t\rangle$ domain, it also ignores a lot of structure by looking only at the singletons in any generalized quantifier. *Most men*, for instance, will never contain any singletons, so *be most men* will always be empty; similarly for distributive readings of plurals like *two men*, *several men*, etc.
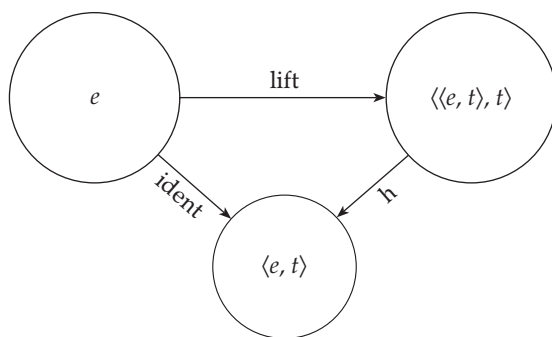
Figure 10.3

(Group readings of such plurals yield good predicative readings, which is predicted if groups or plural individuals are treated as entities, as in Link (1983).) *Every man* contains a singleton only if there is just one man; although it is probably too strong (certainly among logicians!) to claim that *every* presupposes "more than one", one and zero are degenerate cases, usually included only for the sake of generality, and to use *every man* predicatively you would have to *know* you were dealing with a degenerate case, in which case *the* or *the only* would be appropriate and more straightforward. Note that BE(no man') = not(BE(a man')); English seems to prefer the latter construction, Dutch the former, although I don't think either would be declared ungrammatical in either language.

In general it seems that the NPs that yield sensible predicative readings fall into two categories: those formed with "weak" determiners (Milsark (1977), Barwise and Cooper (1981)), which are intuitively the indefinites, and definite singular NPs. In the former case the predicative reading is tantamount to stripping A off the generalized quantifier reading and leaving the common noun meaning (since BE and A are inverses); in the case of definite singulars, the extensionality of the system discussed here would make the predicative reading tantamount to applying *ident* to the corresponding entity, probably an unsatisfactory analysis.[16]

Having established the naturalness of BE as a type-shifting functor from $\langle\langle e, t\rangle, t\rangle$ to $\langle e, t\rangle$, one question that springs to mind is: For what possible DET meanings is it true that $BE(DET(P)) = P$?[17] One answer is A, as is familiar from the fact that in PTQ, (*be a man*)' comes out equivalent to *man*'; hence A meets one reasonable condition for naturalness by virtue of being an inverse of BE. (But *exactly one* is also an inverse for BE; the general requirement is that the singleton sets contained in DET(P) must be all and only the singletons of elements of P.)

Two other potentially significant properties of A are that it is symmetric and is monotonically increasing in both arguments; I conjecture that these are both "nice" properties. That's a vague claim, but I would expect to see it borne out in order of acquisition and in cross-linguistic distribution of determiners and of any other functor categories for which those properties are definable. The properties certainly distinguish A from *exactly one*, which has neither of them.

I would conjecture, in fact, that among all possible DET-type functors. A (which combines English *a* and *some*) and THE are the most "natural" and hence the most likely to operate syncategorematically in natural languages, or not to be expressed overtly at all, and that BE is the most "natural" functor from $\langle\langle e, t\rangle, t\rangle$ meanings to $\langle e, t\rangle$ meanings. On the formal side, this requires finding and arguing for further formal criteria for what makes a functor "natural", and showing that A, THE, and BE score high under such criteria. On the linguistic side, I would expect to see further evidence that the semantic force of A, THE and BE is often carried by constructional rather than lexical meaning.[18]

10.4.4   Mappings to and from type *e*

In Montague's *PTQ*, no English expressions were analyzed as type *e*; on our approach, there is still no syntactic category uniformly interpreted as type *e*, but many NPs have type *e* interpretations as one of their possible interpretations. Lexical NPs, proper nouns and singular pronouns may be basically of type *e* and acquire $\langle e, t\rangle$ and $\langle\langle e, t\rangle, t\rangle$ meanings by *ident* and *lift* respectively. Non-lexical NPs with *e*-type interpretations are probably most easily accounted for as resulting from type-shifting operations applied to initially higher type interpretations, although it is possible that type-lowering has become grammaticized so that, for instance, *the* may have an interpretation as *iota* as well as (or instead of) an interpretation as *THE*. (It may not be easy to find arguments to decide whether the *e*-type interpretation of *the king* is best analyzed as *iota(king′)* or as *lower(THE(king′))*.) We have already mentioned several mappings to and from type *e: lift* and *lower*, *ident* and *iota*, *nom* and *pred*. In this section we will say a bit more about *lower*, and particularly about the Kamp–Heim treatment of indefinites as type *e*. Then we will suggest that the type-shifting perspective fits well with recent proposals by Link and others for the treatment of mass and plural noun phrases using model structures which impose additional structure on various subdomains of the domain of entities.

10.4.4.1   *Lower and indefinites*.   As described in section 10.4.1, *lower* applies to any generalized quantifier which is a principal ultrafilter and maps it on to its generating element in the *e* domain. This accounts for *e*-type readings of definite singular NPs like *the king, this dog, Bill's car* (and *John* and *he*, if these are not directly generated as type *e*.) It does not directly give *e*-type readings for definite plurals like *those three men*, a principal filter whose generator is a set, nor to indefinite singulars like *a man*, which on their standard treatment are not principal filters at all. The former case will be taken up when we discuss Link's treatment of plurals, the latter right now.

   While Kamp's and Heim's proposals for the treatment of various kinds of noun phrases and anaphora suggest rather far-reaching changes in the semantic framework, Zeevat (1989) has recast central parts of their proposals in terms that help to localize the major innovations around the treatment of free variables and the mechanisms of variable-binding. Using Zeevat's notation, an "indexed indefinite" like [*a man*]$_n$ can be translated as in (7),

(7) $\lambda P[P(x_n^*) \wedge man'(x_n)]$

where the asterisk is a diacritic that plays a role in the non-standard rules for variable-binding. Alternatively, it could be translated as $\lambda P[P(x_n^*)]$ plus the condition $man'(x_n)$, if the condition is treated as a separate clause as in Heim (1982). In either case, as Heim has emphasized, the removal of the existential

quantifier from the interpretation of indefinites makes their meanings much more like pronoun meanings, and apart from the complication that we are here dealing with variables, the meanings are similar to proper noun meanings like $\lambda P[P(j)]$, and *lower* can apply to give *a man* an *e*-type reading x_n^* (together with the condition $man'(x_n)$).[19]

10.4.4.2   *Plurals and mass noun phrases.*   Link (1983) proposed additional structure within the domain of entities, including the recognition of a subdomain of "plural individuals" and a subdomain of quantities of matter, each with a certain amount of Boolean structure and with a mapping from the former to the latter; in terms of this structure Link is able to solve a number of puzzles in the semantics of plurals and mass nouns. To integrate his structure with the perspective suggested here, we can see that there is a natural pair of mappings relating Link's plural individuals in the *e* domain to sets of ordinary individuals, in the $\langle e, t \rangle$ domain; let us call these mappings *link* and *delink*, as in figure 10.4.

   Then $link(\{a, b\}) = a \oplus b$; $delink(a \oplus b) = \{a, b\}$. *Link* is total (singleton sets map on to the single individuals which are the atoms of the plural-individual structure) and injective; *delink* is partial and surjective.

   With this possibility of easy shifting between the group (individual) perspective and the set perspective, we can readily generate *e*-type readings of definite plurals like *the three men*, in fact via several equivalent routes. If we start with a distributive reading like Barwise and Cooper's, taking the generator set of the principal filter (a new operation we call *genset*) would get us a set of (the) three men, whence *link* would get us a plural individual. Starting with the kind of group reading provided by Link, we could apply *lower* directly to get the same plural individual.

   The behavior of the cardinals *two, three, . . .* can probably also be illuminated on this perspective; briefly, I would suggest that the primary interpretation of *three* is as an $\langle e, t \rangle$ adjective applying to plural individuals (here it means "exactly three"), which can be promoted to an $\langle \langle e, t \rangle, \langle e, t \rangle \rangle$ prenominal (intersective) adjective by standard techniques. Then either by composition with *A* or by the Kamp–Heim treatment of indefinites it can become a
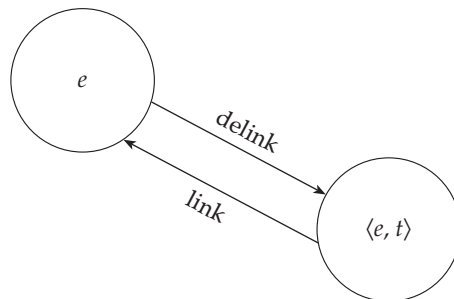
Figure 10.4

determiner (group reading), picking up the explicit or implicit existential quantifier which would account for the "at least" reading normally associated with cardinal determiners. Lastly, the *delink* operation could naturally be extended to a corresponding operation on all "group" determiners to yield corresponding distributive determiners; an analogous operation was proposed in Michael Bennett's dissertation (Bennett 1974).

Pelletier and Schubert (1989) discuss a wide range of problems in the syntax and semantics of mass expressions and provide an excellent critical survey of suggested solutions, offering some new proposals of their own. Drawing in part on the work of Link and of Chierchia discussed here, as well as earlier work by Parsons, Pelletier, ter Meulen and others, they sketch several alternative approaches which make use of implicit semantic operations. Some of these operators perform type-shifting operations, others have what we might call 'sort-shifting' effects within a single type; as noted earlier, the distinction is a very theory-dependent one that we don't wish to lay any emphasis on here. Much of the heaviest debate in the mass noun literature concerns the semantics of predicative mass expressions and the question of what they are true of: ordinary objects, quantities of matter, and/or substances or kinds. Pelletier and Schubert show how one can take various positions both on the number and nature of the ontological distinctions made in the model and on the number and nature of discrete senses of mass predicates relative to a given ontological background. A number of the proposals they describe involve sort-shifting operators which convert, for example, a mass predicate true of kinds (as in 'Red wine is *wine*') into one true of objects or quantities of matter (as in 'The puddle on the floor is *wine*') or vice versa. Their own proposals suggest the desirability of letting the 'unmarked' or default case for mass predicates be that a given mass predicate such as *beer* can apply indifferently to entities of a number of different sorts: quantities of beer, kinds of beer, conventional servings or kinds of servings of beer; objects coincident with or constituted by quantities of beer, and involving what we might call 'sort-restricting operators' as part of the semantics of constructions which limit the applicability of the predicate to some proper subset of these cases; these can be viewed as a special kind of sort-shifters which take a more general sort on to a subsort. Such a possibility does not exist for type-shifting operators in a type theory like Montague's but would in some more general theories of types and is therefore an interesting potential addition to the inventory of natural type-shifting operations.

Pelletier and Schubert, following Chierchia, also propose type-shifting operators converting mass predicates (typically expressed as common noun phrases) of these various sorts to mass terms denoting substances (typically expressed as determinerless full NPs) and vice versa. As in Chierchia, these are basically the same *nom* and *pred* operators that apply in the semantics of bare plurals and other nominalization phenomena.

And of course the ease of shifting between mass and count senses of the same common noun phrase has long been noted and illustrates the existence

of other apparently very natural short-shifting operations that may or may not be grammaticized in different languages: count to mass via the Pelletier/Lewis "universal grinder" (put in a chair and you end up with chair all over the floor); mass to count with either a "conventional portion of" or "kind of" interpretation.

10.4.4.3 *Structure in the* e *domain.* All of the operations *nom* and *pred*, *link* and *delink*, and analogs for mass terms depend on the existence of richly structured subdomains in the domain of entities; these structures can be seen to be taking over some of the work previously done by the type theory. More of the same sort of shift can be seen in proposals for the semantics of comparatives which treat "degrees" as entities, and in proposals for an event-based ontology in which events are also entities. First-order theories put virtually *all* of the burden on structure internal to the entity domain; Chierchia (1984) argues that linguistic evidence favors a semantics which is at least second-order but not a fully recursive type system like Montague's. This kind of investigation of trade-offs between strongly typed systems and less strongly typed systems with multiple subsorts of entities is also being carried out in the domain of programming languages; see Goguen and Meseguer (1984), Meseguer and Goguen (1984) and Futasugi et al. (1985).[20] It is partly because this kind of study opens up so many possibilities that have not been explored that I feel in no position to argue for a "best" way of analyzing particular constructions.

In closing this section, let me note that there remain NPs for which none of our operations provide *e*-type readings; these, not surprisingly, are the ones traditionally thought of as most clearly "quantificational": *no man*, *no men*, *at most one man*, *few men*, *not every man*, *most men*.[21] *Every man* could get an *e*-type reading via *lower* in case there is only one man; but linguistically it never seems to act as a singular "referential" term, suggesting again (cf. section 10.4.3) that it is at least pragmatically anomalous to use *every* in a way that constrains it to just one. Such NPs can occur in *e*-type positions only by "quantifying in", which would account for the traditional distinction between them and "referring expressions". On the perspective advanced here, we can capture such traditional distinctions without giving up the unification achieved by Montague's work, which we still need in order to account for the possibility of conjunctions like "King John and every peasant", which would be inexplicable on an analysis which captured only the differences and not the common $\langle\langle e, t\rangle, t\rangle$ structure.

10.5 The Williams Puzzle

Anticipating the kind of proposal put forward in section 10.4.3, Williams (1983) argued that the possibility of $\langle e, t\rangle$ readings for NPs can *not* be predicted from the determiner, citing examples like (8), where virtually any determiner can occur.

(8)   This house has been every color.

I believe this apparent counterexample and others like it can be explained in
terms of the idiosyncratic and language-particular behavior of the head noun.
In English (but not e.g. in Dutch) many "attribute" nouns allow this kind of
construction: *color*, *size*, *length*, *weight*, *age*, *price*. A relatively "tolerant" context
which accepts such nouns rather easily is "This dress is the wrong—", a more
restrictive one is in the use of these "attribute NPs" as postnominal modifiers,
as in (9), where grammaticality judgments are my own – there appears to
be considerable individual variation on judgments about particular words,
reinforcing the idea that this is a quite idiosyncratic lexical property.

(9)   a dress that size / that color / that length / that price /
        *that material / *that design / ?that pattern / *that origin.

In this construction we have a predicative ($\langle e, t \rangle$) use of an NP that does not
correspond to the result of any of the type-shifting operations we have seen so
far. To see what's going on semantically, consider the following pattern:

(10)a.   This shirt is blue.
    b.   Blue is a nice color.
    c.   This shirt is a nice color.

In (10a), *blue* is an adjectival predicate ($\langle e, t \rangle$), predicated of the shirt. In (10b),
we have the nominalized property *blue*, type e, and the expected $\langle e, t \rangle$ pre-
dicative use of *a nice color*; the entities in the extension of *color* are colors:
blue, red, green, etc. – not shirts. Semantically, (10c) is quite different from
(10b), and amounts to something like a combination of (10a) and (10b) with
the color unspecified. Many languages do not allow this kind of predication
to be expressed with a simple noun phrase but require the equivalent of (11a)
or (11b) below, construction types which also occur with some attribute nouns
in English.

(11)a.   This shirt is of a nice color.
    b.   This shirt has a nice color.

The possibility of using bare NPs as predicates in this way in English is reminis-
cent of the adverbial use of NPs studied by Larson (1985), which is also quite
idiosyncratic: *that day*, *that way*, *that manner*.
    The crucial formal tool that allows a straightforward account of this special
predicative use of attribute NPs is Chierchia's nominalization theory, which
relates predicative properties like *blue* as in (10a) to their type e nominalizations
as in (10b). Although Chierchia's theory takes properties as (intensional) prim-
itives, I don't think it does any harm here to misrepresent the predicative
property as type $\langle e, t \rangle$ for ease of exposition.

If we take adjectival *blue*, $\langle e, t \rangle$, as basic, the *e*-type proper noun *blue* can be translated in Chierchia's system as $^\cap blue'$; if we take the *e*-type noun as basic, the adjective is $^\cup blue'$; in either case the two are related by those inverse operators, the ones we called *nom* and *pred* in section 10.4.1. Recall that *pred*, or "$^\cup$", is defined only for entities which are the "entified" counterparts of properties.

Color is a common noun, its type $\langle e, t \rangle$; entities in its extension are, as noted above, properties (*blue*, *red*, etc.). This is the semantic content of what I mean by "attribute noun": these nouns express properties of properties. In addition to knowing this semantic fact about the noun *color*, we must encode with a diacritic syntactic feature – say, +A – the syntactic difference between "adjectival" attribute nouns like *color*, *size*, *weight* and *age* which do fit into constructions like those in (8), (9), and (10c) and other attribute nouns like *property*, *virtue*, and *origin* which do not. The combining stem *-thing* can function as a +A attribute noun, as in the frequently puzzled-over construction in (12).

(12)   He is everything I hoped he would be (intelligent, non-sexist, vegetarian, etc.)

I am not sure what to call the syntactic category of this special predicative use of attribute NPs; here I will assume that they belong to a syntactic category *Pred* (semantic type $\langle e, t \rangle$) which includes predicative adjective uses of NPs, since these special attribute NPs can occur in constructions where other predicative NPs cannot, such as postnominal position as in (9) and in *there*-constructions as in (13) below (on some analyses these are the same fact):

(13)a.   There's nothing here a good color.
     b.   There's no one here the right age.
     c.   *There's no one here a good teacher.
     d.   *There's nothing here the right answer.

To complete the analysis, I need just one syntactic and semantic rule and a couple of uncontroversial assumptions. The first assumption is that any NP whose head noun has the feature +A also has the feature +A; this follows from most theories of feature inheritance.[22] The second is that the rule of quantifying-in[23] quantifies generalized quantifiers into *e*-type positions only, not into $\langle e, t \rangle$ positions. I will also assume a pro-form *that*_i as an *e*-type +A variable over (entified) properties; this corresponds to the use of *that* discussed by Ross (1969), illustrated in (14).

(14)   They said she was beautiful and {that she was / she was that}

The syntactic and semantic rule for attribute predicates can be formulated as follows:

Attribute Predicate Rule
Syntactic Rule: If [$_{NP}\alpha$] is +A, then [$_{Pred}$[$_{NP}\alpha$]] is a Pred.

Semantic Rule: If [$_{NP}\alpha$] translates as α', then [$_{Pred}$[$_{NP}\alpha$]] translates as $^{\cup}\alpha'$.

Note that the semantic rule is defined only for NPs of type *e* and turns them into $\langle e, t \rangle$ predicates; so this rule applies to attribute NPs like *that color*, *the color Mary liked best*, *a color I once saw in a sunset*, *two colors* (group reading), and the pro-form *that*$_i$, which all have *e*-type readings via the general principles discussed earlier, but not *every color*. The generalized quantifier reading of +A NPs is just like that of any other NP, and no special rules apply to them; we only need assume that only a +A NP can be quantified into a +A position. We can now illustrate the syntactic derivation and semantic interpretation of Williams's example (8).

(15)   (10) This house has been every color

(9) [every color]$_{NP}$ (8) this house has been [$_{Pred}$[$_{NP}$ that $_i$]]

(7) this house   (6) has been [$_{Pred}$[$_{NP}$ that $_i$]]

(5) has   (4) be [$_{Pred}$[$_{NP}$ that $_i$]]

(3) be   (2) [$_{Pred}$[$_{NP}$ that $_i$]]

(1) [$_{NP}$ that$_i$]
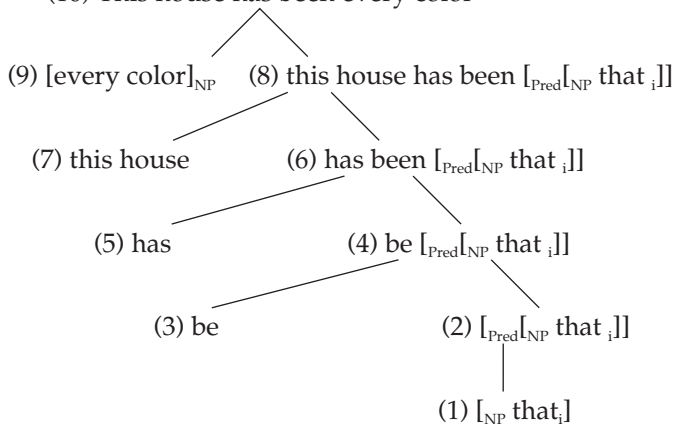
(1) x_i (type *e*)
(2) $^{\cup}x_i$ (type $\langle e, t \rangle$)
(3) $\lambda P \lambda x[P(x)]$
(4) $\lambda P \lambda x[P(x)](^{\cup}x_i) \dashrightarrow \lambda x[^{\cup}x_i(x)]$ (type $\langle e, t \rangle$)
(5) $\lambda Q \lambda y[H(Q(y))]$ (here H is a past operator)
(6) $\lambda Q \lambda y[H(Q(y))](\lambda x[^{\cup}x_i(x)]) \dashrightarrow \lambda y[H(^{\cup}x_i(y))]$ (type $\langle e, t \rangle$)
(7) h_1 (type *e*; I ignore the internal structure of this NP here)
(8) $\lambda y[H(^{\cup}x_i(y))](h_1) \dashrightarrow H(^{\cup}x_i(h_1))$
(9) $\lambda P[\forall x[color'(x) \rightarrow P(x)]]$
(10) $\lambda P[\forall x[color'(x) \rightarrow P(x)]](\lambda x_i[H(^{\cup}x_i(h_1))]) \dashrightarrow$
        $\forall x[color'(x) \rightarrow [H(^{\cup}x(h_1))]$

The last line gives the desired interpretation: for all x, if x is a color, at some time in the past this house has had the property $^{\cup}x$, the predicative version of the property x.

Semantically, this analysis depends heavily on Chierchia's treatment of nominalization; syntactically, it depends on having a syntactic derivation in which the *e*-type NP position contained within the derived Pred remains accessible to quantifying in, since I assume one cannot generally quantify into $\langle e, t \rangle$ positions. I believe that the same principles account for the exceptional relativization out of predicate position exemplified in (12).

A similar approach might account for another kind of case of quantified NPs appearing in predicate position, as in (16).

(16)   Olivier has been every Shakespearean king.

Here we have an ordinary noun as head, and various treatments are possible, depending on what one considers the best analysis of sentences like (17).

(17)   Olivier is Richard III.

If one analyzes both NPs as *e*-type, either treating this *is* as "is playing" or by admitting a *be* of identity, then this isn't really a predicative position and quantifying in is to be expected. I would suggest that we have the same *be* here as elsewhere, and that Richard III as a role is a non-rigid individual concept of (type $\langle e, t \rangle$) (see Janssen (1984) for related discussion), which can be turned into a predicate nominal, in this case [$_{\text{PNOM}}$[$_{\text{NP}}$Richard III]], interpreted as $\lambda x[x = {}^\vee r]$. However, unless we map "roles" as individual concepts back into the entity domain in a move analogous to Chierchia's, we would still need to give a non-standard type analysis to *every Shakespearean king*.

10.6   English *Be*

In section 10.4.2 above we suggested that the semantic operation we called *BE* should be treated not as the meaning of English *be* but as a type-shifting functor freely applicable to generalized quantifier meanings of NPs to yield predicative readings for those NPs. We suggested further, following Williams (1983), that English *be* subcategorizes semantically for an *e* argument and an $\langle e, t \rangle$ argument, with a meaning paraphrasable as "apply predicate". (This treatment of *be* was adopted in the derivation (15) of example sentence (8).) We may want to say further that *be* imposes no sortal restrictions of its own, requiring that its $\langle e, t \rangle$ argument be predicable of its *e* argument. Depending on how inclusive the *e* domain is, one may want to go further and call *be* genuinely polymorphic, taking one *X*-type and one $\langle X, t \rangle$-type argument, for any type *X*.

If we accept Williams's argument that the arguments of *be* may occur in either order, we get the added benefit of automatically generating both readings of ambiguous pseudoclefts; this is discussed further in Partee (1986). An appropriate treatment of this "semantic transparency" of *be* should also be

able to account for cases of control phenomena and other instances of "syntactic connectedness" (Higgins 1973) across *be*, provided the control phenomena are treated semantically; but this is a suggestion in need of considerable work before it becomes a serious proposal.

It may be going too far to think of *be* as making no semantic contribution of its own, although this is a fairly traditional view. On the proposals just sketched, there would be no difference in meaning at all between *cat* and *be a cat*, *asleep* and *be asleep*, etc. While this is also true of Montague's treatment and of most proposals that are expressible in first-order logic, it seems questionable. One should consider in this regard the insightful work of Stump (1985), who assigns to *be* a kind of sort-shifting meaning, turning predicates of stages (G. Carlson ontology) into predicates of individuals but otherwise still semantically transparent.

The syntax and semantics of the copula in English and other languages is of course a vast subject which I can't hope to do justice to in a few paragraphs. But it does seem promising that the present approach allows a treatment of *be* that accords well with traditional views suggested by the word *copula*, preserving the positive aspects of Montague's treatment of the *be + NP* construction while unifying that construction with other kinds of *be + Pred* construction.

10.7   Conclusions

Much work remains to be done to determine the appropriate way to incorporate the kinds of operators studied here into a theory of grammar. I have said very little about syntax or about constraints on the mapping of syntax to semantics in this paper. Most of the emphasis has been on the exploration of certain kinds of operations which I believe are at work somewhere in the semantics of English and many of them probably universally. Some of them may be built into the operation of specific rules, e.g. the *nom* operator in the semantics of rules of nominalization: some may apply freely whenever there is a mismatch between the simplest type of a given expression and the type needed for a particular occurrence of it to be well-formed, e.g. *lift* provides a simple *e*-type NP like *John* with a generalized quantifier meaning so that it can occur in conjunctions like *John and every other student*. Some may be language-specific, like the + A-rule discussed in connection with the Williams puzzle in section 10.5; others, like the free applicability of *lift* to provide generalized quantifier meaning to *e*-type NPs, may well be universal, at least among languages which have NPs with generalized quantifier meanings at all. Finding which are which, and undoubtedly uncovering new type-shifting and sort-shifting principles in the process, would appear to be an important and promising venture which will require close study of a wide range of languages.

Another general direction of research suggested by these beginnings that may be of interest beyond the study of semantics is the search for "cognitively natural" operations. As I suggested at various points above, I believe an

interesting case can be made for regarding certain semantic operations or functions of a given type as more "natural" than others on various plausible criteria, vague as such a notion must be. I will close by reiterating the need for interdisciplinary collaborative efforts on this issue, empirical studies to help determine what kinds of operations and functions are particularly widespread in the world's languages, frequently occur syncategorematically, are acquired early, etc.; and formal studies to help us gain a better understanding of the possible structures of semantic domains and possible formal criteria of naturalness to apply to mappings between them. One can imagine such studies of "natural mappings" extending well beyond the sorts of cases studied here, and relating to such disparate issues as the role of symmetry in perception, the problem of projectible predicates ("grue" vs. "green"), the interpretation of metaphors, and the development of mathematical intuition. Wherever one can uncover richly structured domains and evidence of an important role being played by mappings between them, it should be possible to investigate the relative cognitive "naturalness" of various such mappings, and such studies should in principle help to advance our understanding of the contribution our "hard-wired" predilections make to the way we make sense of the world we find ourselves in.

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Notes

1 Since the requirement of a homomorphism from syntactic categories to semantic types is fundamental to Montague's approach, one cannot literally allow a single syntactic category to map on to more than one semantic type within that approach. There are various ways of reformulating my proposal to conform to the homomorphism requirement, e.g. by exploiting the common view of syntactic categories as feature bundles. Flynn (1981) argues for the inclusion of both X-bar and categorial identification in syntactic categories, and there is considerable independent motivation for such a move, e.g. in the cross-classification of X-bar categories such as "PP", and "AdjP" and categorial grammar categories such as "predicate", "predicate modifier", etc.

   Incidentally, nothing I say in this paper is meant to decide between the use of type theory and the use of sorted domains in a type-free or less strongly typed theory. I use type theory because it is more familiar to me; I don't really know how much difference it makes. Chierchia and Turner (1988) discuss this question.

2 Here and throughout I am simplifying to a purely extensional sublanguage unless explicitly stated otherwise. That is one of the big gaps in this work that needs to be filled.

3 See, for instance, Partee and Rooth (1983) on conjunction, Reinhart (1983) on bound-variable anaphora.

4 See Chierchia and Rooth (1984), Zeevat (1984).

5 This of course goes beyond the bounds of a purely extensional fragment; what I do in this paper is systematically misrepresent properties as sets, hoping that the differences between them will not affect the main ideas.

6 See Bach and Partee (1980), Reinhart (1983).

7 So I would predict that any language which has expressions like "every man" as a syntactic NP of semantic type $\langle\langle e, t \rangle, t \rangle$ will also allow proper names like "John" to be $\langle\langle e, t \rangle, t \rangle$, hence will allow conjunctions like "John and every man". Similarly, while children acquiring English may start out with only e-type NPs, once they acquire quantificational NPs they should soon show signs of promoting simpler NPs to the higher type as well.

8 I am using expressions of Montague's intensional logic, with his conventions as to the types of variables, to denote corresponding model-theoretic objects, occasionally recasting things in set-theoretical vocabulary where it may add perspicuity. The type-shifting operations are defined on model-theoretic objects; we might find it useful to add their names as logical constants to the intensional logic or other intermediate representation language.

9 See note 5.

10 In a fuller treatment, the same should apply to definite plural and mass terms as well, like *the men* and *the water*.

11 There could be (and would be unless something rules it out) a second generalized quantifier reading of *the king, lift(iota(king'))*. I'm not sure how one would get evidence for or against such an ambiguity.

12 I believe one can interpret Frege (1892) as making such a claim about subject NPs.

13 I assume that the grammar specifies various positions as e, $\langle e, t \rangle$, etc., via subcategorization and other rules. I believe that positions are not subcategorized as $\langle\langle e, t \rangle, t \rangle$ unless they are also intensional, like the object of *seek*, hence outside the scope of this discussion. In cases of ambiguity, I would predict that if any NP can be either e or $\langle e, t \rangle$ in a certain position, e would be the preferred choice not only because it is a simpler type, but also because e and $\langle\langle e, t \rangle, t \rangle$ are (I believe) unmarked types for NPs, while $\langle e, t \rangle$, the unmarked type for VPs, AdjPs, and many PPs, is a marked type for NPs. I don't know what to expect in cases of ambiguity between $\langle e, t \rangle$ type and $\langle\langle e, t \rangle, t \rangle$ type for a given NP in a given position, since there is then a conflict between simplicity of type and markedness as an NP-type.

14 My thanks to Johan van Benthem for showing me that Montague's BE functor is indeed "natural", both intuitively and by various formal criteria, something I had never appreciated in spite of years of familiarity. This section was much weaker before he helped with it.

15 Thanks to Johan van Benthem for the fact, which he knows how to prove but I don't, and to Hans Kamp who gave me further help in understanding it.

16 This is yet another place where it seems evident that we want properties and not sets to play a basic role in what we are calling the $\langle e, t \rangle$ domain. The *predicate* reading of "the owner of this land" should neither presuppose that the land has an owner nor depend on who the owner is if there is one. Although intensionality will probably complicate the type-shifting picture, I believe it is indispensable for a satisfactory analysis.

17 That is, we are asking what determiner-type meanings are inverses of *BE* in one direction. We cannot expect any determiner meaning to be an inverse in the other direction, i.e. to satisfy $DET(BE(\alpha)) = \alpha$ for all α, since *BE* loses information: $BE(\alpha) = BE(\beta)$ for any α and β that contain the same singletons.

18 Moortgat (1985) gives evidence of *the*, *a*, and Carlson-type bare-plural readings in first elements of noun-noun compounds in English, Dutch, and German, where semantic NP-type readings are carried by syntactic CNs. The formation of bare plurals should also count as "natural", I would hope, but I am following Chierchia in viewing it as basically a nominalization operation ($\langle e, t \rangle$ to e) rather than a DET-type functor; its composition with *lift* would then be a DET-type functor.

19 Johan van Benthem has warned me that the kinds of type-shifting functors I have been employing cannot be assumed to apply straightforwardly to variables, since we are not then dealing directly with model-theoretic objects in the same way. But I believe that the same principles *ought* to apply, and it would at least be

straightforward if we included logical constants like *lower* and *lift* in an intermediate representation language such as Zeevat's reconstruction of Kamp's DRS language.

20 My thanks to Jose Meseguer, Joseph Goguen, and Ray Turner for making me aware of related work in the semantics of programming languages. I'm not able to understand and appreciate much of the technical work in that field, but it seems clear to me that this is another problem area where interdisciplinary collaboration could have considerable payoff.

21 Sometimes "most men" seems to have an *e*-type reading paraphrasable as "a group containing most men"; this seems even easier to get with "most of the men". See Doron (1983) for discussion of some of these issues and of differential availability of predicative $\langle e, t \rangle$ readings for partitive and non-partitive plural NPs. Plurals and mass terms raise many more semantic issues than can be touched on here; it would take at least another paper to examine a significant fraction of current work on mass terms and plurals in the light of the type-shifting perspective suggested here. See, for instance, Scha (1981), Hoeksema (1983), van Eijck (1983). Westerståhl (1989), Pelletier and Schubert (1989), Lønning (1984).

22 NPs formed with the bound CN-stem *-thing* must also be able to be marked +A, perhaps optionally as illustrated in (18); there should probably be some general way of indicating that *-thing* has maximally permissive selectional features and corresponds to a maximally inclusive "sortal range" of entities.

23 The same restriction could be applied to other proposed mechanisms for dealing with quantifier scope, such as Cooper-storage, quantifier-lowering, or QR (quantifier raising).

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Chapter 11

The Airport Squib: *Any*, *Almost*, and Superlatives

11.1   Preamble: A Word of Explanation

(September 2, 1986) This squib is being written in the airport where I'm faced with a several-hour delay meeting a plane and don't have my bookbag with my more urgent obligations in it with me. Since I don't expect to be able to get back to this topic once I'm reunited with my obligations, I'm trying to write this as a self-contained squiblet to distribute informally; otherwise, I'm afraid it will become buried and forgotten and be of no use to anyone. I'm just glad the news-and-gift shop had writing tablets.[1]

Issue: Is there a way to unify negative polarity *any* and free choice *any*?

11.2   Chief Background

I'm starting from Carlson (1981), which gave pros and cons. His reluctant conclusion is that they are different. One salient piece of evidence is that free choice *any* is like a universal in allowing modification by *almost*, as in (1), whereas negative polarity *any* is like an existential in disallowing modification by *almost*, as shown in (2).

(1)   Almost any doctor will tell you . . .

(2)   *John didn't eat almost anything this morning.

My main interest here is in checking out whether there's anything about the behavior of *almost* that could make that argument less decisive than it has seemed to be.

11.3   First New Observation

This emerged in conversation with Roger Schwarzschild on September 1, 1986: Roger was surprised that I judged (2) ungrammatical, and on reflection it may *be* surprising. In Hebrew, which uses multiple negation or "negative agreement", it's perfectly grammatical to say (3), and in English both (4) and (5) are fully grammatical, and (6) is common colloquially, though I believe (2) is impossible in both formal and colloquial styles.

(3)   John lo   axal kimat (klum/shum davar).
      John NEG ate   almost nothing[NPI]/no[NPI] thing
      "John ate almost nothing" (*Lit.*: "John didn't eat almost nothing")

(4)   John ate almost nothing.

(5)   John ate hardly anything.

(6)   (*colloq.*) John didn't eat hardly anything.

Standard views about the relation of *any* and *no* going back to Klima (1964) would lead one to expect that (2) and (4) should be paraphrases. If (6) were standardly grammatical, we might suppose that *hardly* is a polarity-sensitive alternate of *almost*, but the fact that (5) is standard, and not (6), shows that can't be quite right for the standard dialect (though it could be for the dialect which has (6) instead of (5)).

11.4   Older Observation

I don't know whose first – conceivably my own but I would guess Larry Horn (Horn 1972) and/or Gilles Fauconnier (Fauconnier 1975), or at least that they would best be able to make sense of it. There is, I think, an open class of superlative expressions that pattern with both free-choice *any* and polarity-sensitive *any*, both syntactically and semantically, as in (7) and (8):

(7)   The slightest noise will set off the alarm.
      (cf. Any noise will . . .)

(8)   John didn't make the slightest noise
      (cf. . . . didn't make any noise)

All sorts of superlatives can be used in these positions, though only certain ones produce the semantic effect of patterning with *any*; I don't know if I can pin this down, and will return to it. It's clearly something about implicatures. I take this patterning of superlatives with both kinds of *any* as one of the strongest reasons to want to find a way to unify the two *any*s.

11.5   Second New Observation

This arises from combination of the above: *almost* does not combine freely with superlatives, and I'm not sure why not. But perhaps if we can figure it out, it will turn out that the distribution of *almost* does not after all constitute an argument against the unification of the two *any*s.

(9)   ??Almost the thinnest woman will claim she's overweight.

(10)   *The almost thinnest woman will claim she's overweight.

But

(11)   Almost any woman will claim she's overweight.

(12)   *He didn't make almost the {slightest/smallest} sound

(13)   *He didn't make the almost {slightest/smallest} sound

Oh, but

(14)   ?He can't stand almost the gentlest criticism.

(15)   (colloquially OK, I think)
    (a)   He didn't make hardly the slightest sound.
    (b)   He didn't hardly make the slightest sound.
    (synonymous, I think: (b) probably more natural)

Now I would have supposed that universals and superlatives would be quite alike with respect to such properties as modification by *almost*. But I think it's worth a closer look. Some on-line observations follow.

  I.   Greg Carlson observed:
       almost every
       *almost some
 II.   But of course it isn't just universal/non-universal:
       almost ten
       *almost many
       almost a majority
       *almost most
III.   *Almost one* is fine if the reference scale includes fractions or real numbers; same for *almost two*, in fact, which would be peculiar if it could only mean *one*.

So part of it is that *almost* has to have a definite value to modify and (cf. Larry Horn's (1972) thesis) a scale along which to approach it. (Larry discussed ambiguities of direction of scale in cases like *It's almost 20 below zero outside*.) So universal/existential is not really the relevant parameter.

IV.   New, I think: Isn't there an ambiguity in (16)?

(16)   Almost the minimum number of Town Meeting members to form a quorum showed up for the special meeting called in July.
   (a)   Just over the minimum, i.e. almost *that few*
   (b)   Just under the minimum, i.e. almost *that many*.

V.   New, at least to me: Sometimes, though not always, *almost* can modify an expression that denotes not a definite amount, but "more than x" or "over x".

(17)a.   *? almost over 16
     b.   almost over the limit

(18)a.   * almost more than a pound
     b.   almost more than I could eat

VI.   Can *almost* modify expressions that have equative or comparative degree modifiers? If *almost* required a definite "boundary" expression characterizing its argument, it should be OK modifying something specified with *as . . . as* but not something specified with *more . . . than*.

(19)a.   Bill is almost as big as his mother.
     b.   Bill is almost bigger than his mother.
     c.   Aunt Marion is almost as small as her son.
     d.   Aunt Marion is almost smaller than her son.

Why is (b) OK? When we use it, do we imply that Bill is already as big as his mother? I think not – if he's growing fast and we only see him at intervals, he may be shorter now but we predict he'll be taller when we see him next. Is (b) better than (d) because (b) suggests a temporal dimension which (d) doesn't normally allow?

I guess "bigger than x" does count as a definite size; with both (V) and (VI) we're into the realm of the problems of distinguishing closed and open intervals.

That suggests an explanation for the contrasts in (V): perhaps there isn't any direct measure or evidence, in a given case, of being exactly *at* the limit or exactly *as much as* I can eat – perhaps the buzzer goes off when you're *over* the limit but not before, or discomfort sets in when you've eaten *more* than you can but not before. So for instance, when you've almost exceeded my patience

is when I'm almost ready to scream. Maybe these are cases where we can't tell exactly where the boundary *is*, we only know when we've gone past it. Those considerations would perhaps explain the goodness of (17b) and (18b). Then we might predict that (17a) and (18a) are well-formed but pragmatically odd: being over the limit or whatever is in those cases defined in terms of exactly where the limit is, so "almost over 16" seems to be an unnecessarily verbose way of saying "just 16" (or perhaps "almost 16"). On reflection you can probably even come up with contexts where they're OK, where the property of being over 16 is the important property.

The simplest grammar should probably make all of (17a–b) and (18a–b) *good*; it's just that in order for (17a) to be OK there has to be a reason not to have said "he's 16" or "he's almost 16".

11.6   Interlude

I need to pause and consider some of the basics of the distribution of modifiers to cardinal expressions in positive and negative sentences and the behavior of *almost*.

(20)   I had almost 50 students in that class.

(21)   #I didn't have almost 50 students in that class.

Example (21) is no good except as emphatic denial-negation; I guess this means *almost* is itself a positive polarity item.

(22)   Almost 50 men can lift that log.

Sentence (22) lacks a group reading that plain "50" has, and allows only a distributive reading. But that's not an absolute property of *almost n N* phrases, since they can occur just fine with predicates like *gathered*, and in fact without *can*, (22) would be ambiguous between group and distributive readings. So it has to be something about interaction of *almost* 50 with *can*; I don't know yet whether that's connected to the fact that *can* can license free-choice *any*.

(23)   I didn't have as many (students) as that.

So *as many as that* is OK in negative contexts.

(24)   #As many (men) as that could lift the piano.

(OK on distributive reading, not OK on group reading.)

(25)   As few (men) as that could lift the piano.

(OK group, ? distributive. I think the oddness on the distributive reading results from some kind of clash between "could" and its entailments on the one hand and the implicatures generated by "as few as that" on the other hand. And similarly for the oddness of the group reading of (24).)

(26)   I didn't hear so/as much as the slightest noise.

(27)   *I didn't hear as little as the slightest noise.

[Note: Don't ask me to define "*" vs. "#", though I mean it roughly as ungrammatical (*) vs. semantically or pragmatically anomalous (#). But in this realm of data it's hard to judge in advance what component should be claimed to be making something sound funny.]

(28)   As little as the slightest noise will set off the alarm.

(29)   #As much as the slightest noise will set off the alarm.

I think that here, too, the oddness is directly connected with implicatures – where we expect lower bounds, where we expect upper bounds. If a little noise will set off the alarm, then it follows (from facts about alarms, I guess; not directly from grammar) that a bigger noise will set it off, so (28) can be informative but (29) can't be.

(30)   ?So much as the slightest noise will set off the alarm.

(31)   So much as a peep will send him into a rage.

(32)   If you make so much as a peep, it will send him into a rage.

(33)   If you make even as little as a peep, it will send him into a rage.

Examples (30)–(32) show that there's some difference in distribution between *so much as* . . . and *as much as* . . . , with *so much as* having some affinity for negative polarity contexts, but I'm not going to explore that here. I don't know whether anything has been written on it. Examples (32) and (33) seem to be rough paraphrases; it should be interesting to work out how that comes about, if it hasn't already been done by someone.

11.7   Second New Observation, Continued

Now returning to the main topic: is it possible that both *any*s are instances of a single *any* which has an interpretation something like a minimal existential, and/or like an "arbitrary" existential? (Here I'm searching for a way to unify "minimal", as "arbitrarily small" and "free-choice", as "arbitrarily selected".)

And could the differences in the constructions derive from the differences in the implicature-generated scales that go upward from or downward to this arbitrarily chosen or arbitrarily small existential point?

(34) John has almost as many cards as Mary
     OK: John: 9   Mary: 10
     NOT: John: 10   Mary: 9

(35) John has almost as few cards as Mary.
     OK: John: 10   Mary: 9
     NOT: John: 9   Mary: 10

(36) Almost as few as 3 men can lift the piano.
     OK: 4 men can lift it (entailed: also 5, 6, 7 . . . can lift it)
     NOT: 2 men can lift it

Oh, but I'm afraid I am mixing up *minimum measure* with *arbitrary choice*. I'm trying to approach the OK-ness of *Almost any doctor will tell you* from *Almost as few as 3 men can lift the piano*; but I think you can't get there from here. I'm temporarily (I hope only) stuck. This pad is only about half the size of a yellow pad (page size) – maybe that makes it harder to gaze at all the facts together.

   New bits of data – thinking about "tripartite structures" in Kratzer's (1979) and Heim's (1982) sense.

(37) The dog barks if almost anyone new comes in.

Structure, approximately:

(37') [almost any x] [$_{\text{Restrictor}}$ x is new and x comes in] [$_{\text{Nuclear Scope}}$ the dog barks]

   No, it needs an event or temporal argument to connect the restrictor and the nuclear scope. First rough approximation (still needing to sort out whether it's quantification over events or over individuals or both, and if both, then together or with separate scopes):

(37'') [almost any x, t] [$_{\text{Restrictor}}$ x is new and x comes in at t] [$_{\text{Nuclear Scope}}$ the dog barks at t]

(38) *(on intended sense) He doubts that almost anyone can solve that problem.
     [OK as free-choice *any*, * as polarity *any*]

This is similar to the example we started with, but with the polarity licensor inside the lexical item *doubt*. As with the original example, plain *anyone* would be fine, but in this case there's no paraphrase with *almost no one*, because there's no negative morpheme that we can pull out of *doubt*.

   Let's look at the original examples again now.

(ii)   *John didn't eat almost anything this morning.

(iv)   John ate almost nothing.

(v)   John ate hardly anything.

(vi)   (*colloq.*) John didn't eat hardly anything.

In the original example (iv), what's the logical structure?

(39)   He ate almost nothing = ALMOST (NEG (he ate something)).

   (That *something* would be expressed as *anything* because of the negative environment, if I can put it that way.)
   Then suppose that *hardly* = ALMOST + NEG:

(40)   He hardly moved = he almost didn't move.

Then (v) is just like (iv): John ate hardly anything = ALMOST (NEG (John ate something)). (And I guess standard (v) vs. colloquial (vi) relates to whether *hardly* incorporates NEG or is itself an NPI, just as for the *n-* words in standard vs. non-standard English.)
   So is the trouble with (ii) a problem about the relative scope of NEG and ALMOST? Maybe. We saw in (21) that *almost* is itself a positive polarity item. (That should be further checked, but it makes sense.) Then in the colloquial dialect, maybe we can say that *hardly* is a NPI alternative to *almost*. (Except it's not exactly synonymous – it may need to be licensed by NEG in the colloquial dialect, but it still takes scope over its own "internal" NEG, and means "almost not", not "not almost".)

(41)   He's almost 20. Means he's just a little *less* than 20.

(42)a.   He's hardly 20 (*standard*)
    b.   He isn't hardly 20. (*colloquial*).

I *think* those both mean that he's 20, but only just barely – he's "almost not 20" (that's hard to process!). Could they also mean just less than 20? I feel a pull in that direction but I'm resisting it because I can't make sense of it. That would make *hardly* and *almost* equivalent, which I'm quite sure they're not. (I'm not discussing *barely*: *barely 20* very clearly means just barely on the positive side of 20, and *barely* is positive polarity: # *He isn't barely 20.*)
   So then the bad one, (ii), repeated below, would be trying to have a logical structure as in (43), with the scopes reversed from the good (39).

(ii)   *John didn't eat almost anything this morning.

(43)   NEG (ALMOST (John ate something)).

So that's out because of *almost* being a positive polarity item, I guess. And from here the place I would look would be at analyses of various "negative words" as containing a real negative morpheme vs. being themselves some kind of polarity items, to see if we can figure out the difference between Hebrew and English that's behind Roger's question.

Another direction that might be worth looking in: I seem to recall that in Hank Zeevat's compositional reconstruction (Zeevat 1989) of Kamp's Discourse Representation Theory (Kamp 1981), he reconstructed negation in terms of conditionals, with something like (44).

(44)a.   "If φ, then anything" means φ false
   b.   "If anything, then φ" means φ true.

Where I've written "anything", I think he used something like a bottom symbol ⊥. But I can't reconstruct what that was from memory and it's time to go check whether David's flight has come in.

11.8   In Retrospect 2003

In retrospect (2003), none of this succeeds in giving arguments for unifying the two kinds of *any*, nor in undermining the *almost*-argument against unifying them. More recent work (Dayal 1998; Giannakidou 1999; Haspelmath 1997; Kadmon and Landman 1990; Krifka 1995; Lee 1997; Lee and Horn 1994; Werle 2001) makes me think I was looking for too simple a unification. I think the most interesting part was probably getting into the beginnings of a study of what kinds of things *almost* can modify. We saw that it isn't just universal vs. existential, and it isn't just a matter of the modifiee having a definite "boundary" that one can approach, because of examples like *almost more than I can bear*. And the difference between good and bad examples of that linguistic form seemed to be clearly a matter of pragmatics rather than straight semantics: the well-formedness of a phrase like *almost more than I can bear* implicates that I may not be able to tell when I'm at my limit, I only know when I've gone beyond it.

Note

1   (February 2003) This squib was never published, but was circulated informally, and was referred to (by Larry Horn and a few others, as well as by me) as "the airport squib", for reasons explained in the preamble (which used to be an explanatory interjection in the middle), so I've added that phrase to the title now. I've done some minimal editing for clarification, and I've expanded the ending, which in the original was mostly just examples without prose. And I've filled in the bibliography.

But I haven't tried to turn it into a proper scholarly article; I haven't studied what other people had written on this topic then or in the meantime, except for noting a number of relevant newer references at the end.

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Chapter 12

Many Quantifiers

12.1   The Puzzle

It is a familiar fact that the quantifier words *many* and *few* are vague and context-dependent. How many counts as many and how few counts as few depend on the context. In this respect *many* and *few* share many properties of relative adjectives like *big* and *small* or *old* and *new*.

The puzzling question is whether *many* and *few* are also ambiguous. In particular, are they ambiguous between a *cardinal* reading and a *proportional* reading? What makes the question challenging is that if they are ambiguous, each reading is undoubtedly still vague, and that vagueness obscures the kinds of evidence that would normally be used to help settle the question of whether they are ambiguous.

The cardinal and proportional readings that I take to be the leading contenders for the interpretations of *many* and *few* if they are indeed ambiguous are displayed below in (1) and (2).

(1)   Many aspens burned.
   (a)   Cardinal: $|A \cap B| > n$
   (b)   Proportional: $\dfrac{|A \cap B|}{|A|} \geq k;$ k a fraction or percentage

(2)   Few aspens burned.
   (a)   Cardinal: $|A \cap B| \leq n$
   (b)   Proportional: $\dfrac{|A \cap B|}{|A|} \leq k$

That is, *many* as a vague cardinal quantifier would have a meaning like that of the cardinal numbers, *at least n*, with the vagueness located in the

unspecified choice of *n*, it being part of the meaning of *many* that the value of *n* must be one that counts as large in the given context. The cardinal reading of *few* is similar except that it means *at most n*, and *n* is generally understood to be small. The truth conditions of a simple sentence like (1) on its cardinal reading are then that the cardinality of the set of aspens that burned is at least *n*. (In normal usage it seems that we do not expect the context to narrow down the choice of *n* to a single precise value, but only to narrow it down enough to be communicatively useful.)

On the proportional reading, on the other hand, sentence (1) would be saying that a relatively large proportion of the aspens burned: at least *k*, where we may think of *k* either as a fraction between 0 and 1 or as a percentage, since these are equivalent notions as far as our purposes are concerned. (Other proportional readings have been suggested in the literature, especially by Westerståhl (1984), and I will mention some of the others below, but for the time being I will start from this one as the most likely candidate.) And similarly (2) would be saying that at most a certain fraction of the aspens burned.

In an early treatment of plural quantifier phrases in a Montague grammar framework, Bennett (1974) proposed treating *many* and *few* as context-dependent *cardinal* quantifiers only, with a possibly different context for each *occurrence* so as to allow for sentences like (3) and (4) below.

(3)   Many men date many women.

(4)   Few of his few friends are still around.

In a context in which we are discussing the dating habits of American men, for instance, we might well expect the first *many* to be in the millions while letting five or six count as many women, even though the cardinality of the set of men and that of the set of women are roughly the same. It seems that for the subject term we take the relevant context to be the set of all American men, and for the occurrence in the object position we consider not American women in general but how many women it's normal for a given man to date.

Bennett did not posit an ambiguity in the interpretation of *few* and *many*. And indeed, given their vagueness and context-dependence and the possibility of the relevant context being local to each occurrence, it is not obvious how we could detect or argue for ambiguity, or how it could matter. An explicitly anti-ambiguity position has in fact been argued for by Löbner (1987). He interprets a sentence of the form (5) as in (5′) below, remarking that it is left to the context to provide the criterion for markedness and that the so-called proportional and absolute meanings need not be distinguished semantically (1987: 72).

(5)   Many/few N′ VP′

(5′) |N′ ∩ VP′| is relatively high/low

I want to argue that we can tell whether *many* and *few* are ambiguous, that it does matter whether they are, and that indeed they are ambiguous between cardinal and proportional readings. I will claim that the ambiguity has both syntactic and semantic repercussions. I am less than fully confident of this conclusion; but I believe that as theories of quantifiers and quantifier-like expressions become more sophisticated, we become increasingly able to settle such issues with a combination of empirical and theoretical arguments. The analysis I will defend has much in common with the proposals of Milsark (1977). Milsark himself recognized that with the tools of first-order logic it was hard to make compositional semantic sense of his proposals. I will draw heavily on ideas introduced by Kamp and Heim, by Carlson, and by Link, who introduced possibilities unavailable to Milsark, with the help of which Milsark's proposals can be given clear semantic content and new arguments.

12.2   Into the Swamp

I will begin by introducing data and arguments that lend initial plausibility to the positions that we really can't tell whether *many* and *few* are ambiguous, or that it doesn't matter, or that the distinction if there is one shouldn't be made in the semantics.

To my mind the most significant fact in support of such positions is the truth-conditional equivalence of interpretations containing a vague context-dependent cardinal reading of *many* or *few* and those containing a vague context-dependent proportional reading. This can be illustrated with sentence (6) and its two putative interpretations (6a) and (6b).

(6)   Few third-year students are signed up for semantics.
 (a) $|\text{Third year} \cap \text{Signed up}| \leq n.$ context-dep. n
 (b) $\dfrac{|\text{Third year} \cap \text{Signed up}|}{|\text{Third year}|} \leq k.$ context-dep. k

It is not too difficult to show that in any particular context, there is a value of n that makes (6a) true iff there is a value of k that makes (6b) true. Or to put it differently, for any choice of n, there exists a value of k such that (6a) and (6b) have exactly the same truth conditions, and vice versa. (That is not to say that there exists any general mapping between n and k that would insure truth-conditional equivalence across different sentences and different contexts. There is surely not. In the case of (6a) and (6b), for instance, one can only determine the appropriate mapping between n and k if one knows the cardinality of the set of third-year students.)

Aristotle in *Categories* (1963: 15), may also be construed as arguing against an ambiguity theory. After giving examples to illustrate the relativity of *small* and *large*, he goes on: "Again, we say that there are many people in the village

but few in Athens – though there are many times more here than there; and that there are many in the house but few in the theater – though there are many more there than here." In effect we might be using proportional considerations in determining a relevant value for *n* on a cardinal reading, making it futile to try to tease apart cardinal and proportional *readings*.

Keenan and Stavi (1986) give a novel argument which purports to show that *many* and *few* cannot be treated extensionally at all, and hence are not to be classed with the quantifiers treated in terms of generalized quantifier theory or related approaches at all.

> [V]alue judgment APs are generally non-extensional . . . it is not difficult to imagine a situation in which the doctors and the lawyers are the same but (7a) is true and (7b) is false.

> (7)a.   A surprisingly large number of lawyers attended the meeting.
>   b.   A surprisingly large number of doctors attended the meeting.

> In fact *value judgment dets* in general are non-extensional. Such dets include for example: *too many*, *too few*, *not enough*, *just enough*, *many more than four*, and in our judgment, *many* and *few* themselves. . . . [they provide a scenario] . . . then (8a) is true and (8b) is false:

> (8)a.   Many lawyers attended the meeting this year.
>   b.   Many doctors attended the meeting this year.

> Thus *many* (*few*) cannot be treated extensionally.

I am not convinced by this reasoning, however, since it fails to take into account the possibility that the only element of value judgment that may have to enter into the interpretation of simple *many* and *few* may be in determining a suitable value for *n* or *k* in the given context; but each such meaning, once *n* or *k* is fixed, is clearly extensional (as in (1) and (2) given above). Similar difficulties have arisen in the past in trying to establish whether relative adjectives like *tall* and *expensive* are intensional (like *good*) or, as Kamp (1975) suggested and Siegel (1976) convincingly argued, vague context-dependent extensional adjectives.

12.3   Three Possible Positions

There are three mutually exclusive but not exhaustive positions one might take with regard to the question of ambiguity of *many* and *few*: that they are ambiguous; that they are unambiguously cardinal; and that they are unambiguously proportional. Of these, I have only found the first two attested.

Among authors favoring the ambiguity position, Milsark (1977) is the earliest I know of. He gives arguments which I will review in section 12.4

below, but not a formal analysis. Blau (1983) offers a semantic analysis which embodies the ambiguity thesis but does not give arguments. The present paper will also end up favoring this position, although not entirely conclusively; I am actually more interested in opening up possibly new lines of argument on the issue than in absolutely resolving it one way or the other.

Among those who have regarded *many* and *few* as unambiguously cardinal quantifiers, I have already mentioned Bennett (1974), who did not explicitly raise the ambiguity issue, and Löbner, who raised it and dismissed it on the grounds that there is no point in positing ambiguity on top of vagueness if a vague context-dependent cardinal interpretation handles all the data adequately.

Hoeksema (1983) analyzes numerals and *many* as adjectives interpreted as (cardinality) predicates of groups. This is a not uncommon view of occurrences of numerals and *many* in positions following an overt determiner, as in *these three alternative hypotheses*, positions I will refer to later as "explicitly adjectival." But Hoeksema goes farther than that; on his analysis, numerals and *many* are still adjectives even when there is no overt determiner preceding them. The mechanism that makes this possible and in fact to be expected is the mechanism of bare plural formation of Carlson (1980) which forms a bare plural NP from any plural common noun phrase with no morphological change. So from a CNP *ten boys* or *many children* a full NP *ten boys* or *many children* is formed by the same rule, and with the same alternation of existential and generic readings discussed by Carlson, as illustrated in (9a–d).

(9)a. Ten boys were on our porch.
  b. Ten boys can't form a soccer team.
  c. Many children were playing video games.
  d. Many children always make a lot of noise.

But note that the generic reading so obtained, illustrated in (9b) and (9d), is a "generic cardinal" reading, not a proportional reading. Thus we might agree with Hoeksema that cardinals and *many* in what look like determiner positions *can* be adjectives without concluding that they always are.

As for the third position, that *many* and *few* are unambiguously proportional, I have not found that position defended in print. The most plausible version of such a position that I can imagine would be to claim that they are always proportional, though not always proportional to the cardinality of the common noun they are combined with. But note that the specific proportional reading spelled out in (1b) and (2b) makes the proportional reading of *many* similar to *most*, and hence leads to some relatively clear predictions about its properties (see section 12.4), whereas a looser version of proportionality that detached it from dependence on the head noun would be harder to distinguish from the cardinal reading, given that the latter involves choice of a "relatively" large *n*, and "relative" and "proportional" are similar notions. Arguments against *many* and *few* being unambiguously proportional in the sense of (1b) and (2b) will be given in the next section.

12.4   Theoretical Relevance and Evidence for Ambiguity

One reason that the choice among these competing views on the ambiguity of *many* and *few* is of potential importance is that the decision has repercussions on a number of larger theoretical issues, particularly in the realm of semantic universals, classifications, and typological properties as proposed by Barwise and Cooper, Keenan and Stavi, van Benthem, Westerståhl, and others. In the search for the right higher-order generalizations, it could clearly make a difference what properties are attributed to *many* and *few* or if they're excluded altogether as proposed by Keenan and Stavi. In particular, in the pioneering classification of properties of determiners presented by Barwise and Cooper, there are in fact a number of "?" judgments in the entries for *many* and *few* at points that affect several potential universal claims. We'll return to some of these below.

In addition, the properties of words analogous to *few* and *many* in different languages may be expected to be relevant for empirical linguistic generalizations that depend on the semantic classification of determiners. And if it's hard to decide if these words are ambiguous in English, it may well be hard in other languages as well, putting an impediment in the way of the investigation of universals and typology in this domain. On the other hand, independent progress in finding strong supportable universals or theoretical generalizations could help to provide evidence concerning the ambiguity or lack of it in particular instances. (It would of course be interesting to find a language which has two different words corresponding to the two putative senses of *many*, or of *few*, but I would not take that as direct evidence that the English word is ambiguous, only as making that hypothesis a bit more plausible.)

12.4.1   Milsark's generalizations

Milsark's arguments for *many* and *few* being ambiguous were of the sort alluded to above, driven more by the patterning of general properties correlating with the distribution of different determiners than by any direct intuitions of ambiguity or truth-conditional differences. Milsark argued that some restrictions normally posed in terms of definiteness could be better explained on the basis of a classification of determiners as "weak" or "strong", and he formulated a number of generalizations in terms of that distinction. Roughly, the strong determiners are definites, universals, and *most*, and the weak determiners are *a*, *sm*, cardinal numbers, and the non-universal Ø determiner with mass and plural NPs. The generalizations have stood up well and the distinction has proven fruitful, although Milsark was only able to characterize it informally. Two of the principal generalizations are given below in (i) and (ii).

(i) Only *weak Dets* are allowed in existential *there*-sentences like (10).

(10) There were ____ people cycling along the creek.

(ii) Only *strong Dets* cooccur with "property" predicates in simple NP VP sentences like (11).

(11) *Sm people were Democrats.
Some people were Democrats.

In order to maintain this pair of claims in the face of certain classes of counter-examples such as the ability of some determiners to appear in both kinds of context, Milsark argues that many weak determiners, including *many*, *few* and the cardinal numbers, have strong doublets. While the semantics Milsark offers is somewhat informal and vague, it includes the following claim: "the weak determiners . . . are not quantifiers at all . . . [but] *cardinality words*. . . . If this is the case, the strong determiners can be regarded as being exactly the set of natural language quantifier words" (1977: 23).

Milsark goes on to offer evidence to make this widespread ambiguity more plausible; but the strongest arguments for it remain the robust generalizations (i) and (ii), which are supported by the behavior of the unambiguous determiners and in turn support the ambiguity analysis of the others. If *many*, *few*, and certain other determiners are not ambiguous between weak and strong interpretations, then that distinction cannot be the correct explanation for the patterns of determiner restrictions in sentences like (10) and (11). Note that Milsark makes the cardinal numbers ambiguous in the same way as *many* and *few*; this is incompatible with our characterization of the ambiguity of proportional readings of the form of (1b) and (2b). We will return to this point in section 12.6, and argue that *many* and *few* have an ambiguity beyond the weak/strong doublet readings they share with the cardinals.

12.4.2 Barwise and Cooper's reconstruction of *weak* and *strong*

Barwise and Cooper (1981) offer a formalization of the properties *weak* and *strong* within the framework of a model-theoretic characterization of NP interpretations as generalized quantifiers and determiners as functions from CN interpretations (sets of individuals) to generalized quantifiers. Readers familiar with Barwise and Cooper can skip this section, which is a brief review of their reconstruction. I give both their formal definitions and their natural language diagnostics; the latter also provide an intuitive introduction to the content of the former.

(12) *Definition*: D is *positive strong* iff whenever D(CN) is defined, then CN ∈ D(CN).

This definition translates into the diagnostic test sentences in (13). Since (13a) comes out true in all models, *every* is positive strong; and since (13b) is false in any model in which there are more or fewer than 5 books, *exactly 5* is not positive strong.

(13)a.   *Every* book is a book.   : YES
     b.   *Exactly 5* books are books.   : NO

(14)   *Definition*: D is *negative strong* iff whenever D(CN) is defined, then
         CN ∉ D(CN).

(15)a.   It's not the case that *neither* book is a book.   : YES
     b.   It's not the case that *exactly 5* books are books.   : NO

(16)   *Definition*: D is *weak* iff it is not strong.

On these definitions, the determiners that are classified as weak include *a*, *some*, *1,2,3, . . .* , *many*, *few*, *a few*, *no*, and a few others. Strong determiners include the definites, universal quantifiers, *most* and *neither*. Note that with the definitions formulated in this way, no determiner will be classified as both weak and strong. All the Dets that Milsark called ambiguous come out weak on these tests; but that would be consistent with a weak/strong ambiguity, since a Det will pass one of the *strong* tests in (12) and (14) only if it is unequivocally strong. So Barwise and Cooper's formulation seems to be largely faithful to Milsark's distinction except for being insensitive to the putative weak/strong ambiguity of most of the weak determiners.

Barwise and Cooper's semantics of existential sentences of the form *there is/are NP* is as given below in (17), where *Dom* is the domain of all entities in the given model.

(17)   there is NP = true iff Dom ∈ NP

The set *Dom* could be represented and thought of in various ways. It can be represented as {x|x = x}, a property every entity has. One might think of Dom as the interpretation of "exists" or "has some property" or "is somewhere," although any such interpretation requires caveats and more discussion. In any case, the important result is that on this analysis, existential sentences turn out to be contingent just for the weak NPs, as illustrated in examples (18)–(19).

(18)   There are at least five winners.

(18′)   Dom ∈ at least 5 winners, i.e., the domain contains at least 5 winners:
        CONTINGENT.

(19)   There is every winner.

(19′)   Dom ∈ every winner, i.e., every entity that is in the set of winners in the
        model is in the domain of the model: TAUTOLOGY

Other strong determiners may yield contradictions or statements which
either assert or deny what they presuppose. The analysis thereby achieves
what Milsark suggested: a uniform syntactic and semantic analysis coupled
with a semantics that automatically filters out the bad cases without imposing
stipulative restrictions on the rule.

It is in this context that I should mention what I think is probably the chief
rival to the ambiguity analysis of *few* and *many*. That is the possibility that
many and *few* have unambiguously cardinal interpretations, like the cardinal
numbers themselves, and the strong/weak ambiguity that affects *many*, *few*,
and the cardinals alike actually reflects whether or not the set denoted by
the associated CNP is presupposed to be non-empty or not. The existential
construction requires that existence not be presupposed and hence requires
weak determiners; partitives, which we will discuss briefly below, pre-
suppose existence of their basis set and hence require strong determiners.
I will return to consider this alternative further in section 12.6. But first
I want to consider some theory-driven evidence for ambiguity in the form
of a set of crucial "?"-judgments in Barwise and Cooper's classification of
many and *few*.

12.4.3   Barwise and Cooper's question marks

Among the classificatory properties of determiners which Barwise and Cooper
find fruitful for expressing various explanatory generalizations, there are
two cases where they express uncertainty or internal disagreement about
whether *few* and *many* do or do not have the property in question. In both of
these cases ambiguity would explain the difficulty of making unequivocal
judgment, because in both cases the cardinal and proportional readings differ
on the given property. The two properties are the *intersection property* and
persistence. I will discuss them in turn.

(20)   *Definition*: D has the *intersection property* iff:
        (i)   D(A)(B) iff D(A ∩ B)(B)   or equivalently
        (ii)   D(A)(B) iff D(B)(A)   or equivalently
        (iii) D(A)(B) iff D(A ∩ B) ('exist')

Barwise and Cooper report disagreement about whether *few* and *many*
have this property. Cooper thinks all weak determiners have it, while Barwise
believes that *few* and *many* are weak but do not have the intersection property.
If we could say that only the cardinal readings of *few* and *many* have the
intersection property, however, Cooper's generalization would be upheld.

The three (logically equivalent) versions of the test for the intersection property yield three different versions of the diagnostic tests with English sentences, (21a–c).

(21)a. Many linguists are women iff many women linguists are women.
     b. Many linguists are women iff many women are linguists.
     c. Many linguists are women iff there are many women linguists.

While judgments about the different sentences in (21) are not identical, I think I and many other speakers tend to have conflicting feelings about all three of them. I also think the tendency toward calling them all false correlates with a tendency toward reading the first clause proportionally. And as one can verify by substituting the explicitly cardinal *at least 4,000* and the explicitly proportional *at least 40 percent of*, it does indeed hold that the cardinal *at least n* reading given in (1a) has the intersection property while the proportional reading given in (1b) does not. The ambiguity hypothesis and Cooper's proposed universal that all weak determiners are intersective thus support one another, since the ambiguity hypothesis removes the only known counter-examples to the otherwise well-supported hypothesis.

We turn now to the property of persistence, where we will see similar results.

(22)   *Definition*: D is *persistent* iff whenever A $\subseteq$ B, then X $\in$ D(A) $\Rightarrow$ X $\in$ D(B).

(The property of *anti-persistence* is defined in the same way but with the direction of the implication reversed.)

To test a determiner D for persistence, we should see whether the sentences like (23a–b) are valid; to test for anti-persistence, we must interchange the predicates in the *if*-clause and the main clause and then test for validity.

(23)a. If D men over 40 were there, then D men over 30 were there.
     b. If D voters in Amherst will vote for candidate X, then D voters in the US will vote for candidate X.

Note that (23a) and (23b) seem alike in form, and yet they tend to yield different results for *many*. Many speakers tend to judge (23a) valid but (23b) invalid for *many*; I believe this is because the lexical content of the sentences biases us towards a cardinal *at least n* reading in (23a) and a proportional reading in (23b).

If we test clear cardinal and clear proportional determiners, the results are as given in (24) and (25):

(24)   Clear cardinals
            at least 100 : persistent
            at most 100 : anti-persistent
            exactly 100 : non-persistent

(25)   Clear proportionals
          every, most, at least/at most 50 percent of the : non-persistent

When we test *many* and *few*, however, the results seem unclear and our intuitions vary from example to example, as with (23a–b). If *many* and *few* are ambiguous as suggested, the question marks about the data can represent a clash between a non-persistent proportional reading and persistent (*many*) or anti-persistent (*few*) cardinal reading.

12.5   Further Evidence for Ambiguity

12.5.1   Explicit partitives

If we retry the tests for intersection and persistence with the partitive *many of the*, it then seems even more clearly to fail the tests, as a proportional quantifier would. This contrasts, as noted, with the behavior of *at least 100*, which passes. Interestingly enough, it also contrasts with the behavior of partitives formed with cardinal numbers, like *at least 50 of the men*. These "cardinal partitives" are strong, unlike plain cardinals, but they pattern with the plain cardinals with respect to intersection and persistence (at least where they are defined). The fact that *many* in the partitive thus differs in important ways from numerals in the partitive provides evidence against the alternative hypothesis mentioned at the end of section 12.4.2, according to which *many* is unambiguously cardinal and just has the same strong/weak ambiguity that the cardinals have. That much ambiguity could well be explained in terms of the presence or absence of a presupposition of non-emptiness of the set to which the determiner meaning is applied (the set denoted by the common noun or by the partitive phrase; see Barwise and Cooper 1981, and Westerståhl 1984), but the further differences between partitives with cardinal numbers and partitives with *many* or *few* support the thesis that *many* and *few* have an ambiguity that is not shared by the cardinal numbers. The positing of a distinction between proportional and cardinal readings for *many* and *few* but not, of course, for the cardinal numbers gives us a natural account of these differences.

12.5.2   Explicit adjectives

If we examine the properties of *many* and *few* in explicitly adjectival positions, as in phrases like *the many women*, *the few third-year students in the class*, we find only the cardinal reading. While this does not prove that *many* is ambiguous, it adds support to the hypothesis that there is a cardinal *many* which is adjective-like and patterns with the cardinal numbers in being able to be used as either an adjective or a determiner, and also a proportional *many* which is

only a determiner. In phrases like those in (26)–(27) we find both at once; in
these cases, the first is probably almost always construed proportionally, the
second obligatorily construed cardinally.

(26)   few of the few jurors (from Westerståhl 1984)

(27)   Many of the many protestors advocated violence.

12.5.3   Huettner's test: when can *few* be *all*?

In an unpublished seminar paper, Alison Huettner (1984) made the observa-
tion that there are some constructions in which it is possible for "few CNs" to
amount to all the CNs there are (though *few* certainly never *means* "all"), and
other constructions in which "few" must definitely be less than all. Existential
sentences like (28) are one such context; (28) could be true in a situation where
all the faculty children were at the picnic, but there were few faculty children
back then.

(28)   There were few faculty children at the 1980 picnic.

   Ordinarily NP-VP sentences with stage-level predicates, especially "existence-
asserting" ones, also allow the possibility of few being all.

(29)   Few egg-laying mammals turned up in our survey, perhaps because
       there are few.

   But when the NP is the subject of an individual-level or "property" predicate,
few cannot be understood as amounting to all.

(30)   # Few egg-laying mammals suckle their young, perhaps because there
       are few.

   Huettner's observation gives added support to the cardinal vs. proportional
distinction described in (1) and (2). One can argue that *few* can never be
"all" on the proportional reading, as follows: If *few* means "≤ k percent,"the
context-dependent value of k cannot be understood to be either 0 percent
or 100 percent, but must be somewhere in between. (It cannot be 0 percent
simply because *few* is never understood to *require* 0 even though it is often
compatible with 0.) It cannot be 100 percent because "at most all" could never
fail to be satisfied and would therefore be totally uninformative. The cardinal
reading, on the other hand, is quite compatible with few being all, since it
asserts that the number of CNs that satisfy the predicate is small without
saying anything about what proportion that is of the set of all CNs. In so far as
the distinctions made by Huettner's test are compatible with the other criteria

for determining which contexts force one or the other reading and which instances are ambiguous, which I believe they are, Huettner's test supports the ambiguity hypothesis.

Note in passing that since the proportional reading is incompatible with few being all, Huettner's observations effectively eliminate the possible hypothesis that *few* is unambiguously proportional, mentioned in section 12.3. Note also that we do not have the same evidence for *many*; "many" is compatible with "all" on either the cardinal or the proportional reading. But it is reasonable to assume that *many* and *few* will be ambiguous or unambiguous together, given that they pattern alike with respect to the other evidence we have considered.

12.6   Towards an Analysis

When we review the evidence that has been adduced thus far, we can note a striking correlation of properties, many of which have been observed by previous researchers, and which seem to invite an analysis in terms of the perspective of Kamp (1981) and Heim (1982).

On the one hand, we have Milsark's and Hoeksema's observations that the cardinal reading seems to be basically adjectival and not intrinsically quantificational. And it is this reading which is weak, intersective (and hence symmetrical), and persistent. (See the Appendix, below, for a summary of the formal properties of the two readings.) As has been proposed by various authors for the cardinal numbers, these properties would follow from an analysis that treated these NPs as Kamp–Heim indefinites, either by assuming that *many* and *few* are still adjectives and there is a zero indefinite determiner with a Kamp–Heim interpretation, or by treating *many* and *few* as determiners whose interpretation on this reading is the composition of the interpretation of a zero indefinite with the interpretation of adjectival *few* or *many*. (See Partee, 1986, for some discussion of a type-shifting approach to the alternation between adjectival and determiner versions of the numerals, which could equally be applied to *few* and *many*.)

On the other hand, the proportional reading is unavailable in unambiguously adjectival positions and shows up most clearly when *many* and *few* are most clearly Dets. This reading does seem to be essentially quantificational, though that notion may be hard to pin down. (See Partee, 1986, for one suggestion.) It is this reading which is strong, non-intersective (and hence non-symmetrical), and non-persistent. These properties also characterize the quantificational determiners *every* and *most*, and would be captured by an analysis in Kamp–Heim terms in which they were treated as operators which required what Kamp's theory represents as "box-splitting" and Heim's as the creation of tripartite structures consisting of Operator + Restrictive Clause + Nuclear Scope.

I can do no more here than sketch the lines I think such an analysis would take; I have not undertaken a full working out of such an approach. For the basic structure I would appeal to a Kamp–Heim-style analysis as alluded to

above; but note that all the controversy surrounding the proper treatment of *most* will carry over to the proportional reading of *many* and *few*, so an appropriately refined version of such an approach is needed. (See Kadmon, 1987, for discussion of the "proportion problem" and various approaches to its solution.) The treatment of cardinal *many* and *few* as adjectives is simplified if plural individuals can be regarded as entities, as proposed by Link (1983). For the stage-level vs. individual-level distinction among predicates, which seems to capture Milsark's distinction between episodic predicates and property-denoting predicates, we can appeal to Carlson (1980) and other work that has built on that work. And perhaps even more appropriate than Barwise and Cooper's *weak* for characterizing Milsark's *weak* determiners is the property Keenan and Stavi (1986) call *existential*, defined below in (31). The property *existential* clarifies the adjectival character of the weak determiners particularly clearly; but the properties *existential*, *cardinal* and *weak* are all very similar, and it is not yet clear which is the most fundamental.

(31) *Definition*: A determiner D is *existential* iff the following equivalence is valid: D(A)(B) iff Dom ∈ D(A ∩ B)

That is, a determiner is *existential* if "Det CNs VP" is equivalent to "Det CNs that VP exist" or "there are Det CNs that VP."

The following sketches of Kamp–Heim-style structures for cardinal and proportional readings of (32) can give a rough idea of this way of analyzing the distinction.

(32) Many students arrived today.

(33) DRS for cardinal reading; existential quantifier implicit.

Truth conditions: There is (was) a group of students whose cardinality is many and which arrived today
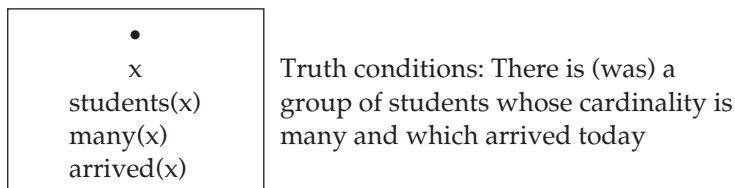
(34) (Extended) DRS for quantificational (proportional) reading.
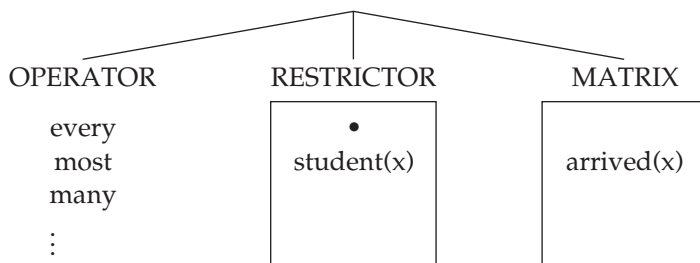
In the structure above I put *many* in a list with *every*, *most*, etc., just to indicate that on the proportional reading it is to be treated in the same manner as those operators. The observation that these essentially quantificational cases are almost paraphrasable by partitives even when there is no overt partitive structure is captured to some degree by the fact that these operators all require that a certain proportion of the set of things satisfying the restrictor also satisfies the matrix; that is quite similar to carving out a subset of a given set by number or proportion, as the partitive constructions tend to do. The difference is that in the general case, the restrictor clause can be quite open-ended, whereas partitives generally involve a definite set. One subtlety that deserves further investigation is that when the restrictor does involve a very open-ended set, "proportion" as characterized in (1b) and (2b) becomes ill-defined, and some extended sense of "frequency" may be needed, including an atemporal sense conceptualized in terms of an imagined survey of the given domain. Proportion proper may then be viewable as a special case of frequency.

In addition to the basic cardinal and proportional readings represented above, we can also give an account of the generic cardinal reading discussed by Hoeksema. I use the dummy cover term "Generic" to represent a generic operator without embarking on a serious investigation of its properties.

(35)   Few children get along well together.

(36)   Generic cardinal case
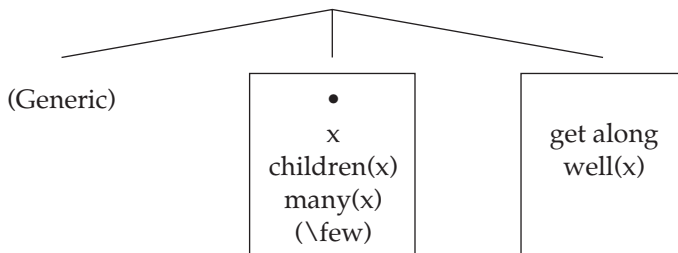
I believe that on this way of analyzing the ambiguity, we can succeed in predicting that the proportional reading patterns with *most*, *every* and other strong Dets, and the cardinal reading with the numerals. Contexts which admit both are predicted to be ambiguous, although possibly without any truth-conditional ambiguity.

I realize that a number of loose ends remain, and that there are relevant arguments in this area that I have not addressed at all. Milsark's general weak/strong ambiguity applying to cardinal numbers and to *many* and *few* alike has not been given a clear place in the analysis, although I believe it is compatible with it. I have also left untouched some important proposals from Westerståhl (1984), who argues that there are also proportional readings for *many* which are not based on proportion of the common noun set. These

actually violate the constraint that determiner meanings are always conservative (Barwise and Cooper's "lives on" universal), and it is partly for this reason that I have ignored them. But both for honesty's sake and as a pointer to an important area for future research, I should mention some new data that I noticed very recently, which offer potentially differing truth-conditions for testing the purported ambiguity of *many* but which appear then to clearly argue for the existence of a non-CN-based proportional reading as well.

Consider sentences (37)–(39).

(37)   There are more illiterate people in small rural towns than in large cities.

(38)   Small programs give financial support to more of their students than large programs do.

(39)   Some small programs support more students than some large programs do.

Such sentences are potentially valuable sources of data, since comparatives generally remove the ambiguity of vague predicates, and clear truth-conditional differences can then show up between cardinal and proportional readings. However, I think that judgments about the range of possible readings for sentences like (37)–(39) show a surprising range of possibilities, including a non-CN-based proportional reading for (37).

I thus conclude the paper with a call for more work in this interesting area; sorting out the behavior of *many* and *few* and finding universals of quantifier interpretations are mutually relevant tasks, and the time seems ripe for making new progress on them, a task to which I hope this paper makes some contribution.

Appendix: Properties of Cardinal and Proportional *Many*

$many_{CARD}$: at least n, for some context-dependent n such that $n > 0$
$many_{PROP}$: at least k percent, for some context-dependent k such that $k > 0$

Results of Tests

	P. Strong	Weak	Card	Inter/Symm	Mono	Pers
$many_{CARD}$	−	+	+	+	+	+
$many_{PROP}$	+	−	−	−	+	−

Tests:
P. Strong (Positive Strong):   "DET books are books" true in all models.
Weak: "DET books are books" true in some models, false in others.
Card (Cardinal):   DET books are yellow iff |Book ∩ Yellow| ∈ K, for some set K of cardinal numbers

Inter/Symm (Intersective/Symmetric):   See (20) and (21) in the text.
Mono (Monotone[1]):   DET men left before 11 p.m. ⇒ DET men left before midnight.
Pers (Persistent):   DET linguists like grammar ⇒ DET people like grammar.

[1] Note added in 2003: Barwise and Cooper's property "monotone" is more standardly called "right monotone increasing," and their "persistent" is more standardly called "left monotone increasing" (see Barbara Partee, Alice ter Meulen, and Robert Wall, 1990, *Mathematical Methods in Linguistics*, Dordrecht: Kluwer, p. 379).

Acknowledgments

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Chapter 13

Binding Implicit Variables in Quantified Contexts

13.1 Background and Overview

It is well known that English third-person pronouns can function variously as deictic or demonstrative elements, as discourse anaphors, and as bound variables, as illustrated in (1), (2), and (3), respectively.[1]

(1) Deictic or demonstrative: Who's *he*?

(2) Discourse anaphoric: A woman walked in. *She* sat down.

(3) Bound variable: *Every man* believed *he* was right.

In a typical use of (1), the pronoun gets its value from the non-linguistic context of the utterance, the context in which the speech act occurs. In a discourse anaphoric case like (2), the pronoun takes its value from the constructed discourse context. In a bound variable case like (3), the pronoun is interpreted as a variable bound by a variable-binding operator associated with the interpretation of *every man*.

  Unified treatments of these uses of pronouns became available with the work of Kamp (1981) on discourse representation theory and Heim (1982, 1983) on file change semantics. Extensions to temporal and locative anaphora, where similar ranges of behavior can be found, have been made by Bäuerle (1979), von Stechow (1982), Hinrichs (1981), Partee (1984b), and Cooper (1986), among others. Some temporal examples are given in (4)–(6).

(4) Deictic past reference time: I didn't turn off the stove.

(5) Discourse anaphoric reference time: Mary woke up sometime in the night. She turned on the light.

(6)   "Bound-variable" past reference time: Whenever John wrote a letter to
      Mary, she answered two days *later*.

For arguments that (4) must be understood as anchored to a contextually
definite past reference time rather than (as in traditional tense logic) as invol-
ving existential quantification over past times, see Partee (1973). Example (5) is
parallel to example (2) in that the reference time which anchors the tense in
the second sentence in (5) is introduced by an indefinite description ("some-
time in the night") in the preceding sentence. And example (6) shows bound-
variable-like behavior of the reference time: the dependent element *later* in the
main clause is interpreted, in effect, as "later than t," with t the letter-writing
time that is quantified over by the *whenever*-clause.

   Against this background, the descriptive and theoretical concerns of this
paper can be stated as follows. First, as the central descriptive concern, I want
to argue for the need for extensions of treatments of pronominal anaphora to
a much broader class of contentful context-dependent elements which can also
exhibit bound-variable-like behavior, such as *local*, *enemy*, *foreigner*, *arrive*,
opposite, *unfamiliar*. A key claim on which this concern rests is that "anaphoric"
or "dependent" elements which exhibit the range of types of behavior
illustrated in (1)–(3) and (4)–(6) occur an commonly (proportionally) among
open-class as among closed-class items.

   Among the demands that a descriptively adequate treatment of such ele-
ments will place on the lexicon is the need for a way to lexically specify
constraints on the kinds of contexts that different dependent elements may be
sensitive to. For example, although English third-person pronouns exhibit the
full range of behavior illustrated in (1)–(3), there are other dependent elements
that do not. The first-person pronoun *I* in English can anchor only to the
utterance context,[2] as *he* does in (1), and has no behavior analogous to that
of the pronouns in (2) and (3). Thus we cannot use *I* as a bound variable
even when quantifying over speakers;[3] (7) and (8) below have no readings
where *I* ranges over the speakers in question.

(7)   Every speaker has difficulty stopping when I should.

(8)   Every person in line said that I had been waiting for over an hour.

On the other hand, English reflexives like *himself* and *myself* have only bound-
variable uses[4] and can only find their antecedents sentence-internally. The
plural first-person pronoun *we* presents an interesting descriptive challenge:
its interpretation is a group which must include the *I* of the utterance context,
but whose other members may be anchored to any of the kinds of contexts
given in (1)–(3) or to a combination thereof, as I will illustrate later.

   I should note explicitly that there are many other properties of anaphoric-
like elements that need to be explored within and across languages. I will be
focusing here on the variation illustrated in (1)–(3) and (4)–(6), particularly on
evidence that shows that large numbers of open-class lexical items act as though

their meaning includes something like a bound-variable part. It is this behavior that I think argues most strongly for a need to integrate this kind of context-dependence more thoroughly into sentence-grammar. But I think that this is probably just the tip of an iceberg, and that once we start looking more systematically at the possible extension of typological classifications of pronoun-like elements to large parts of the open-class vocabulary, we will find a very large and fertile field of study opening up.

The theoretical concern that naturally emerges from such observations is how to articulate a theory which illuminates both the commonalities and the differences between pronouns and other dependent elements, and the kinds of parameters along which such elements can vary both within and across languages. I do not have such a theory to offer here, but I will suggest some properties that I believe such a theory should have. At the very least, I am convinced that we need a more comprehensive theory of context-dependent elements in which pronouns occupy one relatively extreme position on a continuum and open-class predicates with descriptive content and *no* dependence on context are at the other. If words like *local*, *enemy*, *arrive*, etc., which have both descriptive content and pronoun-like context-dependence in their meanings are the norm rather than the exception, then we can't rest with theories which divide lexical meanings into constants (names, predicates, "R-expressions") and variables, or into constants, variables, and demonstratives, treating these as disjoint classes.

In section 13.2 I will present some of the kinds of data that support my basic descriptive claims about the varied kinds of context-dependence, including bound-variable-like behavior, of many open-class words. In section 13.3 I will make some brief comparisons between pronouns and this broader class of dependent elements with respect to syntactic constraints. Since the similarities raise the natural suggestion that the "pronoun-like parts" of the meanings of open-class context-dependent words might just reflect the presence of some kind of null pronouns at some syntactic level of representation, I will discuss this possibility in section 13.4, along with my reasons for finding it implausible and preferring to explore other approaches. Finally, in section 13.5, I will offer some positive suggestions in the direction of a unified theory of "quantified contexts," building on Heim's view that the basic semantic values of expressions are their context-change potentials. I think it should be possible to extend earlier insights of Stalnaker, Kamp, Heim, and others so as to bring context-dependence and semantic content even closer together and to forge a more unified treatment of context-dependence and variable-binding; but my suggestions in this section remain speculative.

13.2 Initial Data

The possibility of bound-variable-like dependence of open-class predicates was first brought to my attention by the work of Jonathan Mitchell in the early

1980s (see Mitchell 1986). Mitchell's observations included examples like (9) below.

(9)a.   John visited a *local* bar.
   b.   Every sports fan in the country was at a *local* bar watching the playoffs.

Ignoring the sense of *local* which contrasts with *regional*, *national*, *international*, etc., we can say that *local* has to be anchored to some reference location, and means something like "in the vicinity of [the reference location]." In example (9a), the reference location could be the utterance location, or, if the sentence is part of a longer narrative with John as the protagonist, the reference location could be wherever John was at the time. These represent deictic and discourse anchors respectively. While *local* in (9b) *could* also be understood as anchored to the utterance location or some specific discourse location, the most likely interpretation and the one I am most interested in here is one with a "bound variable reference location" – i.e. a possibly different location for every sports fan (his home or home town, for instance, or whatever it is that makes a bar "your local bar").

   A similar phenomenon, though one which looked more like a case of a null argument, had been noted by Dowty (1982), who gave examples (10a,b) below:

(10)a.   Bill was nervously biting his nails.   Everyone noticed.   [13]
    b.   Every secretary made a mistake in his final draft. The good secretary corrected his mistake.   Every other secretary didn't even notice.   [16]
    c.   Every man who shaves off his beard expects his wife to *notice*.

Intransitive *notice* is interpreted like transitive *notice* with a contextually definite object (unlike intransitive *eat*, which is interpreted as having an existentially quantified object argument). In (10a), the discourse context provides the understood value for the "missing object." Dowty offers (10b) as an example parallel to Karttunen's well-known "paycheck" sentences, where the missing object acts like a kind of "pronoun of laziness." And in (10c) we have an example that permits a bound-variable interpretation, where the understood argument of *notice* is, for each man, his own newly beardless state.

   The examples in (9) concerned an adjective, (10) a verb; Partee (1984a) observed that the same behavior can be found with one-place versions of some relational nouns, like *enemy* and *friend*, as in (11).

(11)a.   An *enemy* is *approaching*.
    b.   John faced an *enemy*.
    c.   Every participant had to confront and defeat an *enemy*.

Enemy in (11a) is likely to be understood as my or our enemy; note that *approaching* in (11a) is itself context-dependent, and if the context supported an

understood goal argument of *approaching* other than me or us, the interpretation of *enemy* would probably shift accordingly. (This phenomenon is easier to observe if one changes the example to past tense.) In (11b), a likely interpretation of *enemy* is an enemy of John or of John's group, partly because of the choice of verb.[5] And in (11c), we have the possibility of a bound-variable reading, where who counts as enemy or friend could be different for different participants.

The case of *enemy* raises interesting issues concerning the relative primacy of the two-place relation *enemy of* and the one-place property that results when the second argument is filled in – e.g. the one-place property that Richard Nixon had in mind in compiling his "Enemies List," which might be expressed as "enemy of Richard Nixon." The two-place relation is clearly more general, but, as Mitchell (1986) argued,[6] it does not follow that every instance of the one-place property is best analyzed as derived from the two-place one by filling in or quantifying over one argument place. In particular, an egocentric one-place version of *friend* or *enemy* may be ontogenetically and developmentally prior to the emergence of the two-place relation, and may remain directly accessible even for those who have fully acquired the two-place version. I could imagine (I have no empirical evidence, so I present this just as a possibility in principle) that dogs may have one-place concepts of *friend* and *enemy* – ways of classifying people and other dogs into one category or the other – but may lack completely the possibility of classifying some person A as a friend of B but an enemy of C. And children may well go through a stage where they similarly have a "one-place egocentric" concept of *friend* and *enemy* before developing the two-place concept that would let them acquire the adult interpretation of those words.[7] If that were the case, then we should not analyze the child's early use of the one-place *enemy* as resulting from two-place *enemy* with an argument filled in, e.g. as meaning "my enemy" (much as we have learned to analyze children's earliest uses of *bit* and *took* as unanalyzed morphemes rather than as "correct" past tense forms). The question would then remain open whether the one-place egocentric concept is *lost* when the two-place one is acquired, or whether it remains active; the corresponding linguistic question is whether the apparently one-place common noun *enemy* is to be analyzed in all occurrences as having an implicit argument or context parameter, as it must in (11b) and (11c) on the given readings, or whether it sometimes maps directly on to the old egocentric one-place concept, as it could in (11a). It would also be interesting to look for evidence for a stage at which *enemy* takes a "point-of-view" contextual parameter but not yet an explicit argument, as a possible bridge between the purely egocentric version and a fully "objective" two-place relation; such evidence might take the form of the use of sentences like (11b) but no possibility of using *enemy* with an *of*-complement or a genitive.

Returning to our central data, it is also of interest that the famous "donkey-pronoun" sentences like (12), whose successful analysis is one of the central arguments for the theories of Kamp (1981) and Heim (1982), also have analogues with a wider class of context-dependent elements, as in (13).[8]

(12)   Every man who owns a donkey beats *it*.

(13)a.   Every man who stole a car abandoned it *2 hours later*.

   b.   Every man who stole a car abandoned it $\begin{cases} \textit{within 50 miles.} \\ \textit{50 miles away.} \end{cases}$

In the standard donkey-sentence (12), the pronoun *it* in the matrix has an indefinite NP antecedent *a donkey* embedded in a relative clause on a quantified subject. In the examples in (13), both the dependent and the antecedent are implicit, but their relative locations in the sentence are just as in (12). So in (13a), for instance, the temporal adverb *2 hours later* has an implicit reference time parameter that must be specified for the expression to be interpretable. Where does the reference time come from? On the relevant reading, it's understood as "when he stole the car," i.e. a time indefinitely and implicitly given by the relative clause on the quantified NP, a variable time that will be different for different occurrences of men stealing cars.

As a final set of initial data, to illustrate some of the further variety of aspects of context that can be implicitly quantified over in sentence-internal constructions, consider the richness of spatial and perspectival structure presupposed by systems of locative deixis and locative anaphora, as described, for instance, by Fillmore (1975) for English (see Weissenborn and Klein, 1982, for a sampling of equally rich but often different contextual factors on which the interpretation of locative deixis and anaphora depends in other languages). To start from examples in simple discourse contexts, note the differences in possible interpretations of the italicized expressions in (14b,b′,b″), taken as alternative continuations to (14a). In particular, note the ways in which the respective interpretations of *away*, *ahead*, and *farther away* depend upon different presupposed properties of the context which must be supplied or inferred in order to interpret the expressions at all.

(14)a.   John entered the store and saw a woman he knew.
   b.   Three feet *away* was a small child.
   b′. Three feet *ahead* was a small child.
   b″. Three feet *farther away* was a small child.

In the case of *away* in (14b), we need only a single reference location, which in the given example could easily be either John or the woman; *three feet away* is then understood as three feet from that location in any direction. *Ahead* in (14b′) requires more: its interpretation requires both a reference location and a direction of orientation which qualifies as "forward." In the given example two likely possibilities would be (i) John's location and his direction of travel as he entered the store, or (ii) the woman's location and the direction of John's line of sight when he saw her.[9] *Three feet ahead* is understood in either case as three feet from the reference location in the reference direction. *Farther away* in

(14b″) requires two reference locations (one as for *away* and the other as an implicit argument for the comparative) and perhaps an orientation, although it may be only a cancelable implicature that the child is in the same direction from John as the woman is. Be that as it may, it is not uncommon for contextual parameters such as spatial orientation, point of view, direction of sight or motion, etc., to be crucial for the interpretation of locative deictics and locative "dependents," as Fillmore and others have richly demonstrated. The new point I want to add to these observations is that we find sensitivity to these same factors in sentence-internal quantified constructions, so that the integration of context-dependence with the sentence grammar of variable-binding constructions has somehow got to include such aspects of context as axis of orientation, as well as more "reference-like" parameters such as "reference time" and "reference location."

To illustrate this last claim with an example that combines properties of the implicit "donkey anaphor" cases illustrated in (13) with the rich locative structure illustrated in (14), consider (15).

(15)   Every traveler who stops for the night imagines that there is a more comfortable place to stay a few miles *farther on*.

Consider in particular the interpretation of the italicized phrase *farther on*. Its interpretation requires, and we can easily provide via inference from the interpretation of the subject noun phrase, two reference locations and a path; its meaning is paraphrasable as something like "more distant from [source reference location] along [path from source] than [comparison-base reference location]." (No weight should be placed on my choice of terms for identifying the relevant contextual parameters; there is much written in this area, and I am not an expert in it.) What I want to draw attention to is that we are readily able to interpret the needed parameters in (15) in terms of the (variable) traveler's path of travel; for each traveler, we can identify the traveler himself as the source, his route *qua* traveler as the path, and the place where he stopped for the night as the comparison-base reference location. And these will in general be different for each traveler, i.e. they act like bound variables. But much as Cresswell (1973) argued against the analysis of contexts as discrete tuples of contextual parameters in the early years of the study of indexicality, I will want to suggest that the implicitness and indirectness of all of this information in the subject NP of (15) argues against trying to treat such cases by adding explicit variables over locations, paths, directions of travel, etc., in some syntactic level such as a level of deep structure or a level of logical form. I want to suggest rather that in cases like this we want the possibility of "quantifying over contexts" in a rather holistic sense, although my suggestions fall far short of providing an articulated theory. But first let's look at some of the respects in which syntax *does* clearly play a role in the interpretation of such constructions.

13.3   Syntactic Constraints

To summarize the observations I will make in this section, it appears that the constraints on the syntactic location of dependent items like *local*, *enemy*, *notice*, *later*, *ahead*, *farther on*, etc., relative to the syntactic location of the material that provides the understood anchor or "antecedent" for the dependent element are very similar to the constraints on pronominal anaphora of both "coreferential" and "bound-variable" types. I cannot state the constraints with any precision or confidence, however, for several reasons: (i) as in the case of pronominal anaphora, judgments are often conflicting and unclear; (ii) the history of the study of pronominal anaphora makes it clear that far more work than I have put into this question would have to precede any even halfway trustworthy generalizations; and (iii) to make matters even harder in this case, both the dependents and the "antecedents" are hard to localize in many of the most interesting of these cases; their very implicitness and the uncertainty of whether they exist in the syntax at all means that questions such as whether the "antecedent" c-commands the "dependent" in a given case run the risk of being ill-founded and unanswerable questions. Hence what follows is brief and approximate.

With those caveats, I will claim that the basic (precede and) command types of syntactic constraints on sentence-internal "bound" context-dependence and "discourse-anchored" context-dependence are either just like the constraints on the corresponding uses of pronouns or slightly less restrictive (perhaps closer to the anaphoric uses of definites[10]); in clear cases, the judgments generally agree. So, for instance, (16a), with a referential anchor, is grammatical, just as backwards coreferential pronominal anaphora is, as long as the pronoun doesn't directly c-command the antecedent. But (16b), with a quantified anchor, is pretty bad when we try to interpret *away* as anchored to the variable pigeon locations, in line with the observation that for bound-variable anaphora a quantified antecedent must usually c-command the pronoun.

(16)a.   From five feet *away* I tried to toss a peanut to *the pigeon*.
   b.   #?From five feet *away* I tried to toss a peanut to *every pigeon*.

Certainly the difference in acceptability in (17a) and (17b) is in the expected direction: it is much harder in (17a) than in (17b) to understand there to be possibly different local unions involved for the different professors.

(17)a.   #?The leader of the *local* union wrote a letter to *every untenured professor in the state*.
   b.   *Every untenured professor in the state* received a letter from the leader of the *local* union.

The same contrasts are illustrated in (18a–c), where on the quantified reading we are interested in nearness to each respective senator.[11] The relative badness

of (18b) on a bound interpretation of *nearest* seems comparable to, if perhaps slightly less pronounced than, the relative badness of a bound-variable pronoun in the same position, as illustrated in (19a–c).

(18)a. Only the *nearest* photographer got a good picture of *Reagan*.
   b. #?Only the *nearest* photographer got a good picture of *every senator*.
   c. *Every senator* directed a smile at the *nearest* photographer.

(19)a. Only *his* top aide got a good picture of *Reagan*.
   b. #?Only *his* top aide got a good picture of *every senator*.
   c. *Every senator* directed a smile at *his* top aide.

Given these similarities in syntactic constraints between open-class dependent elements and pronouns, and given their similar ranges of semantic behavior as illustrated in section 13.2, there are at least two ways one might proceed to try to account for the new data. One way, the one I favor, is to try to redesign our theories so that open-class context-dependent elements like *enemy*, etc., are the general case, and pure pronouns and context-independent content words are extreme cases at opposite poles. But another approach with considerable plausibility would be to posit empty pronouns in the representations at some appropriate level to make the anaphoric or pronoun-like parts of the meanings of these various dependent elements explicit. This is particularly plausible for examples like *notice*, *away*, *enemy*, which can be argued to have an argument structure that would naturally accommodate an implicit argument (*notice x*, *away from x*, *enemy of x*). The phenomena I have been discussing might just be reflections of the behavior of a certain kind of empty category, one which might or might not be identical to some previously posited empty category.

I have no conclusive arguments against the latter approach, but I can and should say something about my reasons for being skeptical about it.[12] The following section is directed to that issue.

13.4   Why Not Do It All with Pronouns?

The question of this section is not an easy one. I'm familiar with a lot of the properties of real pronouns, and I can demonstrate some clear differences between the behavior of overt pronouns and the behavior of the "empty" pronouns that might be posited in the open-class cases. But I'm in the uncomfortable position of not being at all familiar with the properties of empty pronouns and not being sure whether that's inevitable because there aren't any or whether my resistance to acknowledging their existence has just prevented me from learning to recognize them and become acquainted with their properties. In any case, all I can do here is offer some of my own reasons for finding it implausible to try to "do it all with pronouns," reasons which might well evaporate if a suitable theory of such pronouns were developed. (It is in

any case perfectly consistent with these arguments that *some* of the cited examples might use some kind of null pronouns.)

What I mean by a "do it all with pronouns" approach, or "uniform pronoun approach" for short, would be an approach which analyzes intransitive *notice* as differing minimally from the phrase *notice it*, but with a phonologically null pronominal element in place of the *it*, and which then proceeds to find ways to analyze *all* context-dependent predicates of the sort I have been discussing into a context-independent lexical predicate plus suitable pronouns or pronoun-like elements, presumably filling argument positions of the given predicate.

The problems I see for such a uniform pronoun approach are of two sorts, the first concerning the antecedents and the second concerning the decompositional analysis of the dependent elements. The first is that overt pronouns in their discourse anaphoric and bound variable uses normally require overt antecedents.[13] We will see below some examples with quantified contexts but no overt "antecedent" where a bare dependent element like *nearby* without an overt pronominal argument can be used, but a corresponding form *with* an overt pronoun cannot (*near it*, *near there*). The second problem is that not all dependent elements take complements or admit of a plausible (to me, at least) decomposition into a context-independent predicate plus pronominal arguments. We will also see examples of that below. But it is clear, as I indicated above, that these problems are not necessarily insurmountable; they can simply be taken as challenges by those who would prefer to try the uniform pronoun approach.

I gave some initial hints of my arguments against the uniform pronoun approach in my discussion of (15) in section 13.2. To make the arguments more explicit, let's look at some other examples.

As a first example consider the discourses in (20a–c) containing *left* and *right*. *Left* and *right* as used in these examples are context-dependent with two arguments or parameters: to the left *of what* and *from whose point of view*. The former is naturally expressed as an argument of an *of*-complement, but the latter can only be made explicit via the sort of paraphrase just given ("from the point of view of *x*") which looks like some sort of an adjunct more than an argument.[14] The ungrammatical (20b) represents an attempt to make the second "argument" overt as a source or experiencer.

(20)a. John had a black spot on the middle of his forehead. *To the left of it* (from John's point of view/from an observer's point of view) was a green "A."

   b. . . . *? to the left of it from/for *him*

   c. Every man had . . .   [same data]

For a similar set of examples, but showing the existence of idiosyncratic lexical variation among similar words in the ability to take overt pronominal arguments, consider (21a–b).

(21)a. Citizens of every country tend to find $\begin{Bmatrix} \textit{foreign} \text{ cars} \\ \textit{foreigners} \\ \textit{strangers} \end{Bmatrix}$ attractive.

    b. [*foreign* to them/that country], [a *stranger* to them/that country], *[a *foreigner* to them/that country]

All the examples in (21a) are well formed, with the context-dependence of *foreign*, *foreigner*, and *stranger* all left implicit. But (21b) shows that while *foreign* and *stranger* can also take overt pronominal arguments, *foreigner* evidently cannot. (Whatever approach one takes to these phenomena, it is already a challenge to try to imagine how to represent such apparent idiosyncratic differences between a lexical item's subcategorization for overt pronominal arguments and its semantic dependence on given (potentially covert) context parameters.)

    The following examples use the dependent adjectives *opposite*, *different*, and *similar*. These adjectives can take an overt pronominal argument when there is an overt accessible NP antecedent for the pronoun, but in the examples in (22) the "antecedent" for the use of *opposite*, etc., while sentence-internal and even quantified, is indirect and inferential with respect to its introduction of a child-rearing method (22a), a strategy (22d), a sleep pattern (22e), a problem (22f), and does not support the use of a pronoun.

(22)a. Not everyone who thinks their parents did a bad job of bringing them up actually switches to the *opposite* child-rearing method.
    b. Interpretation: for each x, the child-rearing method opposite to the method used by x's parents in bringing x up.
    c. * . . . the child-rearing method opposite to *it*.
    d. Every beginning general who loses his first battle switches to a *different* strategy in his second. (#a strategy *different from that/it*)
    e. Why do so many people marry people with the *opposite* sleep pattern? (#sleep pattern *opposite from that/it*)
    f. I wish that just once when I had just worked out a good solution for one client, my next client would come in with a *similar* problem. (#*similar to it/that*)

The similar but good examples (23) below contrast minimally with (22d) above, strongly suggesting that it is not the simple lack of an overt NP antecedent denoting a strategy that makes (22d) bad, but the combination of that fact with the fact that the inferred strategy in (22d) may be a different one for each general. Neither of these factors alone is fatal: (23a) lacks an NP antecedent for the strategy but introduces a unique strategy in the VP "played hard-to-get"; (23b) introduces an NP antecedent for the strategy but, as in typical donkey-pronoun sentences, as a quantified indefinite it may be a different strategy for each general.

(23)a.   Few of the women who had played hard-to-get in the fifties switched
         to the *opposite* strategy after their first divorces in the seventies.   (also
         OK: strategy *opposite to that*)

   b.   Every beginning general who loses his first battle using one strategy
         switches to a *different* strategy in his second.   (also OK: a strategy
         different from that)

This last-illustrated phenomenon can also be seen with example (13),
repeated below.

(13)a.   Every man who stole a car abandoned it *2 hours later*.

   b.   Every man who stole a car abandoned it $\begin{Bmatrix} \textit{within 50 miles.} \\ \textit{50 miles away.} \end{Bmatrix}$

We cannot substitute *later than that*, *within 50 miles of there*, *50 miles away from
there* in (13a–b) as they stand, but if we added a simple *at some time* or *some-
where* in the respective antecedent relative clauses then we could.

Turning back to the locative domain, it seems to me that many of the pa-
rameters to which locative deictics and dependents are sensitive are reflections
of the richly structured presupposed spatial/motional context in which such
expressions are used rather than "arguments" of those expressions in any
familiar sense. And even when such expressions can be used with a pronom-
inal argument, the way locative anchoring works when we quantify over shift-
ing "points of view" or displacements of the understood axes of orientation
does not seem to be the same as the way pronominal anchoring works (though
I am far from being able to articulate the differences in any systematic way).
The examples in (24) illustrate these claims.

(24)a.   In all my travels, whenever I have called for a doctor, one has *arrived*
         (*set out*, *departed) within an hour.

   b.   . . . *arrived there, **set out for there* . . .

   c.   . . . *arrived here, *set out for here . . .

The contrasts in (24) are particularly interesting in suggesting differences
between *here*, *there*, and an implicit contextual point of view. I believe the
anchor for *arrive* and *set out* in (24a) in the *I* in the sense that it is "my" point
of view that establishes the frame of reference. The implicit reference place
being quantified over is wherever I was on any given occasion of calling for a
doctor; that reference place provides the needed goal parameter (or argument)
for *arrive*. (The contrast between *set out* and *depart* I don't understand, but my
location also apparently serves as the goal for *set out*. It may be that *depart*
obligatorily requires a specified *source* and *set out* doesn't.)

Now part of what's interesting in this case is that my varying location
seems to be something like a quantified-over shiftable "here." But the
actual word *here*, as shown by the impossibility of (24c), does not allow such
a bound-variable interpretation. Although *here* is more shiftable than *I* and

can anchor to a third-person discourse protagonist's subjective point of view in a narrative, it cannot anchor to a quantified antecedent as would be required for (24c) to be well formed. *There*, on the other hand, can function perfectly well as a bound variable, but its antecedent or anchor must be "third-person-like," a place looked at from somewhere else, so to speak, not the "here" of ego's point of view. This is apparently the source of the badness of (24b). In fact if we just changed "called for a doctor" to "called from any place for a doctor," (24b) would become fine; "any place" apparently provides a sufficiently externalized perspective on the places where I was when I called to license *there*.

Putting the examples in (24a,b,c) together, we can roughly summarize the situation by saying that *here* must be anchored to the *origo* of the utterance or discourse and disallows a bound-variable use; *there* can be anchored to the non-first-person reference location of the utterance, discourse or sentence-internal context, including the possibility of acting as a bound variable; while *arrive* with its implicit goal parameter can anchor to an explicit or implicit *origo*[15] in the utterance context, the discourse context, or a sentence-internal quantified context. The behavior of the latter thus has properties which overlap those of first-person and third-person locative anaphors but is interestingly different from both.

To summarize this section, I suggest that it would be most fruitful to try to get a picture of the full range of behavior of different open-class and closed-class context-dependent and anaphoric elements, looking at all of them on their own terms, so to speak, before reaching any conclusions about the extent to which it is possible and appropriate to regiment all the cases into a narrow typology using decomposition, for instance, to bring the unfamiliar kinds of cases into line with more familiar patterns.

13.5   Steps toward a Unified Theory of "Quantified Contexts"

13.5.1   Contexts, cases, and tripartite structures

My goal in this section is to try to suggest ways in which natural extensions of the work of Stalnaker, Lewis, Kamp, Heim and Kratzer might help us to unify context-dependence and variable-binding in the kinds of ways the data presented above appear to demand. Stalnaker (1978, 1984) made the notion of *conversational background* prominent and emphasized the two-way dynamics of the relation between the context and the interpretation of successive sentences, the latter both depending on and affecting the former. Lewis (1979) posits a "conversational scoreboard" as an abstract accompaniment to the interpretation process: the "scoreboard" is used to record relevant aspects of the context, such as speaker, reference time, currently most salient individuals, etc.; the scoreboard is updated as the conversation progresses.

What the examples in the previous sections have shown is that many elements can be sensitive "in the same way" to various aspects of any of three different sorts of context: the external context of the utterance, the discourse-level linguistic context, and the sentence-internal linguistic context, which in quantificational constructions can be a quantified context. This last shows the necessity of integrating the relevant "scoreboard" information into the recursive mechanisms of sentence grammar. The parallel sensitivity to all three kinds of context is reminiscent of the behavior of pronouns which motivated the Kamp–Heim theory, and suggests the use of "tripartite structures" as in the Kamp–Heim treatment of donkey-sentences. These tripartite structures, illustrated schematically in tree form in (25a) and in Kamp's box-like Discourse Representation Structure (DRS) in (25b),[16] have historical antecedents in Lewis's (1975) treatment of adverbs of quantification, in McCawley's (1981) emphasis on the preference of natural languages for restricted rather than unrestricted quantification, and in Kratzer's (1977) work on the semantics of modals and conditionals.

(25)a.
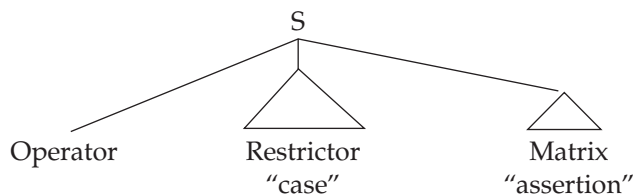
b.
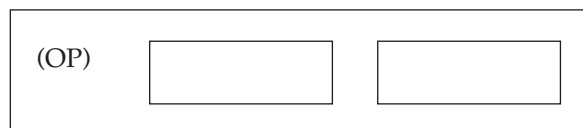
The work of Kamp, Stalnaker, Lewis, Heim, and Kratzer (and others) has made great progress in bringing context-dependence and semantic content closer together. Heim's theory is expressed in terms of "context-change potential," and the manipulations of context in the process of interpretation in her framework are reminiscent of the familiar manipulations of the time index, world index, and variable assignments in other theories.

Kamp's and Heim's theories incorporate a notion of *accessibility* for potential antecedents of pronominal elements; this notion, though syntactically expressible, is fundamentally semantically determined.[17] In a structure like (25a) or (25b), a pronoun in one part can anchor to an antecedent in any higher part, where *higher than* (not their term) is defined as follows: the restrictor is higher than the matrix, and the outer discourse structure is higher than either. As Heim has emphasized, the satisfaction of presuppositions in quantificational and non-quantificational structures shows a similar sensitivity to this kind of structure: the presupposition in the matrix can be satisfied via material introduced in the restrictor clause or anywhere "higher."

So it seems very natural to add the generalized context-dependence we've been discussing to this same schema: a context-dependent element of any kind in the matrix clause can anchor on to material in the restrictor or anywhere "higher." This then would seem to unify pronominal anaphora, presupposition, and the varieties of context-dependence illustrated in the previous sections. This observation does not, of course, constitute a theory; flashing out a real theory along these lines will take much more work.

But I can give a rough sketch of the sort of treatment I imagine; (26) below represents a first approximation in extended DRS terms to a structure for (13a), repeated below.

(13)a.   Every man who stole a car abandoned it 2 hours *later*.

(26)   DRS for (13a) (first approximation)

C_0

C_1

C_2 $\dot{e}_1$ $\dot{u}$ $\dot{v}$
man (u)
car (v)
e_1:

| steal (u, v) |

$\Rightarrow$

C_3 $\dot{e}_2$

2 hours later C_2 (e_2)
e_2:

| abandon (u, v) |
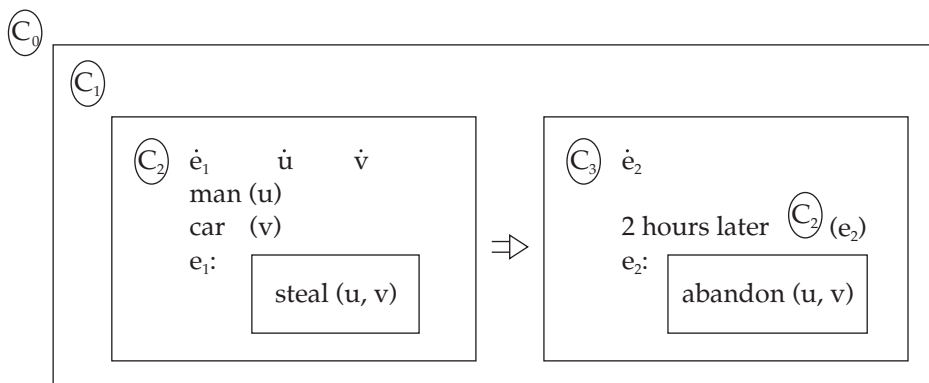
The circled C_0, C_1, etc. represent nested contexts: C_0 the external context of utterance, C_1 the context of the discourse at the point at which (13a) is evaluated, C_2 the (quantified) context of the restrictor clause, and C_3 (understood as an extension of C_2) the context of the matrix, which is thus embedded within all three of the others. In (26), the element *later* in the matrix needs an anchor: my suggestion is that, rather than introduce an explicit time variable to mediate this dependency, we simply index *later* to some accessible context. It is part of the lexical semantics of *later* that whatever context it anchors to must have, either overtly or inferably, a reference time to interpret *later* in terms of. For the quantified interpretation, illustrated in (26), *later* is marked as anchored to the context C_2, whose (variable) reference time would be times of the stealing events that are being quantified over.

In general in such tripartite structures, the matrix is interpreted relative to a "case" as established by the "restrictor." The specification in the restrictor will generally establish a partially defined context. In (26), for instance, each "case" (i.e. each car theft) provides an implicit time, place, original owner, motive, method, and undoubtedly more. In so far as the whole construction is interpreted as quantifying over such "cases," with the matrix interpreted in the

quantified context established by the restrictor, we may then be able to interpret many context-dependent elements in the matrix just by indexing them globally to the context of the restrictor, without having to posit explicit variables for time, place, manner, motive, etc.

13.5.2   Syntactic and semantic c-command-type restrictions

The kinds of c-command restrictions discussed in section 13.3 should probably be related to the construction and manipulation of nested contexts, and to the hierarchy of accessibility for pronominal anaphora as graphically articulated in file change theory or DRS theory. It is important to realize that most occurrences of expressions are located in many contexts at once, including nested contexts such as were illustrated in (26). For many dependent elements, particularly those sensitive to first-person-like *I*, *here*, *now* parameters of the context, just indexing them to a whole *context* may suffice, since many relevant aspects of context seem to be of a "unique-per-context" sort (e.g. the temporal anchor for *later* in (26)). But this is clearly not the case for third-person pronouns, and may be similarly too strong for other third-person-like elements such as locative *there*.

 The idea of nested contexts and indexing to context can be further illustrated with an example involving *we*, showing not only ambiguity in nested context situations, but the possibility of anchoring to a context which draws elements into itself from some of the higher accessible contexts.

 Consider the sample text in (27) and the DRS in (28).

(27)   John often comes over for Sunday brunch.
       Whenever someone else comes over too,
       we (all) end up playing trios.   (Otherwise we play duets.)
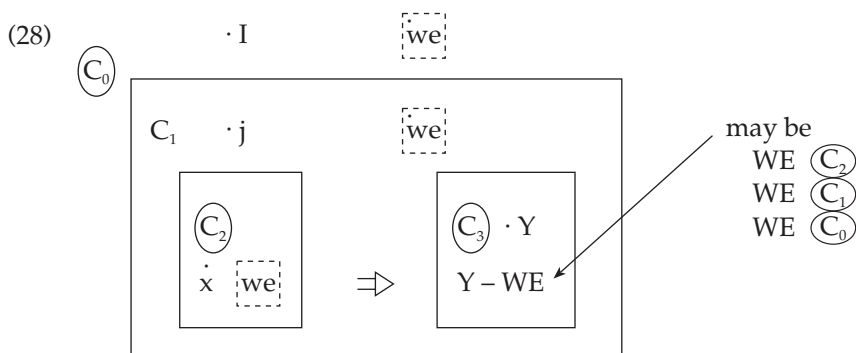
The *we* that occurs in the matrix has as its most plausible interpretation a bound-variable interpretation anchored to (accommodated into) the restrictive clause; that *we* in turn can be understood to denote a group including me,

John, and the somebody else being quantified over in the sentence, i.e. a combination of individuals from the external utterance context, the discourse context, and the context of quantification. Of course, there are other readings in principle possible for the *we*: it could anchor to the utterance context alone (*we* being then some particular known individuals in the speech situation, e.g. my family) or to the discourse situation alone (where it would likely pick up *John and me* as the salient group).

As another example of nested contexts, consider sentence (29) and the rough DRS (30) for it.

(29)   Most Europeans speak a foreign language.

(30)
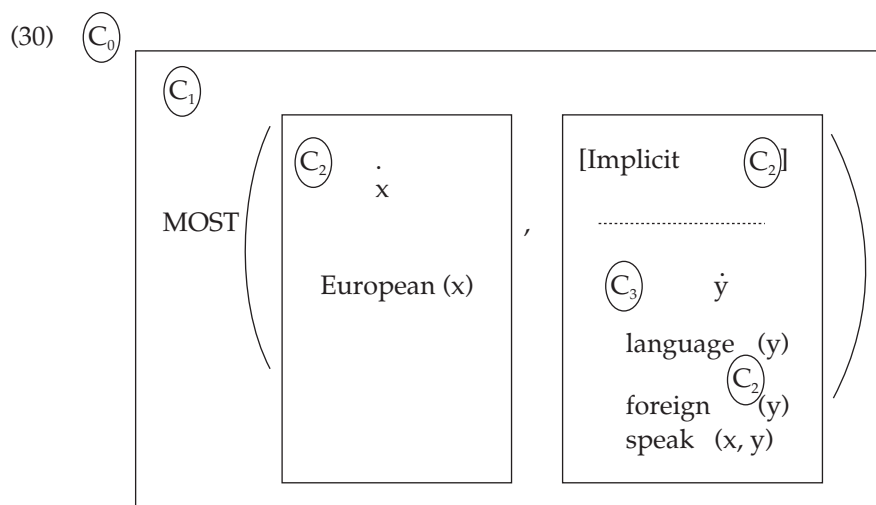
If, as in the diagram given in (30), we anchor *foreign* to the quantified context C_2, we mean *foreign* from each European's point of view – French for Germans, English for Danes, etc. However, the sentence could also be used by the stereotypical "ugly American" to say why he doesn't like to travel in Europe: to him the Frenchman speaking French in speaking a foreign language. That would be represented by anchoring *foreign* to C_0, giving the egocentric point of view. And an anchoring to the discourse content C_1 could represent the egocentric point of view of a discourse protagonist – e.g. in a narrative about a certain ugly American and his attitudes.

The sentence (31), offered by Gregory Ward, shows the same ambiguities and more.

(31)   Most foreigners speak a foreign language.

While both occurrences of *foreign* could be egocentrically anchored to C_0 (the ugly American again), a more interesting reading is one where the first

occurrence of *foreigners*, which will be in the restrictor clause, in anchored to the utterance or discourse context, while the second, in the matrix, in anchored to the restrictor, i.e. to the perspective of the (variable) subject.

13.5.3   Lexical information about dependent elements

One of the principal tasks that faces the working out of a theory along the lines of these suggestions is to articulate a framework in which the relevant lexical information about dependent elements can be appropriately captured. In general, I think we can say that dependent elements, both closed-class and open-class, are interpreted as *functions from contexts to semantic values or referents*. This means that we would have to specify at least the following three kinds of information about each dependent element:

 (i)   what *kind(s)* of context it can anchor to (utterance situation, discourse, sentence-internal);
 (ii) *requirements* on the context for the element to be defined, as presuppositions or implicatures (e.g. *farther on* requires a point of view and a reference location);
(iii) *meaning*, generally as a function of the elements required in (ii), which is presumably why they're required (*farther on*: "more distant from the point-of-view location along the point-of-view directional orientation than the reference location is").

When a dependent element occurs in several nested contexts at once, the requirements of type (i) and (ii) may or may not disambiguate it; if not, plausibility factors may disambiguate it or it may remain genuinely ambiguous. The ease with which we seem to disambiguate most such elements in natural speech may partially account for the apparent lack of attention to their pronoun-like properties. For the pronouns, there is essentially no descriptive meaning beyond the identification with an antecedent, so one can't help but notice their dependence properties, a point which leads us to the topic of the next section.

13.5.4   Pronouns as an extreme case

As I have tried to suggest throughout this paper, I believe that the general case of lexical meaning is a combination of inherent meaning and dependence on context. As we seek a theory that adequately captures the right amount of power, the right constraints, and the right articulation of important properties and parameters, we have to simultaneously try to analyze the linguistically relevant properties of contexts and the relevant properties of the lexical items.

One observation that seems to surface from the examples we have looked at is that some aspects of contexts seem to be generally unique per context, at least if we analyze contexts into the right-size chunks: e.g. reference time, reference place, point-of-view. And there seems to be a corresponding sub-class of context-dependent elements which anchor on to such properties of contexts, and for which indexing to a choice of context is therefore probably sufficient and appropriate, rather than trying to introduce an overt empty pronoun or variable to try to capture the anchoring via explicit identity. I suspect, as I mentioned above, that this is more generally the case for "first-person-like" dependents which anchor to the *I-here-now* or point of view of a context, the implicit versions of which seem to be much more shiftable and bindable than their explicit counterparts (as discussed above in connection with example (24)).

Other aspects of contexts, such as salient individuals, are not generally unique per context, and for the corresponding dependent elements which anchor on to them, there may be more than one potential anchor per context and hence a need to structurally indicate not only the choice of anchoring context but the choice of a particular antecedent within it. This is probably the general rule for third-person pronouns and "third-person-like" dependents in general, and if so, this would support something like the familiar uses of indexing and coindexing mechanisms. I am, therefore, not proposing the elimination of explicit variables or indices altogether, but just arguing that not all context-dependence should be so represented.

Third-person pronouns, then, appear from this perspective to be a limiting case of a broader phenomenon. They have essentially no descriptive content of their own, so that their interpretation is exhausted by a description of their anchoring and binding possibilities. They may have many potential antecedents per context, and their antecedents must normally be overt NPs, especially in the bound-variable case. From a broader perspective we can see that none of these properties holds of all dependent elements.

13.6   Summary

The fact that context-dependent phenomena of many kinds operate even in quantified contexts argues strongly for the integration of such kinds of context-dependence into sentence grammar. Theories such as DRS theory and file change semantics which emphasize the dynamics of context change have helped to unify the treatment of presupposition and anaphora in quantified constructions, and although much work remains to be done, it looks possible and necessary to generalize and extend these ideas to context-dependence of many kinds. It will be important to look at as many languages as possible, and as many kinds of "pronoun-like" elements as possible, and to try to identify other linguistically relevant aspects of context that the interpretation of such elements can be sensitive to. Several approaches to further work in this

direction suggest themselves, and I expect that pursuing them all will be valuable. One task is to go through studies of the properties of pronouns (in various languages and in various theories) and see which of these properties extend to or contrast with properties of open-class context-dependent elements. Another important task is to start from studies of context-dependence of many kinds and in many languages, and see which properties need to be recognized within sentence grammar, using the behavior of bound-variable contexts as a diagnostic. I would expect that we will find many purely pragmatic context-dependent phenomena that do *not* integrate into sentence grammar, such as the use of honorific forms.

When we have a better idea of the range of the phenomena, both in terms of the class of dependent elements and in terms of the properties of contexts they are dependent on, we will be in a better position to identify properties and parameters that play an explanatory role in the overall organization of the system(s) of dependence. The observations in this paper suggest what some of the important properties might be, but the central questions in this area are still open ones.

Acknowledgments

Notes

1   See, for instance, Partee (1984b). I am ignoring finer distinctions and controversies which are irrelevant to the main concerns of this paper.

2   In Amharic, on the other hand, the first-person pronoun is also used as a logophoric pronoun coreferential with the subject of a verb of saying or believing (Emmon Bach, personal communication); I would conjecture that this would lead to bound-variable possibilities in examples like (8) below, though not (7).

3   There does seem to be the possibility of a bound-variable use of *I*, not with quantified antecedents, but in the formation of relative clauses by predicate abstraction in certain cases where tension between syntactic agreement and semantic interpretation undoubtedly plays a role. Thus (i) below tends to admit a bound-variable reading of the second *I*, perhaps even as its preferred reading.

(i) I'm the only one around here who will admit that I could be wrong.

4 Some speakers can also apparently get external referential anchoring for the English reflexives. The difference shows up in tests for strict vs. sloppy identity in examples like (i) and (ii), where the bound-variable-only "dialect" gets only sloppy identity (Bill voted for himself), and the other "dialect" can also get a strict-identity reading (Bill voted for John/me).

  (i) John voted for himself, and so did Bill.
  (ii) I won't vote for myself unless Bill does.

5 Among the important properties I am ignoring here are some that would be involved in distinguishing between reflexive-like and non-reflexive-like "implicit arguments," including issues of locality requirements on the relation between antecedent and implicit argument.

6 Mitchell discusses a variety of examples of perspectival properties, including some for which various species seem to be "hard-wired" for an egocentric version. The information a bat obtains from its sonar system is an example of such a case; all the information it obtains about distance and direction and speed of motion of objects it detects are relative to the bat's own position, orientation, and direction and speed of motion.

7 Janet Fair reported to me after the oral presentation of this paper that her 3-year-old had gone through a noticeable evolution in the understanding of *enemy* from about 33 months to about 36 months, including passage from the question "What's an enemy?" to the questions "What's an enemy to a mouse?," "What is an enemy to a bear?"

8 These examples were first brought to my attention by Roger Schwarzschild.

9 I'm not sure whether shuffling these pairs yields available contextual anchors as well, or not; I suspect not. If John's line of sight is the same as his direction of motion, we can't tell; if he sees the woman to his left while walking straight ahead through the door, my intuition is that we have to be consistent in the sense of taking both the location and the orientation from the same conjunct of (14a). This intuition is reinforced by the fact that if we give the second conjunct of (14a) a separate temporal adverb, such as "and two minutes later saw . . . ," then (14b′) must get its temporal and locative anchors all from the same conjunct, presumably the second.

10 Irene Heim (personal communication) noted that weak crossover effects tend to be milder in German examples with *die Mutter* "the mother" than in corresponding English examples with *his mother*. The context-dependent elements I discuss may line up more with the anaphoric definites than with the overt pronouns, where these differ; in fact, anaphoric definites may well be an example of the kind of context-dependence I am trying to treat here.

11 It was pointed out to me by Zi-Qiang Shi that (18b) improves noticeably if the (episodic) *got* is replaced by (generic or habitual) *gets*. This would seem to be the result of introducing quantification over situations of photographing, and no longer limiting the quantification to the senators. But I have no explanation in detail.

   The following examples, from John Kingston, are likewise generic, and it may be that the *for everybody* in (i) and (iii) is a adjunct delimiting the domain over which the generic claim holds.

(i)   The *nearest* exit isn't the best for *everybody*.
(ii) The girl *next door* is the best wife for *every man*.
(iii) A seat in the *local* bar is the best place to watch the superbowl for *everybody*.

An even harder apparent class of counter-examples was pointed out to me by Wayles Browne; these have the structure of "MIGS and pilots" sentences.

(iv) The *successors* were better than the *predecessors*.
(v)   The *successors* are always an improvement over the *predecessors*.

I have no account for (iv) and (v).

12 I will offer what seems to me to be rational grounds for my skepticism, but I have to confess to sometimes wondering if I don't have a temperamental objection to the uniform pronoun approach. I have resolved several times in the past to try to work out an analysis *with* pronouns, and have not been able to bring myself to do it. But I hope someone will try to work out such a theory so that results can be compared.

13 The claim that overt pronouns require overt antecedents requires caveats. It accounts for the difference between my old examples (i) and (ii), but (ii) is not totally ungrammatical with a substantial pause before *it*, and other instances of "accommodated" antecedents can be found in the literature.

(i)   One of the ten balls is missing from the bag.   *It's* under the couch.
(ii) Nine of the ten balls are in the bag.   #*It's* under the couch.

14 Jerry Sadock pointed out in discussion that *to his right* is unambiguous in a way that *to the right of him* is not.

15 A term introduced by Bühler (1934); see discussion in Weissenborn and Klein (1982).

16 The double arrow in (26) and (28) is an abbreviation for a special case of the operator of (25a,b), (30), namely for the selective universal quantifier.

17 This is pointed out by Heim (1982) and discussed more fully by Chierchia and Rooth (1984).

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Chapter 14

Weak NPs in *Have*-Sentences

———————

Landman and Partee (1987) is an occasionally cited abstract of a never-written paper which offers a solution to the problem of how to compositionally interpret sentences like (1) and explain the ill-formedness of sentences like (2).

(1)   John has two sisters.

(2)   *John has every sister.

In this short note we repeat that proposal in slightly more detail and discuss its motivation and possible modifications in the light of recent work by Szabolcsi and others.

The restrictions on NPs that can occur in *there*-sentences are closely paralleled by restrictions on NPs that can occur in relational *have*-sentences, as observed by Partee in the early 1980s[1] and as illustrated below.

(3)   There is/are ____ candidates for the job.

(4)   John has ____ sisters.

(5)   OK in (3), (4): *a, some, three, at least three, several, many, a few, no, few, at most three, exactly three.*

(6)   * in (3), (4): *the, every, both, most, neither, all, all three, the three.*

Earlier characterizations of the class of NPs permitted in (1) as "indefinite" have yielded to a description in terms of the weak/strong distinction suggested by Milsark (1977) and given varying formal explications in the work

of Barwise and Cooper (1981), Keenan (1987), Jong (1987), Diesing (1990, 1992). Heim (1987) suggests a synthesis of the novelty/familiarity theory of definiteness with the weak/strong distinction of Barwise and Cooper. Jong (1987) and Diesing (1990, 1992) propose that the relevant notion of strength rests on the presence of an existential presupposition in the noun phrase. Szabolcsi (1994) agrees with the presuppositionality characterization and views strength as amounting to a kind of specificity, with definiteness a special case of specificity.

There-sentences have long played an important role in explorations of the syntactic and semantic properties of determiners and NPs, and have themselves been the focus of much investigation in syntax and semantics, while *have*-sentences and the corresponding restrictions in them had received relatively little attention before the last decade or so; Keenan (1987) was one of the earliest explicit discussions in print. The analysis of *have*-sentences does not follow automatically from any familiar analysis of *there*-sentences, and the relational interpretation of the nouns heading the post-*have* NP in sentences like (4) raises interesting challenges for a compositional interpretation. Outside of the tradition of formal semantics, the relation between existential *be* and *have*-sentences has been discussed from theoretical and typological perspectives; see Bach (1967) and Freeze (1992). And the relation between *have*-sentences and possessive or genitive constructions has been a topic of recent investigation by Jensen and Vikner (1994, 1996), and by Szabolcsi (1986, 1994), who offers a detailed syntactic and semantic analysis of the relation among possessive constructions, *have*-sentences, and existential sentences in Hungarian.

The basic problem for compositionality presented by existential *have*-sentences like (4) can be described thus. On the one hand, the NP following *have*, like the NP in existential *there*-sentences, appears to be a complete NP (or "DP," following Abney 1987). It must be an "indefinite" (weak) NP, but the range of determiners illustrated by the list in (5) shows that it is not limited to the possibly $\langle e, t \rangle$ type of predicative NPs (actually, $\langle e, \langle e, t \rangle \rangle$ type in this case, since these are relational NPs), which exclude determiners like *few* and *exactly three* (and in English normally exclude *no*); these would be classified as NPs in a system making the NP/DP distinction, which we are not making here. The indefiniteness restriction also eliminates all prototypical *e*-type NPs from this position, such as proper names and NPs headed by *the*, *this*, *that*. So it is most natural to assume that it is a normal NP interpreted as a generalized quantifier, and to look for a semantic explanation of its required weakness along the lines of the explanations that have been proposed for the indefiniteness requirement in existential *there*-sentences.

On the other hand, if we start from the evident meaning of the sentence as a whole and try to see how to build it up compositionally, it is not clear how the NP following *have* can be interpreted as a generalized quantifier, of type $\langle \langle e, t \rangle, t \rangle$,[2] when it contains a relational head noun *sister* one of whose argument places is filled by the subject *John*. The meaning of the whole sentence

is given in (7); the meaning of the VP is given in (8). The problem is then how to find reasonable meanings of *have* and *a sister* which can combine to give the meaning in (8).

(7) *John has a sister*: $\exists x[\textit{sister-of'}(j)(x)]$

(8) *have a sister*: $\lambda y[\exists x[\textit{sister-of'}(y)(x)]]$

The solution of Landman and Partee (1987) is to give *a sister* a meaning which is not of the simple generalized quantifier type, but rather of an "unsaturated" relational generalized quantifier type $\langle\langle e, t\rangle, \langle e, t\rangle\rangle$, as given in (9), and to give *have* the meaning in (10).

(9) *a sister*: $\lambda P\lambda y[\exists x[\textit{sister-of'}(y)(x) \;\&\; P(x)]]$

(10) *have*: $\lambda R[R(\textit{exist})]$
       where **R** is of type $\langle\langle e, t\rangle, \langle e, t\rangle\rangle$, and *exist* is $\lambda z[z = z]$.

We have borrowed the name *exist* from Keenan (1987) (in earlier work he called the same property "Mercy"); it is the property that holds of every entity in the domain. Keenan's *exist* can be identified with the property $\lambda z[z = z]$ used by Barwise and Cooper (1981) in their analysis of existential *there*-sentences.

  The meaning of the determiner *a* in its occurrence in (9) is as given in (11b), contrasted with its normal meaning in (11a).[3] For other determiners, the corresponding "relational NP" versions can be obtained by the general rule in (12).

(11)a. Normal *a*: $\lambda Q\lambda P[\exists x[Q(x) \;\&\; P(x)]]$
   b. Relational *a*: $\lambda R\lambda P\lambda y[\exists x[R(y)(x) \;\&\; P(x)]]$
          where *P*, *Q* are of type $\langle e, t\rangle$, *R* of type $\langle e, \langle e, t\rangle\rangle$

(12)   If Det has a normal translation $\lambda Q\lambda P[\Phi(Q, P)]$, i.e. Φ, then its translation as a "relational" Det is $\lambda R\lambda P\lambda y[\Phi(R(y), P)]$.

To defend this analysis, we need to show (a) that it gives the right results in *have*-sentences, and (b) that the given translations can be motivated and are not simply *ad hoc*.

  First of all, it can easily be checked that applying the given translation of *have* to the given translation of *a sister* and doing λ-reduction leads, as desired, to the formula in (8). It can similarly be checked that the same holds for the full range of determiners in (5). We give one illustration in (13).

(13)a. *few*$_{Rel}$: $\lambda R\lambda P\lambda y[\textbf{\textit{few}}'(R(y), P)]$
   b. *have few friends*: $\lambda y[\textbf{\textit{few}}'(\textit{friend'}(y), \textit{exist})]$
   c. *John has few friends*: $\textbf{\textit{few}}'(\textit{friend'}(j), \textit{exist})$

And it is encouraging to see that we also get the right result with conjoined NPs following *have*, assuming the generalized conjunction of Partee and Rooth (1983).

(14)a. *a brother and a sister*: $\lambda P \lambda y [\exists x[brother\text{-}of'(y)(x) \& P(x)]]$
         $\lambda P \lambda y [\exists x[sister\text{-}of'(y)(x) \& P(x)]]$
         $= \lambda P \lambda y [\exists x[brother\text{-}of'(y)(x) \& P(x)] \& \exists x[sister\text{-}of'(y)(x) \& P(x)]]$
    b.   *have a brother and a sister*: $\lambda y [\exists x[brother\text{-}of'(y)(x)] \& \exists x[sister\text{-}of'(y)(x)]]$

This is important because, as we see in (15), conjoined post-*have* NPs can each have their own determiner, not necessarily of the same monotonicity. This is a strong argument against the possibility (explored in Partee 1983) of treating the post-*have* NP as an $\langle e, \langle e, t \rangle \rangle$-type relational common noun phrase, with its "determiner" really a modifier. Such an approach would be analogous to the $\langle e, t \rangle$-type meanings proposed in Partee (1987) for predicative NPs (true "predicate nominals"). That approach works well for predicate nominals, which have a more restricted set of possible "determiners," but does not work well for these post-*have* NPs. On the present analysis, on the other hand, the examples in (15) all work as straightforwardly as the one in (14).

(15)a. John has two sisters but no brothers.
    b. John has many friends and exactly two enemies.
    c. John has a brother, two sisters, and at most four cousins.

Furthermore, this analysis explains the restriction to weak NPs in a way exactly analogous to Barwise and Cooper's explanation of the corresponding restriction in *there*-sentences. The interaction of strong NPs with the predicate *exist*, which is true of every entity in the domain, makes existential sentences containing strong NPs come out either tautologous, contradictory, or else asserting or denying something they already presuppose. We leave the derivations as an exercise for the reader. On approaches which identify strength with presuppositionality, the anomaly would always be of the latter sort. That would be an advantage, since otherwise one has to try to tell a convincing story about why these tautologies and contradictions are perceived as semantically anomalous, not merely as tautological or contradictory. In any case, on this approach, it seems that any good explanation of the weakness restriction in *there*-sentences will extend directly to *have*-sentences.

So the analysis does well in terms of covering the data. But where do these meanings come from? Are they simply ad hoc stipulations?

As many authors have argued, *have*-sentences like these are a species of existential sentences, a claim we have implicitly accepted in starting from the translation in (7). So let us review the treatment of *there*-sentences to put the analysis of *have*-sentences in context. One of the earliest attempts to capture the interpretation and explain the definiteness restriction in *there*-sentences came in the classic work of Barwise and Cooper (1981). Barwise and Cooper

analyze a *there*-sentence (without trying to take apart the *there* and the *is/are*) as in (16).

(16)   *There is/are NP*: $NP'(\lambda x[x = x])$ or equivalently $NP'(exist)$.

We suggest that the "dummy" predicate *exist* introduced in the analysis of *have* in (10) and the analysis of existential *there*-sentences in Barwise and Cooper (1981) is the existential generalization of a missing XP argument in a construction whose full form is *have* NP XP (with relational NP) or *there be* NP XP, as in (17).

(17)a.   John has a friend on the committee.
    b.   There is a unicorn in the garden.

Ignoring the problem of how to account for the intuition that the predicational structure, or perhaps the information structure (topic-comment structure), in existential sentences is in some sense "reversed" from that in normal subject-predicate sentences, we can give the semantics for these structures as follows:

(18)a.   *have a friend on the committee*: $\lambda y[\exists x[friend'(y)(x) \ \& \ on\text{-}committee'(x)]]$
    b.   *have on the committee*: $\lambda R[R(on\text{-}committee')]$
    c.   *have* (with coda): $\lambda Q[\lambda R[R(Q)]]$

(19)a.   *There is a unicorn in the garden*: $\exists x[unicorn'(x) \ \& \ in\text{-}the\text{-}garden'(x)]$
    b.   *there is in the garden*: $\lambda P[P(in\text{-}the\text{-}garden')]$
    c.   *there is/are* (with coda): $\lambda Q[\lambda P[P(Q)]]$

If we say in each case that the existential construction (*have* or *there is/are*) has an extra argument place for a "coda" constituent, perhaps typically a locative though this is a big subject for further discussion, then in the absence of the coda constituent, it is reasonable that the result should be existential quantification over a corresponding variable, just as in the case of "missing objects" with intransitive versions of *eat* and *read*. The results would be as follows:

(20)a.   *there is/are* (without coda): $\lambda P[\exists Q[P(Q)]] = \lambda P[P(\lambda z[z = z])] = \lambda P[P(exist)]$

    b.   *have* (without coda): $\lambda R[\exists Q[R(Q)]] = \lambda R[R(\lambda z[z = z])] = \lambda R[R(exist)]$

That gives some independent motivation for the *exist* predicate in both kinds of existential sentences. (This may be seen as one possible formalization of the frequently felt intuition that "exist" *simpliciter* means "exist somewhere.")

    But there still remains the question of motivating the interpretation of the relational NPs in the *have* sentences and the corresponding occurrence of the relational NP variable R in the interpretation of *have*. Partee (1983/ 1997) defends (with some hesitation) a relational type, $\langle e, \langle e, t \rangle \rangle$, for inherently

relational common nouns (TCN: "transitive common noun") like *sister*, *friend* as part of the analysis of the genitive construction *John's sister*, *John's friend*, and Partee and Borschev (1998) argue for a modified version of the analysis of Jensen and Vikner (1994) in which non-relational common nouns are coerced to relational meanings when occurring with a genitive NP. But on those analyses, the full NP *John's sister* is still of the ordinary generalized quantifier type, $\langle\langle e, t\rangle, t\rangle$. Thus that analysis of genitives does not lend any support to the kind of relational NP type that is posited in (9). And in fact Landman and Partee (1987) had no independent motivation for the use of that type; its motivation was simply its success in accounting for the data.

The more recent work of Szabolcsi (1994) on possessives and *have*-sentences in Hungarian suggests a different way of looking at the analysis proposed above, which would relate it both to existential sentences and to possessive constructions, both of which it should clearly be related to. Space does not permit a full review of Szabolcsi's analysis and arguments; we present them in an extremely condensed and superficial form. Szabolcsi argues that Hungarian *have*-sentences are existential *be*-sentences involving possessor extraction; that is, that the Hungarian surface analogue of *John has a sister* has an underlying structure roughly like *there-is a sister of John's*. There are many important differences between Hungarian and English syntax, making such a derivation much less "abstract"-looking for Hungarian than a similar derivation would be for English. But for present purposes, without making any actual claims about derivation, let us look at how such a relationship might make sense of the types posited above for *have*-sentences.

First we should review some basics of English genitive or possessor[4] constructions. Again abbreviating, following the presentation in Partee (1983/ 1997) and that in Partee and Borschev (1998), we can say that the basic genitive construction is the postnominal one, and it takes an *e*-type NP in the genitive:

(21) Postnominal genitive, the "inherent *R*" type:
     teacher of John's: $\lambda x[\textit{teacher}(\text{John})(x)]$ type: $\langle e, t\rangle$
     of John's: $\lambda R[\lambda x[R(\text{John})(x)]]$ or equivalently, $\lambda R[R(\text{John})]$
                      type: $\langle\langle e, \langle e, t\rangle\rangle, \langle e, t\rangle\rangle$
     [$_G$'s]: $\lambda y\lambda R[R(y)]$ type: $\langle e, \langle\langle e, \langle e, t\rangle\rangle, \langle e, t\rangle\rangle\rangle$

Then, departing slightly from the presentation in those papers, we introduce two more constructions for the genitive (here I am inspired by Szabolcsi 1994, although not exactly following her). First, for English prenominal genitives, there is the fusing of the genitive NP, still type-*e*, with an implicit definite article by function-composition.

(22) Prenominal genitive:
     [*John's*]$_{\text{DET}}$ $\lambda R[\_z[R(\text{John})(z)]]$ type: $\langle\langle e, \langle e, t\rangle\rangle, e\rangle$
     = TR([*the*]$_{\text{DET}}$) $\cdot$ TR([*of John's*])
          where type(TR([*of John's*])) = $\langle\langle e, \langle e, t\rangle\rangle, \langle e, t\rangle\rangle$
          and type(TR([*the*]$_{\text{DET}}$)) = $\langle\langle e, t\rangle, e\rangle$

Then there is the possibility of quantifying in a full generalized quantifier-type NP, type $\langle\langle e, t\rangle, t\rangle$, into a e-type genitive NP like (in MG terms) he_3's in he_3's sister or one sister of he_3's to derive NPs like each boy's sister or one sister of each boy's. I give no actual syntactic analysis, but simply assert that since English NPs do not have the kind of "escape hatch" that Hungarian NPs do, the scope of a quantified NP in an English genitive NP construction is strictly limited to the "periphery" of the containing NP, a scope limitation that was built in a stipulative way into the analysis of genitives in Bach and Partee (1980) and Partee and Bach (1981).

(23)   Quantifying into the genitive NP in an "NP's TCN" and "Det TCN of NP's" constructions.[5]
   a.   [*each boy*]$_3$ [*his$_3$ sister*]: $\lambda P[each\ boy'(\lambda x_3[x_3's\ sister'(P)])]$
        (the set of properties P such that each boy's sister has P, i.e. such that for each boy, the sister of that boy has P)
   b.   [*each boy*]$_3$ [*a sister of his$_3$*]: $\lambda P[each\ boy'(\lambda x_3[a\ sister\ of\ x_3's'(P)])]$
        (the set of properties P such that a sister of each boy's has P, i.e. such that for each boy, a sister of that boy has P)

Now how does this relate to existential *have*-sentences? If we think of the postnominal genitive as the basic genitive construction, and think of relational nouns as "wanting" a genitive argument, then whether we adopt such a move syntactically for English or not, we can motivate the semantic structure above by saying it is "as if" the subject of the *have*-sentence is a moved instance of a quantified-in possessor:

(24)   *John$_3$ has a sister-of-x$_3$'s.* Or: John is an x_3 such that there is a sister of x_3's.

In *have*-sentences, there is much more independence of determiners in the two NPs than there is in possessive constructions; so English *have*-sentences look more like their Hungarian counterparts than English NPs with possessives do. (Hungarian NPs with possessives allow two determiners with great freedom, allowing things analogous to **few students' every book*.)

(25)a.   Most boys have at least one and at most four sisters.
   b.   Every student has a brother and a sister.

If we imagine (25b) to be a way of saying "there is, for every student, a brother of his and a sister of his" (as the Hungarian analogue would be analyzed on Szabolcsi's account), then the "λy" we see on the translation *have a sister* in (8) and of *have few friends* in (13b) is not the usual subject-seeking argument, but is rather the abstractor that always accompanies a quantifying-in rule. And the placement of the λy in the translations of *a sister* in (9) and *a brother and a sister*

in (14a) reflects the place where the generalized quantifier must end up having its scope in the possessive construction, as seen in (23).

Of course, it would take much more work to really motivate all the properties of this analysis – or, probably better, to improve it into one that could be more fully motivated – including much more attention to the syntax of the NP and the syntax of existential constructions of both types.

There are a number of loose ends left by this brief sketch. I have not said anything about the relation of "existential *have*" to the true "verb" *have* (roughly, "to have at one's disposal"), topics that are discussed by Jensen and Vikner (1996), Szabolcsi (1994), and Heine (1997). Another important loose end, which was left as a promissory note in Landman and Partee (1987) and which remains to be fulfilled, is the need for a discussion of the status of the above-mentioned "codas" in existential sentences, their relation to locatives, and careful examination of the arguments in the literature concerning whether and when a potentially single NP like *two sisters in the Navy* occurring in an existential sentence of either type is to be regarded as one constituent and when as two. These should all be important parts of the story, but they must all be left for more thinking on another day.

Acknowledgments

Notes

1 The observation was made in comments to colleagues and in the 1983 colloquium presentation in Amsterdam mentioned in the footnote 1. It is reported with attribution in published works of de Jong (1987), Szabolcsi (1986, 1994), and others.
2 In this paper we ignore intensions; all types given are simplified extensional variants.
3 Here, as in our original proposal in 1987, we are simply assuming the Montagovian generalized quantifier treatment of indefinites. Adaptations of the proposed solution to other treatments of indefinites are an open issue that we have not explored.
4 I am not distinguishing between the terms *genitive* and *possessive*; both are frequently used in the literature, sometimes distinguishing between them and sometimes not.
5 In Hungarian, there is a possessive suffix on the head noun; Szabolcsi takes that suffix as introducing the *e*-type argument position that gets quantified into. For English, the syntax at this point needs further investigation. It is harder to get a full range of quantified genitive NPs in the postnominal position, and there are restrictions between postnominal quantified genitive NPs and the choice of head NP determiner that need to be explained.

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Chapter 15

Some Puzzles of Predicate Possessives

Barbara H. Partee and Vladimir Borschev

15.1 Background: Possessives and the Argument-modifier Distinction in NPs

Possessive constructions like *John's teacher*, *John's team*, *John's cat*, *friend of John's* offer an interesting test-bed for the argument–modifier distinction in NPs, both in English and cross-linguistically. Many, perhaps all, possessives seem to have some properties of arguments and some of modifiers, but some seem more argument-like and some more modifier-like. Recent proposals by Jensen and Vikner (1994), Vikner and Jensen (1999), Partee and Borschev (1998), Borschev and Partee (1999a, 1999b) analyze *all* possessives as argument-like, a conclusion we are no longer sure of. It is not easy to settle the question of whether there is a substantive difference between these two "roles" of possessives, and it may well be the case that all or many possessives play both roles at once.

One central question about possessive constructions, then, is the following: Are all, some, or no possessives arguments of nouns, and if so, which ones (and how can we tell?), and of what kind, and at what 'level' of analysis?

Within this larger question, we discuss here a relevant narrower question: Do predicate possessives provide strong evidence against a unified treatment of all possessives as arguments?

15.1.1 Possessives/genitives and related constructions

The terminology surrounding "possessives" and "genitives" is confusing, since the correspondences among morphological forms, syntactic positions,

grammatical relations, and semantic interpretations are complex and debated, and vary considerably across languages. For clarification, let us distinguish at least the following:[1]

1 Possessive pronouns: E. *my*, *his*; R. *moj* 'my', *ego* 'his'; E. predicative forms *mine*, *his* and postnominal forms *of mine*, *of his*.
2 English "Saxon genitives": *John's*, and the postnominal Saxon genitive *of John's*.
3 English PP with *of* + Acc.
4 Russian postnominal genitive NP: *Mendeleeva* 'of Mendeleev', *tigra* 'of a/ the tiger'.
5 Russian prenominal possessive: *Mašin dom* 'Masha's house'.

Some of the problems of the semantics of possessives affect all of these, while some of the problems require making distinctions. Very similar problems arise in corresponding constructions in many other languages, and related problems arise with the English verb *have* and its lexical and constructional counterparts in other languages (Freeze 1992; Landman and Partee 1984; Szabolcsi 1994; Jensen and Vikner 1996; Partee 1999b). The present work concerns the possible need for a distinction between possessives as modifiers and possessives as arguments, and the role that predicate possessives may play in resolving that issue.

One starting point is the following data from Partee (1983/1997:464):

(1)a. John's team
   b. A team of John's
   c. That team is John's

(2)a. John's brother
   b. A brother of John's
   c. (#) That brother is John's

(3)a. John's favorite movie
   b. A favorite movie of John's
   c. (#) That favorite movie is John's

Informally, a unified interpretation of genitive phrase "John's" that applies to all of these cases is that the genitive phrase always expresses one argument of a relation, for which we will use the descriptive term "genitive relation", following Jensen and Vikner (1994). But the relation can come from any of three sources: (1) the context, as in (1) ("plays for", "owns", "is a fan of", etc.); this happens when the noun is a plain 1-place predicate; (2) an inherently relational noun like "brother"; (3) an inherently relational adjective like *favorite*. The puzzles include these: can (and should) examples (1a) and (2a) be given a uniform analysis, and if so, how? Or does the genitive construction combine

differently with plain and relational nouns, and if so, are these differences predictable from some general principles? Should the first case be split into two distinct cases, one being a default preference of the "genitive" construction itself for a genitive relation in the family of "owns", "possesses", "controls", possibly with a distinct syntactic source? The examples in (3) show that argument-like genitives cannot always simply be analyzed as complements of a lexical noun, since it is the whole N-bar *favorite movie* that provides the relation of which *John* is an argument.[2]

The Russian "genitive modifier" (GM) construction exemplified in (4) presents similar challenges, showing a similarly diverse range of "genitive relations", with a similar range of relational and non-relational nouns, although there are interesting differences between English and Russian to account for as well.

(4)a. *ljubitel'*   *košek*
        lover.NOM.SG cat.GEN.PL
        'lover of cats, cat-lover'

   b. *rost*   *čeloveka*
        height.NOM.SG man.GEN.SG
        'height of the/a man'

   c. *nožka*   *stola*
        leg.NOM.SG table.GEN.SG
        'leg of the table, table leg'

   d. *krug*   *syra*
        circle.NOM.SG cheese.GEN.SG
        'circle (wheel) of cheese'

   e. *stakan*   *moloka*
        glass.NOM.SG milk.GEN.SG
        'glass of milk'

   f. *portret*   *Peti*
        portrait.NOM.SG Petja.GEN
        'picture of Petja'

   g. *sled*   *tigra*
        track.NOM.SG tiger.GEN.SG
        'track of the/a tiger'

   h. *sobaka*   *dočeri*
        dog.NOM.SG daughter.GEN.SG
        'the daughter's dog'

   i. *nebo*   *Andreja*   *Bolkonskogo*
        sky.NOM.SG Andrej.GEN Bolkonsky.GEN
        'Andrej Bolkonsky's sky'

In the case of Russian, the question of whether the examples in (4) are all instances of a single construction is even more difficult than in the case of English, since the uses of the Russian genitive NP cover uses analogous to both the English Saxon genitive in (1)–(3) and English PPs with *of* + Acc.

At a descriptive level, virtually all authors who have grappled with the semantics of genitive constructions are agreed that in some cases the genitive NP seems argument-like and in other cases it seems modifier-like. The "argument" nature of at least some genitives is clearest in the case of some deverbal nouns, those called "Complex Event Nominals" by Schoorlemmer (1995), "Derived Nominals" by Babby (1997), and "process nominals" by Rappaport (1998).

To be slightly more precise about our relatively neutral assumed syntax for the first of these constructions, and for the Russian postnominal genitive construction, we represent the syntactic structure as in (5) below, a linearized form of the schematic phrase structure tree of Borschev and Partee (1999b):

(5) $[_N$ N $NP_{GEN}]$, where N is a cover term for N^0 and non-maximal N-bar (Montague 1973's CN and CNP), and NP is a cover term for both N^{MAX} and DP.

The semantic question is: do the possessive constructions $[_N$ N $NP_{GEN}]$ have a uniform compositional interpretation? There are in principle three possibilities. (1) Assimilate all cases to the "free R" reading. That option was proposed by Hellan (1980). Partee (1983/1997) argued against it on the basis of the contrast among the (c) examples in (1)–(3). (2) Posit two different possessive constructions, treating "inherent R" possessives as type-raised arguments and "free R" possessives as (intersective) modifiers (Partee 1983/1997). (3) Assimilate all cases to the "inherent R" reading. This option was introduced by Jensen and Vikner (1994), and further explored in Partee and Borschev (1998), Borschev and Partee (1999a, 1999b), and Vikner and Jensen (1999).

15.1.2   Two theories of possessives

Partee (1983/1997) proposed two distinct genitive constructions with relational and non-relational nouns, the latter incorporating a "free relation variable R" whose value must be supplied by context. On the other hand, (a modified version of) Jensen and Vikner (1994) offers a uniform interpretation of the genitive, with coerced type-shifting of the N-bar to a relational reading when necessary. The investigation of the differences between these two approaches, in part through an ongoing dialogue which Borschev and Partee have been carrying on with Jensen and Vikner over the past two years, has led us to an appreciation that the problem of the semantics of the genitive construction(s) is a much richer domain of inquiry than we had originally imagined, and to convergence on some issues and new questions on others.

A note about notation: In what follows we use CN for a ("plain") N-bar of type $\langle e, t \rangle$ (one-place predicate, with only a "referential" θ-role (Williams 1981, the R role of Babby 1997), and TCN for a ("transitive" or "relational") N-bar of type $\langle e, \langle e, t \rangle \rangle$ like *father*, *favorite movie*.

The analysis of Partee (1983/1997) posits an ambiguity in the construction, with the N-bar supplying the relation if it is relational, and with the construction supplying a "free relation variable" if the N-bar is not relational. We illustrate the postnominal genitive, as in (1b), (2b), (3b), which Partee (1983/1997) analyzed as a modifier, treating the prenominal genitive in (1a), (2a), (3a) as a composition of the postnominal genitive with an implicit definite determiner.

Postnominal genitive (of John's): *combines with CN or TCN to make a CN*
When a genitive NP combines with a plain CN, type $\langle e,t \rangle$: the construction provides a "free R", a variable of type $\langle e, \langle e, t \rangle \rangle$ which we write as R_i.[3]

(6) *of John's:* $\lambda P \lambda x[P(x) \ \& \ R_i(\text{John})(x)]$
     team of John's: $\lambda x[team(x) \ \& \ R_i(\text{John})(x)]$

When a genitive NP combines with a TCN, type $\langle e, \langle e, t \rangle \rangle$, the TCN provides its "inherent R".

(7) *of John's:* $\lambda R[\lambda x[R(\text{John})(x)]]$ or equivalently, $\lambda R[R(\text{John})]$
     teacher of John's: $\lambda x[teacher(\text{John})(x)]$

Jensen and Vikner (1994) propose that an analysis which incorporates coerced type-shifting in the sense of Partee (1987) should be able to do without two separate rules for the genitive. They present an alternative analysis, building on the framework of Pustejovsky (1993, 1995): the genitive must always combine with a relational common noun (phrase), coercing a one-place predicate noun to a two-place relational meaning ("team" to an appropriate sense of "team-of"). Their analysis corresponds to the "inherent R" case of Partee (1983/1997), and with a relational noun like *teacher* the two analyses agree. The difference arises with a plain one-place CN like *chair* or *team*, which on their analysis is coerced to a TCN interpretation. Jensen and Vikner follow Pustejovsky in appealing to the *qualia structure* of the lexical entry to guide the coercion, so that for instance the *telic* role of *chair* ("chairs are to sit in") licenses the shift of CN *chair* to TCN *chair* illustrated below.

(8) CN *chair:* $\lambda x[chair(x)]$
     TCN *chair:* $\lambda y \lambda x[chair(x) \ \& \ \text{sits-in}(x)(y)]$

Initially we had some important differences with Jensen and Vikner concerning the degree to which lexical meaning drives coercion. In their current work and our most recent published work, we are agreed that on the most general version of their approach, the genitive construction should always demand a TCN to combine with, and if it finds instead a CN it will coerce it by whatever means are available and "natural", sometimes lexical, sometimes pragmatic.

(We make a less sharp distinction between lexically and contextually supplied shifted meanings than Jensen and Vikner do, because of the outlook on the integration of information from lexical and other sources described in Partee and Borschev 1998; Borschev and Partee 1998.) A "pragmatic" coercion is seen as shifting the noun to a relational reading that incorporates the "free relation variable" of Partee (1983/1997) into the shifted noun meaning.

(9)   TCN *team:* $\lambda y \lambda x[team(x)\ \&\ R_i(x)(y)]$

As in Partee's analysis, a felicitous use of an expression with a free variable requires that the context make a particular choice of value for the variable salient. Partee and Borschev (1998) propose extensions to Jensen and Vikner's coercion approach to cover also the "contextual" cases, and point to a need for more fine-grained coercion principles to cover phenomena involving the relational adjective *favorite* and the difference in "most likely relation" in the interpretation of examples like *John's movie* and *John's favorite movie.*
    One main difference between the two approaches is then in *where* a "free relation variable" is added in a case where context is driving a pragmatically based coercion. Let's suppose that *team of Mary's* is such a case.

(10)   Jensen and Vikner:
       of Mary's: $\lambda R[\lambda x[R(\text{Mary})(x)]]$
       (shifted) *team:* $\lambda y[\lambda x[team(x)\ \&\ R_i(y)(x)]]$
       team of Mary's: $\lambda x[team(x)\ \&\ R_i(\text{Mary})(x)]$

(11)   Partee (1983):
       of Mary's: $\lambda P \lambda x[P(x)\ \&\ R_i(\text{Mary})(x)]$
       (non-shifted) *team:* team
       team of Mary's: $\lambda x[team(x)\ \&\ R_i(\text{Mary})(x)]$

The final result is the same; but for Jensen and Vikner the free relation variable comes in as part of the meaning of the shifted noun, while for Partee (1983/1997) it comes in as part of the meaning of the genitive construction itself. Does this difference in "where" the free relation variable is situated ever make a detectable difference? Yes.
    Partee and Borschev (1998) give an empirical argument in favor of Jensen and Vikner's approach, based on an analysis of the example *Mary's former mansion*, suggested to us by Norvin Richards (personal communication). The argument rests on four assumptions, as spelled out in (12) below.

(12)   Assumptions:
       1. *mansion* is lexically a 1-place noun.
       2. *former* is an endocentric modifier, lexically a CN/CN, shiftable to a TCN/TCN.
          former as CN/CN: *former monastery*, *former dancer*.
          former as TCN/TCN: *former owner*, *former friend*.

3. The "free relation" variable in this case has as one of its most salient values something like "owns" or "lives in".

4. *Mary's former mansion* has two readings: "Reading A": a former mansion (perhaps now just a ruin) that is (now) Mary's. That is, now Mary's, formerly a mansion; and "Reading B": something that was formerly Mary's mansion; it may still be a mansion, but it's no longer Mary's.

On the Partee (1983/1997) account, there is no motivation for any type-shifting to occur, and the "free relation" "owns" will be introduced with the possessive *Mary's*, after *former* has combined with *mansion*. This means that the free relation ("owns") in the interpretation of the possessive *Mary's* will never be under the scope of *former*. As a result, Partee (1983/1997) can derive Reading A above, but not Reading B. Tree (13) shows the compositional structure of *Mary's former mansion* on the account of Partee (1983/1997).

(13)

```
                              NP
                     ┌─────────┴─────────┐
                   NP's                  CNP
                     │              ┌─────┴─────┐
                  Mary's          CN/CN         CN
                     ↖              │            │
                      \          former       mansion
                       \
      free R introduced here
```
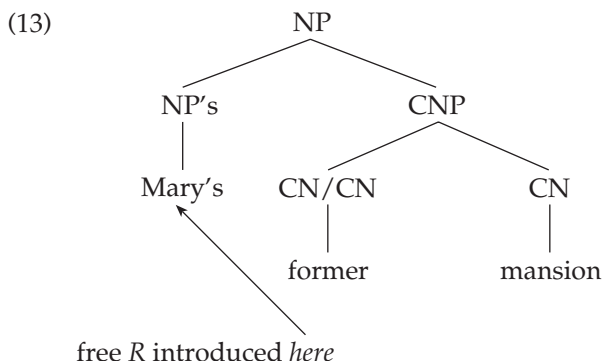
But Jensen and Vikner's account, with coercion of CN to TCN, *does* provide derivations for both readings, which Partee's account cannot. For Jensen and Vikner, *Mary's* coerces *former mansion* to a relational TCN. Given our assumptions, there are two ways that *former mansion* could shift to a TCN.

1 Initially leave *mansion* as a CN, treat *former* as CN/CN, combine them to form a CN, as on Partee account; then shift that CN to a TCN, bringing in the free variable at that stage to get the shifted meaning of *former mansion* shown below in (14):

(14) $\lambda y[\lambda x[\text{former}(\text{mansion})(x) \ \& \ R_i(y)(x)]]$ [R_i: "is owned by"]

This corresponds to Reading A above, with the free R introduced at the point where the CNP shifts to become a TCNP. The compositional structure would be almost identical to that in tree (13), differing only in "where" the free R is introduced.

2 Or shift *mansion* to a TCN, and *former* to a TCN/TCN, combine them to form a TCN as shown below in (15):

(15) $\lambda y[\lambda x[\text{former}(\text{mansion-of})(x)(y)]]$, where mansion-of is an abbreviation for $\lambda y[\lambda x[\text{mansion}(x)\ \&\ R_i(y)(x)]]$

This corresponds to Reading B above, with compositional structure as in (16) below.

(16)

free *R* introduced *here*
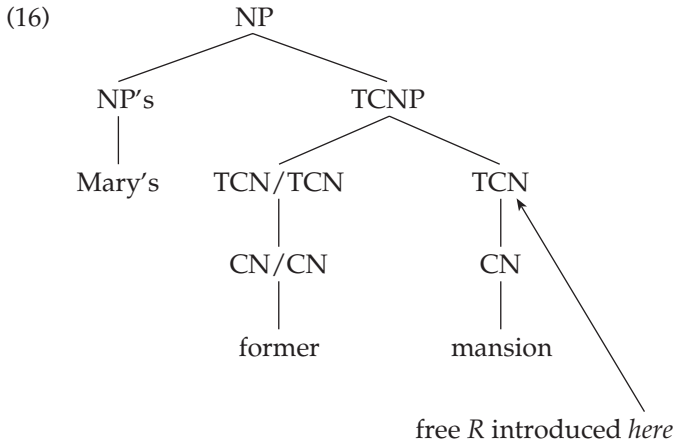
We assume that both of these ways of coercing the phrase *former mansion* are structurally available; different choices of lexical items or different contexts may favor one over the other, but since both are consistent with all the principles that we are aware of, the Jensen and Vikner approach successfully predicts the ambiguity and therefore has a clear empirical advantage over the Partee (1983/1997) approach.[4]

15.2   Predicate Possessives: A Problem for the "One Genitive" Approach?

In spite of the theoretical appeal of the "one genitive" approach and its ability to solve the problem of *Mary's former mansion*, we are still not convinced that it is correct. One of our main worries concerns predicate possessives. We earlier observed that predicate possessives seem to favor "free *R*" interpretations; and predicate possessives are not in a structural argument position unless one posits an empty head noun accompanying all predicate possessives. Both of these factors support the treatment of predicate possessives in Partee (1983/1997) as type $\langle e, t \rangle$, "free *R*" only. There the predicative *John's* was interpreted as $\lambda x[R_i(\text{John})(x)]$. The modifier-type postnominal genitive *of John's* of Partee (1983/1997), given in (6) above, which combines with a plain CN,

amounts simply to intersective modification of the noun by this predicate possessive.

And if some possessives can occur as basic $\langle e, t \rangle$ predicates, that would suggest that when those same possessives occur inside the NP, they are basically modifiers, and not arguments, returning us to the distinction posited in the earlier Partee (1983/1997) approach.

If there are no possessives that demand a treatment as basic type $\langle e, t \rangle$ predicates, that would be an argument in favor of treating all 'modifier possessives' occurring inside an NP within the "one genitive" approach of Jensen and Vikner. That can be done on their approach by type-shifting the head CN or CNP into a relational reading incorporating the free R, so that it then takes the possessive term as an argument. But if we find in some languages that there are systematic differences in form and/or interpretation between certain genitives/possessives that occur only NP-internally and others that occur both predicatively and NP-internally, that would present a serious challenge to the "one genitive" approach, at least for those languages.

But the issue is empirically complex for at least two reasons: (1) there may be independent reasons (syntactic or morphological) why some kinds of possessives (e.g. Russian genitives) cannot occur as predicates; (2) and some predicate possessives may be elliptical full NPs; it is not always easy to tell. Much of what follows is concerned with the latter problem.

In the following sections, we look at evidence about predicate possessives in English, Russian, German, and Polish. The evidence supports the idea of two semantically different kinds of possessives, with some forms, such as English Saxon genitives, used for both. One kind are argument possessives, which fit the Jensen and Vikner analysis; these occur in construction with a relationally interpreted noun (or with an adjective like *favorite* plus a noun). Argument possessives do not occur in type $\langle e, t \rangle$, so when they occur alone, they are interpreted as elliptical NPs[5] with a relational noun implicitly understood. The Russian genitive appears to be of this type, and we consider the Jensen and Vikner analysis correct for the Russian genitive construction. The other kind are true predicative possessives, basically of type $\langle e, t \rangle$, interpreted approximately as in the corresponding analysis of Partee (1983/1997), but with the "free R" preferentially interpreted as some kind of "possession" or "control". To represent the way this distinction differs from the original distinction of Partee (1983/1997), we will stop referring to the "free R" and refer instead to R_{POSS}. When this kind of possessive occurs inside an NP, it is a modifier rather than an argument. We believe that the Russian prenominal possessive forms discussed in section 15.2.2 are of this type. Since the English Saxon genitives, as well as possessive pronouns in all four of the languages looked at here, have both uses, we conclude that the "one genitive" approach cannot be correct for those constructions.

But if we do conclude that in English, for instance, there is a distinction to be made between argumental and modifier constructions both expressed by Saxon genitives like prenominal *John's*, we are left with a puzzle concerning

the large proportion of cases which could seemingly be analyzed either way: are they all "ambiguous"? We will return to this puzzle, which remains open, in section 15.3.

15.2.1   Predicate possessives in English

The nature of predicate possessives is less clear in English than in some other languages. It is difficult to be sure whether an apparent predicate possessive like *John's* in (1c), repeated below, is a simple one-place predicate with an R_{POSS} or "possession" reading, or is an 'argument genitive' occurring as part of an elliptical NP, i.e. with *John's* implicitly in construction with another occurrence of *team*.

(1)c.   That team is John's.

In Stockwell, Schachter and Partee (1973), it was asserted that predicate possessives as in (1c) allow only a "free R" reading, but that conclusion, maintained in Partee (1983/1997) and in Partee and Borschev (1998), was probably based on too small a sample of data and not enough careful examination of possibilities. So while (17a,b) are indeed bad, (17c) (example from Ash Asudeh, personal communication) seems to be able to get a relational reading all right. And (17d,e) (from Ekaterina Rakhilina, personal communication) together with the badness of (17f) strongly support the hypothesis that there is something wrong with the *subject* in (17a,b), not with the unavailability of a suitable interpretation for the predicate possessive as hypothesized by Stockwell et al. (1973).

(17)a.   *That father is John's.
    b.   *That favorite movie is John's.
    c.   That teacher is John's.
    d.   His [pointing] father is also John's.
    e.   Dad's favorite movie is also mine.
    f.   *That father is John's father.

The good examples in (17), namely (17c–e), all have predicate possessives that may be interpreted as elliptical NPs:[6] *John's teacher*, *John's father*, *my favorite movie*. The bad examples (17a,b,f) all have intrinsically relational head nouns (or common noun phrase in the case of 17b) that have to be interpreted non-relationally in the subject but relationally in the predicate, assuming that (17a,b) have elliptical predicate possessives.[7] The head noun in the subject in examples (17a,b,f) must shift to a non-relational reading in order to be compatible with the demonstrative determiner *that*; with such strongly relational expressions as *father* and *favorite movie*, it is not easy to construe them non-relationally, and a strong context is required to interpret the subject phrases at all. It may be that there is a restriction (perhaps a processing restriction) on shifting an

expression "away from" its basic meaning and then "back again". (The "bad" sentences are probably indeed not 'ungrammatical', but are nearly impossible with respect to the intended readings 'John's father', etc.) In the good examples (17d,e) we have the relational readings of the head noun (phrases) in both the subject and the (elliptical) predicate. And the relevant difference between the good (17c) and the bad (17a) may be that unlike *father*, *teacher* is lexically supplied with equally salient and closely related relational and non-relational readings, so that one wouldn't have to 'suppress' the relational reading by shifting in order to interpret *teacher* in the subject NP non-relationally.

The data above, reinforced by the Dutch data mentioned in note 6, strongly suggest that predicate possessives may sometimes be "elliptical" NPs or "Determiner-only" NPs. And if all bare possessives in all languages could be interpreted as elliptical NPs, then predicate possessives would not pose a problem for the "one-genitive" analysis; the difference between possessive or genitive forms that can and that cannot occur "bare" as predicates would simply reflect constraints on NP ellipsis.

But we believe that not all predicate possessives are elliptical.

We do not have conclusive arguments for English; there are several complicating factors, including problems in the analysis of copular sentences. We briefly mention here some data that we consider relevant, but rather than trying to build any arguments based on English, we will then turn to other languages where the structures in question can be identified more clearly.

There are some uses of "bare" *mine*, *yours*, *John's*, etc., that occur in argument positions that are otherwise occupied by full NPs of type *e*, as in (18). We take this as clear evidence that bare possessive pronouns or Saxon genitives do occur as elliptical NPs.[8] (In Russian, for instance, the same is possible with possessive pronouns but not normally with bare genitive NPs.)

(18)   Mine is over there. John's is over here. Sue already took yours and Mary's.

There are postcopular uses as in (19) where the possessives seem very much like inverted elliptical subjects, arguably of type *e* although perhaps of type ⟨*e*, *t*⟩. The debate relates to the problem of "inversion around *be*" and the types of NPs in apparent "inversion" sentences discussed in Williams (1983), Partee (1986), Moro (1997), Heycock and Kroch (1998, 1999), Partee (1999a).

(19)a.   Some of the most interesting results were John's.
    b.   One of the most interesting suggestions was John's.
    c.   Another proposal we will have to consider is Sara's.

Examples (20)–(22) below seem to us to be candidates for genuinely predicative possessives that are not elliptical full NPs, but we have no really convincing structural arguments for making the distinction in English, so our hypothesis that these are predicative rather than elliptical is based so far on

semantic intuitions and translation possibilities into languages where the distinction seems clearer.

(20)   The house, the barn, and the land are finally ours and ready to move into.

(21)   It's already/now/finally/almost ours.

(22)   Anything we find on this land is John's.

Rather than try to support our intuitions about the English examples, we turn to some languages where we have found some syntactic and/or morphological distinctions that provide evidence for a distinction between modifier possessives and argument possessives.

15.2.2   Russian prenominal possessives vs. genitives

In Russian, possessive pronouns and the normally prenominal quasi-adjectival possessive forms can occur in predicate position but genitive NPs cannot.[9] This suggests that Russian *genitive* NPs may always be argument-like, and that the Jensen and Vikner uniform analysis with coercion of CNs to TCNs (extended to Russian in Borschev and Partee 1999a, 1999b) is correct for the Russian *genitive* construction. It also suggests that the Russian *prenominal* possessive forms are at least sometimes modifier-like, and the same for the possessive pronouns. (Evidence of ambiguity of the roles of the possessive pronouns is in section 15.2.4.)

The Russian prenominal possessive construction studied by Koptjevskaja-Tamm and Šmelev (1994) and by Babyonyshev (1997) is illustrated in (23) and the genitive construction in (24).

(23)a.   *Petin*   *stul*
         Petja.POSS.MASC.SG chair.MASC.SG
         'Petja's chair.'
    b.   *Mamin*   *portret*
         Mama.POSS.MASC.SG portrait.MASC.SG
         'Mama's portrait.'

(24)a.   *stul*   *Peti*
         chair.MASC.SG Petja.GEN.SG
         'Petja's chair.'
    b.   *portret*   *mamy*
         portrait.MASC.SG Mama.GEN.SG
         'Mama's portrait.'

In these examples, both constructions can be used in describing the same range of cases; the possible relations of Petja to the chair or of Mama to the portrait are as various as with the English prenominal genitive. But the meanings do not "feel" identical. In the possessive construction in (23), we would like to claim (as did Schoorlemmer 1995) that the possessive *Petin*, *mamin* acts as a *modifier* of the head noun. We believe that the prototypical interpretation of the possessive modifier is indeed 'possession' (of the object denoted by the head noun, by the (animate) entity denoted by the noun in the possessive form.) To maintain such a claim, it seems that 'possession' must be understood in a broadly extended sense to apply to a diverse range of relations; see Heine (1997). Thus in example (23b), possession may be possession proper, 'authorship', or the relation of 'being portrayed'. But the possibility of expanding the sense of 'possession' is evidently not unlimited. Thus 'murderer of Petja' can be expressed in Russian by (25a) but not by (25b).

(25) a. *ubijca*   *Peti*
         murderer.MASC.SG Petja.GEN.SG
         'Petja's murderer' (murderer of Petja)
     b. *Petin*   *ubijca*
         Petja.POSS.MASC.SG murderer.MASC.SG
         #'Petja's murderer' [OK only as e.g. 'a murderer Petja has hired']

In the genitive construction in (24a), we analyze *Peti* as an *argument* of the relation which connects it to *stul*. In the given case, the most salient relation could alternatively be seen as some kind of possession as well; but 'possession proper' is not the prototypical interpretation for the genitive construction. The range of possible relations expressed with a genitive is extremely broad (cf. Knorina 1985, 1988, 1990, 1996; Borschev and Knorina 1990; Partee and Borschev 1998; Borschev and Partee 1999a, 1999b).

   While this data is not completely conclusive, it supports the hypothesis that the Russian genitive construction is correctly analyzed as uniformly argumental, i.e. that Jensen and Vikner's approach to English genitives is correct instead for Russian genitives. And we believe that the Russian prenominal "adjectival" possessives are basically modifiers, with the "free" R_{POSS} as the core of their meanings (see the analysis in (31) below for German). But the high overlap in possible interpretation of the two constructions, as illustrated in (23) and (24), is an example of the puzzle mentioned at the end of the introduction to section 15.2, to which we return in section 15.3.

15.2.3   German possessive pronouns

Tony Kroch (personal communication) suggested looking for languages that would given evidence from agreement behavior as to whether predicate possessives are more like simple (adjectival) predicates or more like full NPs.

Sten Vikner (personal communication) observed that German is a language that gives some evidence: Predicate adjectives in German do *not* agree with subjects, but predicate possessives *do*, suggesting that predicate possessives are indeed more like elliptical NPs than like simple ⟨*e, t*⟩ predicates.[10]

(26) *Diese*   *Bücher*   *sind alt/ *alte.*
      these.NEUT.PL books.NEUT.PL are old/ *old.PL
      'These books are old.'

(27) *Diese*   *Bücher*   *sind meine/*?mein*
      these.NEUT.PL books.NEUT.PL are mine.PL/*mine
      'These books are mine.'

This would suggest that the "one genitive" approach may be correct for German, if all apparent predicate possessives give morphological evidence of being elliptical NPs.

But it was further observed by Hans Kamp (personal communication) and others that actually, the non-agreeing form can sometimes be used. It is used only in "standard" German, not in colloquial German, and it has an "archaic" flavor. Most interestingly, it seems that there are semantic differences between the agreeing and the non-agreeing predicate possessive, and if this data stands up, it is extremely interesting.

(28)a. *Diese*   *Bücher*   *sind meine:* can be any relation.
        these.NEUT.PL books.NEUT.PL are mine.PL
    b. *Diese*   *Bücher*   *sind mein:* (archaic) "Possession" only.
        these.NEUT.PL books.NEUT.PL are mine (no agreement)

Further examples are given in (29) and (30). A newly naturalized citizen might say (29a), but (29b) suggests a conqueror is speaking. Any relation is possible in (30a), with the most likely possibility being the parent–child, but (30b) suggests a custody fight, i.e. a dispute about who is to be in 'possession' of the children.

(29)a. *Das*   *Land*   *ist (jetzt) meins.*
        the.NEUT.SG land.NEUT.SG is now   mine.NEUT.SG
    b. *Das*   *Land*   *ist jetzt mein.*
        the.NEUT.SG land.NEUT.SG is now mine

(30)a. *Die Kinder*   *sind meine.*
        the children are mine.PL
    b. *Die Kinder*   *sind mein.*
        the children are mine.

In all of (28b), (29b), (30b), the form which shows absence of agreement in the way a predicate adjective would is limited in its interpretation to "possession". In other words, the form in which the possessive pronoun appears to be

a simple predicate of type $\langle e, t \rangle$ is interpreted in terms of a relation that appears to be associated with the possessive construction itself rather than with the semantics of any governing noun.

In contrast, the forms which appear to be elliptical NPs have a range of interpretations including possession but also including relations typical of "argument" genitives, where the relevant relation is determined[11] principally by the noun to which the genitive supplies an argument. Typical choices for the "genitive relation" for the "argument" genitive interpretations in (28a), (29a), (30a) might be authorship, citizenship, and the parent–child relation, respectively.

Of course "possession" itself can have metaphorical extensions, so the "possession" cases do not always have to be about ownership in a literal sense. But if these distinctions are correct, this is important evidence for the idea of two distinct genitives.

So we are now inclined to believe that some predicate possessives really are plain $\langle e, t \rangle$ predicates, and that those have just a possession/control reading, which we take to be the semantics of the $\langle e, t \rangle$ possessive, as shown in (31) below. And other predicate possessives may be elliptical NPs, and their interpretation may have the full range of possibilities that would be displayed by a full NP with a prenominal genitive occurring in such a position. (Note that a full NP may itself have meanings of types e, $\langle e, t \rangle$, or $\langle \langle e, t \rangle, t \rangle$, depending on both its internal makeup and the position in which it occurs, so the study of the full range of meanings of bare possessives as elliptical NPs needs more study.)

(31) $[John's]_{\text{PRED}}$: $\lambda x[R_{POSS}(\text{John})(x)]$ type: $\langle e, t \rangle$

15.2.4   Russian and Polish possessive pronouns

In Russian, in the past tense, predicate nominals may be in the Instrumental case, particularly when indicating temporary relations. Babby (1973), Siegel (1976) and others have used case and other agreement behavior to argue that some predicative adjectives are elliptical NPs and others are simple APs. The following data may provide a basis for distinguishing among predicate possessive pronouns that are and are not elliptical NPs.

(32)a.   *Èta   strana   byla   kogda-to*
         that.FEM.NOM.SG country.FEM.NOM.SG was.FEM.SG once
         moej.
         my.FEM.INSTR.SG
         "That country was once mine." ["possession" or citizenship]

   b.   *Èta   strana   byla   kogda-to*
         that.FEM.NOM.SG country.FEM.NOM.SG was.FEM.SG once
         moej   stranoj.
         my.FEM.INSTR.SG country.FEM.INSTR.SG
         "That country was once my country." ["possession" or citizenship]

(33)a. *Èta*   *strana*   *byla*   *kogda-to*
     that.FEM.NOM.SG country.FEM.NOM.SG was.FEM.SG once
     moja.
     my.FEM.NOM.SG
     "That country was once mine." ["possession" only]

    b. **Èta*   *strana*   *byla*   *kogda-to*
     that.FEM.NOM.SG country.FEM.NOM.SG was.FEM.SG once
     moja   *strana*.
     my.FEM.NOM.SG country.FEM.NOM.SG
     "That country was once my country."

A full predicate nominal is impossible in the nominative in the context of (33b), and in the same context, a nominative predicate possessive pronoun can be interpreted only as a possessive, not as an "argument" genitive (even with a seemingly "free" relation.) Thus the predicate possessive in (33a) cannot reasonably be analyzed as an elliptical NP, but must be a simple $\langle e, t \rangle$ predicate, and it is this occurrence of the predicate possessive that unambiguously denotes "possession". This data is similar to the German data, supporting the idea that there is a "possessive" predicate of type $\langle e, t \rangle$ instantiated at least by some possessive pronouns in German and Russian and possibly also by some predicative "NP's" forms in English, distinct from other cases of predicate possessives which are elliptical full NPs and in which the possessive may be an argument of an implicit relational noun.

     Wayles Browne (personal communication) suggested that we should get data on Polish, because in Polish NP – be – NP requires Instrumental on the predicate NP, whereas in Russian the predicate NP may or may not be Instrumental. And in Polish NP – be – Adj requires Nominative on the Adjective, whereas in Russian the predicate AP may be (1) short-form Adjective, (2) long-form Nominative Adjective, or (3) long-form Instrumental Adjective.

     The corresponding Polish data are as follows.[12]

(34)a. *Ten*   *kraj*   *był*   *kiedyś*
     that.MASC.NOM.SG country.MASC.NOM.SG was.MASC.SG once
     moim.
     my.MASC.INSTR.SG
     "That country was once mine." ["possession" or citizenship]

    b. *Ten*   *kraj*   *był*   *kiedyś*
     that.MASC.NOM.SG country.MASC.NOM.SG was.MASC.SG once
     moim   *krajem*.
     my.MASC.INSTR.SG country.MASC.INSTR.SG
     "That country was once my country." ["possession" or citizenship; citizenship preferred.]

(35)a.   *Ten*   *kraj*   *był*   *kiedyś'*
         that.MASC.NOM.SG country.MASC.NOM.SG was.MASC.SG once
         mój.
         my.MASC.NOM.SG
         "That country was once mine." ["possession" only]

   b.   **Ten*   *kraj*   *był*   *kiedyś'*
         that.MASC.NOM.SG country.MASC.NOM.SG was.MASC.SG once
         mój   *kraj.*
         my.MASC.NOM.SG country.MASC.SG
         "That country was once my country." [ungrammatical]

   c.   *Ten*   *kraj*   *to*   *był*   *kiedyś'*
         that.MASC.NOM.SG country.MASC.NOM.SG PART was.MASC.SG once
         mój   *kraj.*
         my.MASC.NOM.SG country.MASC.SG
         "That country was once my country."[13] ["possession" or citizenship]

The Polish data confirm the hypothesis that when a predicate possessive pro-
noun allows an "argumental" reading, it is the remnant of an elliptical NP,
and when it doesn't, it isn't. The "possession" reading, which seems to be
emerging as the clearest case of a non-argumental, or modifier, reading, can
show up either in a remnant of an NP or as a bare $\langle e, t \rangle$ predicate. This
reinforces the idea that a possessive inside an NP can be either an argument
or a modifier. But a possessive which is an $\langle e, t \rangle$ predicate in a predicational
construction cannot be an argument, presumably because it is not in construc-
tion with a head of which it could be the argument.[14]

15.3   Conclusion and Remaining Puzzles

The examination of predicate possessives[15] in section 15.2 leads us to the con-
clusion that not all predicate possessives are remnants of elliptical NPs, and
that there do exist $\langle e, t \rangle$ predicate possessives distinct from argument posses-
sives. When possessives which are identified as $\langle e, t \rangle$ possessives on the basis
of their behavior in predicate position are also found inside an NP, it is there-
fore natural to assume that they are acting as modifiers, like other $\langle e, t \rangle$ predic-
ates (intersective adjectives, relative clauses, locative and other prepositional
phrases). Some possessives seem to occur only in NPs and these are therefore
reasonably regarded as arguments, or arguments that have been type-lifted to
become modifier-like functors (which we also call "argument genitives" or
"argument possessives" insofar as they directly or indirectly saturate an argu-
ment position in the relational CN or CNP). Argument genitives may be in
construction with the head N or with a modified N such as *favorite movie* or
former mansion (but see note 2).
   In some languages, like Russian, it may be possible to argue for a correlation
of the semantic distinction with a distinction in form: we hypothesize that the

prenominal possessives are modifier possessives, while true genitives are always (possibly type-lifted) arguments.[16]

The clearest examples of predicative possessives seem to have meanings that relate to the notional concept of "possession", not to the "free R" readings posited as predicative in the early work of Partee. This suggests that we should work with a different basic split: between (i) predicative or modifier readings that have a (possibly extended) meaning of "possession", a relational notion R_{POSS} that comes from the possessive form rather than from a noun, and (ii) "argument" readings that involve either an inherently relational noun or a plain noun coerced to a relational reading. This is thus not exactly a return to the early Partee (1983/1997) analysis, but an analysis that agrees with Partee and Borschev's extensions of Jensen and Vikner's analysis except for the recognition of a separate predicative "possessive" reading. What Partee (1983/1997) analyzed a "free R" cases may be a mixture of predicative possessives of type $\langle e, t \rangle$, acting as intersective modifiers when they occur inside an NP, and argument possessives in construction with a noun which has been coerced to a relational reading by the incorporation of some lexically accessible relation (such as "part–whole" or "created by") or of a salient free R.

There are at least two major interrelated puzzles remaining open at this point. One is how to think about the notion of "possession" that has been appealed to here, since it is evidently extremely broad. The second, mentioned at the end of section 15.1, is how to think about English Saxon genitives in the light of the hypothesized split: are English genitives inside NPs ambiguous between modifier and argument? Given that Russian very often allows the same relation to be expressed either way, it would be difficult to rule out one analysis or the other of an unclear case on any semantic grounds. And for the same reason, the great semantic elasticity of interpretation shown by both constructions, this seems a very puzzling kind of "ambiguity" and very hard to get clear evidence for. In a language like English where the same form is used for both modifier and argument possessives, is one construction the dominant or default one that is used wherever there is not clear evidence for the other? Or is this just a benign instance of the fluidity of the argument–modifier shifting possibilities discussed by Dowty (1997)? Does one simply use in a given case whichever analysis requires the least type-shifting?

These issues and many others remain to be explored.

Notes

1   We use English and Russian for illustrative purposes, abbreviated below as E and R.

2   An anonymous referee suggests that one should explore a possible approach on which the genitive in (3) is a complement of the lexical adjective *favorite*, so that genitives, when complements, would always be complements of some lexical item. That could certainly be made to work semantically, as long as the adjective *favorite* is always a function applying to the noun's meaning. As the referee notes, "it does complicate the syntax at first blush"; a fuller investigation might best be carried out in connection with a study of the interaction of genitives with superlative and superlative-like constructions as in *John's best picture*, *John's first picture*.

3   As with the use of free variables like x_i to represent pronouns used without linguistic antecedent, we assume as a felicity condition on the use of free R_i that the context should make it sufficiently clear to the hearer what particular relation the speaker has in mind.

4   An alternative analysis of the ambiguity, based on different assumptions which we do not share, has since been offered by Larson and Cho (1999).

5   We use the term "elliptical NP" for occurrences of bare *John's* or *mine*, etc., when they occur in NP positions and are interpreted as if a noun were present, without intending to take sides between a deletion approach and an interpretive approach to such ellipsis.

6   We thank our anonymous referee for pointing out that in Dutch, the predicate possessive in example (17c) is even more clearly an elliptical NP than in English, and that Dutch furthermore is a language which clearly distinguishes elliptical from non-elliptical predicate possessives. In Dutch, in the rendition of (17c), the d-word *die*, signaling the presence of nominal structure, is obligatory, as shown in (i).

   (i) *Die docent   is *(die) van Jan.*
        that teacher is   that of Jan
        "That teacher is Jan's."

   By contrast, in (ii) both options are possible.

   (ii) *Die auto is (die) van Jan.*
         that car is that of Jan
         "That car is Jan's."

7   In fact, if the predicate possessive in (17a) is not understood as elliptical for *John's father*, the sentence is well formed but requires a strong context that can both

support a one-place predicate reading of *father* and some kind of "free" or "possessive" relation in the interpretation of *John's*. A possible scenario could be a gathering of fathers and daughters and a team of reporters (including John) who among them are supposed to interview all the fathers and all the daughters. Similar remarks apply to (17b).

8 See Stockwell, Schachter and Partee (1973) for an analysis of such ellipsis and its relation to the occurrence of the pro-CNP *one*(*s*) in transformational terms. In this paper we are implicitly assuming that possessive pronouns like *my/mine* have the same kind of semantic analysis as the Saxon genitive *John's*, with the morphological alternation between *my* and *mine*, etc., attributable to surface syntactic factors which we can safely ignore (see Stockwell, Schachter and Partee 1973).

9 There are exceptions to the statement that genitives can never occur predicatively; these require further study. But both traditional grammars and native speakers seem agreed that the statement is basically correct.

10 Further evidence that these predicate possessives are elliptical NPs was provided by Sigrid Beck and Irene Heim (personal communication): the possessive pronoun in (27) can be followed by adjectives (i.e. there can be ellipsis of just the head noun), while the adjective in (26) and the adjective-like possessive pronoun in (28b) cannot be.

> (i) *Dieser   Bücher   sind meine   alte*.
>   these.NEUT.PL book.NEUT.PL are my.NEUT.PL old.NEUT.PL
>   "These books are my old ones."

> (ii) **Dieser   Bücher   sind teuer   neu(e)*.
>   these.NEUT.PL book.NEUT.PL are expensive new
>   "These books are expensive new ones."

11 Recall from the discussion in section 15.1 that the "genitive relation" in the case of an "argument genitive" may either be intrinsic to the lexical semantics of the noun, as with *father*, *teacher*, or may result from shifting the noun from a simple CN to a relational TCN by incorporating a lexically or contextually salient relation. In order to find examples that will support both "possessive" and "argument" genitives, we have looked for nouns for which both possibilities are reasonable, i.e. nouns which can easily be construed either relationally or as plain nouns denoting "possessable" entities. Not all nouns can be expected to support both readings, and not all speakers will find both possibilities equally reasonable in the examples we have given in this and the following section.

12 Thanks to Ania Łubowicz and Anita Nowak for judgments. For (34a), Anita reports no preference for one reading or the other, while for (34b) she reports a preference for the "citizenship" reading. Both rejected (35b) as ungrammatical; Ania suggested that it should be corrected to (35c), which she finds possibly ambiguous. Both agreed that (35a) is unambiguously "possession" only, whereas (34a) allows either reading. The basic judgments given above in the text for (34a,b) and (35a,b) were further confirmed by Janusz Bien, Bożena Cetnarowska (and by a substantial majority of a group of 12 students of hers), Bożena Rozwadowska, Piotr Banski, and Joanna Blaszczak, to all of whom we are grateful. Janusz Bien noted that similar contrasts can be gotten, possibly even more clearly, with the Polish *dom*, which can mean either "house" (a plain CN) and "home" (a TCN).

Bożena Rozwadowska reports that when you use the noun *portret* "portrait", the nominative adjectival predicate *moj* (as in (35a)) gives a normal sentence with a "possession" sense: "That portrait was once mine". But when you use the instrumental *moim* as in (34a), the result seems nonsensical because it seems to have to mean "that the person in the portrait was me some time ago but that now it is somebody else." That judgment suggests that the instrumental form requires the argument reading; we have no explanation for why the possession reading is not an alternative possibility here as well.

13   There was a problem about whether or not to include this sentence in the paper. The argument is clear and simple without it, and for non-Polish speakers, including it is simply a puzzling distraction, as our anonymous referee pointed out. However, when we present our work without it to audiences that include Polish speakers, someone always brings it up, so our compromise is to include it just to show that we are aware of its existence but to leave for further study the question of its grammatical and topic–focus structure.

14   Although it might seem self-evident that a predicate separated from a subject by a copular verb cannot function as an argument to the head noun of the subject, English sentences like *This photo is of John* show that the situation is more complicated and requires further investigation of the sorts of constructions Grimshaw (1990) calls "argument adjuncts".

15   One related bit of evidence which has come to light recently and which we have not had time to explore fully enough to discuss in this paper concerns the Russian negative possessive pronoun *ničej* "no one's". Normally a negative polarity item like other Russian *ni*-words (words corresponding to English *n*-words *nothing*, *no one*, *nowhere*, etc., except that Russian is a "multiple negation" language), it occurs with and without accompanying sentential negation in the following minimal pair, for discovery and discussion of which we are grateful to Elena Paducheva and Ekaterina Rakhilina. Sentence (ib) is not considered fully acceptable by the second author.

(i)a.   *Èto*   *ničej*   *ne*   *portret*.
        that [Ø-COPULA] no-one's.MASC.SG.NOM NEG portrait.MASC.SG.NOM
        Èto   *kartina*.
        that [Ø-COPULA] picture
        "That's not anyone's portrait. That's (just) a picture."

   b.   *Èto*   *ničej*   *portret*.
        that [Ø-COPULA] no-one's.MASC.SG.NOM portrait.MASC.SG.NOM
        Ego   *nikto*   *ne*   *kupil*.
        it.MASC.SG.ACC no-one NEG bought
        "That's not anyone's portrait. No one bought it."

The word *ničej* here acts as a normal negative polarity item on its argument use in (ia); but when it occurs as a possessive modifier meaning "belonging to no one" in (ib), it does not take the usual accompanying sentential negation *ne*. While a full analysis of these examples awaits further research, we hypothesize that the argument *ničej* in (ia) in the semantically relevant structure of the NP is governed by the (relational) noun, while the modifier *ničej* in (ib) expresses a predicate that has negation internal to it, and is semantically conjoined (intersected) with the noun (here a one-place predicate). Even without full analysis, such a pair would seem to

further support the existence of a distinction between argument possessives and modifier possessives.

16 We have somewhat more confidence in the conclusion that Russian genitives are always arguments than in the conclusion that Russian prenominal possessives are always modifiers; the latter claim needs further research. The history of these forms merits further investigation; Richards (1976) reports that in Old Russian, the "possessive adjective" forms were much more common than the use of the genitive, the opposite of the situation in modern Russian, where the possessive adjectives are much more limited in their use. Her work suggests that many factors other than the semantics of the construction have been relevant through its history, and she cites examples from late Old Russian (XV–XVII c.) from Makarova (1954) of two-word proper names in which one of the words is in the genitive and the other in the possessive adjective form. Thus we recognize that we need to have caution in possibly trying to read too much semantics into the distinction between the two forms in contemporary Russian.

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