Beyond Truth Theory: Cognitive State Semantics and the Linguistic Analogs of Non-Reductive Physicalism

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Abstract

> On connaît la célèbre affirmation de Claude Lévi-Strauss: "les sciences humaines seront structurales ou ne seront pas". Nous aimerions lui en adjoindre une autre: "les sciences humaines seront des sciences naturelles ou ne seront pas". Evidemment, sauf à en revenir à un réductionnisme dogmatique, une telle affirmation n'est soutenable que si l'on peut suffisamment généraliser le concept classique de "naturalité", le généraliser jusqu'à pouvoir y faire droit, comme à des phénomènes naturels, aux phénomènes d'organisation structurale.
> — Jean Petitot, [47, p. 1]

> The nature of any entity, I propose, divides into three aspects or facets, which we may call its form, appearance, and substrate. In an act of consciousness, accordingly, we must distinguish three fundamentally different aspects: its form or intentional structure, its appearance or subjective "feel", and its substrate or origin. In terms of this three-facet distinction, we can define the place of consciousness in the world.
> — David Woodruff Smith, [55, p. 11]

A leitmotif of Cognitive Linguistics is critiquing "truth-theoretic" semantics — part of a broader objection to linguistic and philosophical paradigms which appear to underappreciate language's subtlety, its lack of mechanical determinism, and its rootedness in human consciousness and sociality. To make the critique precise, I think we can define "truth-theoretic semantics" with an emphasis on two dimensions: first, the idea that linguistic meaning is closely associated with propositionality — that meaning is grounded in states of affairs that make (or would make) statements true; and, second, that there is a formalizable (and potentially computationally reproducible) process whereby language-users parse utterances or sentences to recover their signified propositional content — which is the most important *deep structure*, or organizing principle, determining the form of language. To explain language we have to consider both semantics and grammar: the rules distinguishing senses of one word and selecting among related words; and the rules for combining words into phrases and sentences. Truth-theoretic semantics goes beyond the obvious fact that language often expresses ideas which can be reasonably summarized in logical terms — as a guiding metatheory these paradigms have to argue that the logical forms of such meanings retroactively shapes syntax and semantics. In this paper I will try to lay out a rigorous theory of the limitations and motivations for these paradigms and then suggest alternative "metatheories" for semantics, or the philosophy of language, which are philosophically stronger.

It is easy to summarize how logic *can* in principle, and in some cases, provide an outline to syntactic and semantic structures. Plurals, for instance, correspond to the logical mapping between individuals and sets: assuming we have a theory of the concept *dog*, we then have via logic (qua essential cognitive faculty, perhaps) a correlated concept of a *set* of dogs; isomorphically, insofar as "dog" signifies the singular concept, the plural

"dogs" signifies the *set*. Meanwhile, given discrete ideas like

- (1) Those dogs are Staffordshires.
- (2) Those dogs are females.

we can form compounds using logical disjunction:

- (3) Those dogs are female Staffordshires.

Broadening the expressive scope, *modal* logic can represent hypotheticals and speaker-sentiment:

- (4) The window may be open (it is possible that the window is open).
- (5) I'd like the window closed (I'd prefer to be in a world where the window is closed).
- (6) If the window is open, can you close it (if we are in a world where the window is open, I request we move to a world where it is closed)?

In short, familiar syntactic and semantic patterns have analogous, formalizable constructions in logic and set theory.

The question is then how significantly these formal constructions explain or regulate the informal linguistic analogs. If we believe that the brain is constrained to process language according to logical maxims, we may believe that articulating language-to-logic analogies is a meritous step toward a scientific theory of language. Conversely, if we believe that linguistic understanding spans many cognitive registers — most of which are only tangentially governed by logical parameters — the relatively simple and context-neutral models of (such formations as) sets/plurals, inter-propositional operators (e.g. conjunction and disjunction), and modal possibilia are at most approximately relevant to a robust cognitive theory of language.

It is easy to understand why scientists would find "truth-theoretic" paradigms and logical language models appealing: there certainly is a level of nuance, a contextuality and interpersonal dynamic, which feels somehow beyond and more granular than formal logic. We cannot understand someone's language without some degree of emotional insight and "theory of other minds", and without grasping the environing situations where language-acts are carried out. But human cognition on that emotional and situational level seems holistic and "emergent"; merely observing human behavior (as if sociologically or anthropologically) at the everyday level does not take us to the cognitive or neurophysical particulars that can explain *how* reason and consiousness emerges in the brain. Targeting attention on the logical structures within language, while downplaying some of language's subtlety and "humanness", can be perceived as a strategy to foreground cognitive processes involving language that we can actually hope to understand on a neurological level, and therefore approach from a goal of scientific (physical and/or logico-mathematical) *explanation*, as opposed to philosophical or humanistic *interpretation* — to uncover the physical/causal and logical/regulative mechanisms of the phenomena to be explained.

My perspective here is not to dispute the importance of physical/causal and logical/regulative *explanations*, or that a *perfect* theory of language would need (perhaps in conjunction with an overarching cognitive science) such an explanatory base. However, I believe that trying to isolate a logical model of *language* specifically is essentially a philosophical gambit: a hope that language can be isolated from the totality of cognition and consciousness and have its own reductive theory. When for instance I talk about *dogs* in the plural I am phenomenologically and practically engaged with specific dogs, or else with mental impressions or intentions of dogs, and their plurality is manifest in multiple perceptual and enactive manners — e.g., as a diversified visual expanse, a multi-point attentional (and/or kinaesthetic) focus. Any language production or reception in enmeshed with this phenomenologically and enactive immediacy, and the plurality of *dogs* connects to this pluralized intentional disclosure, not just to the logical reading of plurals as sets. To analyze the morphosyntax of plurals as *only* the appearance, within language-processing, of the logical individual/set distinction is to assume that our diagram of the stages of linguistic understanding can be lifted outside the context of our overall conscious-cognitive engagements. Ditto for other logical patterns like modality/hypotheticals and predicate operations.

Truth-theoretic paradigms are not entirely off-base: certainly there is *some* propositional content which is usually essential to meaning. Although not every sentence baldly asserts some proposition, there is typically a propositional content for which each sentence stands as a kind of complex signifier, and then the sentence as a whole acquires its full meaning in orientation to that

signified:

- (7) Please close the window?
- (8) I think the window is closed.
- (9) The window is closed.

There are indeed several issues which complicate a "mechanical" translation of sentences to propositional contents.[1] The diversity of illocutionary forms (like questions, imperatives, and statements of belief as well as direct assertions) is one complication. A second is context-sensitivity: normal sentences are truth-theoretically incomplete: taken out of context, they do not internally have sufficient precision to fully specify propositional content in isolation. Anaphoric resolution, pronouns, deictic references (*here*, *there*, *now*), and so forth, all are open-ended semantic units that demand pragmantic processing to be completed. Subtler contextual effects are also in play — in a vegan restaurant, say, someone requesting

- (10) Can I have some milk in this coffee?

is presumably intending a vegan milk substitute. Making it the case that *actual* milk is in her coffee is *not* fulfilling her request, as a cooperative conversational partner.

Such pragmantic and contextual nuances, however, do not intrinsically point against a semantics grounded in propositional meanings. We cannot reject the possibility that contextual processing is just one stage in mapping language content to propositional constituents. If for instance *her* is in some context a designation for Alexandria Ocasio-Cortez, U.S. Representative from New York, the relevant sentence can be generalized by substituting for "her" the definitive phrase. Contextuality is a factor for any semantic theory; we should assume that it specifically disfavors truth-theoretic approaches unless there is reason to believe that context is *more* difficult to model truth-theoretically than on other paradigms. Here, instead, I will concede that for typical sentences there *is* a propositional content that determines sentence-meaning and that can be designated, at least under reconstructive analysis, in context-neutral ways — in effect a kind of semantic "deep structure" which resolves pronouns, anaphora, deixis, and other open-ended linguistic surface structures. I take it that such a logically refined *intermediate representation* is necessary but not sufficient for truth-theoretic semantics. Since I also accept this intermediate representation as appropriate for normal language, I will here focus on the *not sufficient* part.

My critique of truth-theoretic paradigms, in a nutshell, is that language-processing can *not* be isolated from the totality of our conscious-cognitive engagements. So although the mappings between sentences and propositions are real, they do not lead us toward a useful heuristic model of language as a kind of "informalized" logic — because the aspects of cognition wherein such a logical gloss is explanatorily useful cannot be isolated as a grounding theory for language in general.

In a typical case, I contend that each sentence has a corresponding propositional content, based off of the relevant contextual and enactive situations where the language use is involved. Certain interpretive processes may be needed to uncover propositional details from surface language, but I will argue that related interpretations are intrinsic to language-understanding on any theory. So I will argue that an important dimension to language is the designation and negotiation of propositional content.

At the same time, I also believe that cognitive engagement with propositional content is endemic to any purposeful, goal-directed, social human activity, including but hardly limited to language. A defence of truth-theoretic semantics would need to demonstrate that linguistic performance, in some essential or formal manner, thematizes propositional content *above and beyond* the latent logicality of human reason and practice in general — or at least that language embodies an especially structured and formalizable manifestation of this logicality. Conversely, a *critique* of truth-theoretic semantics should present arguments that language's logical order is derivative of the ambient rationality of human action in general, and that the specific *linguistic* structures of syntax and semantics do not derive, directly, from the priority of signifying propositional content. For the latter perspective, the question is then from whence syntax and semantics *do* derive, and how that origin connects to the logicality which (I contend and conceed) *is* certainly present in language.

So my second goal in this paper is to sketch a theory of this other origin — drawing from various perspectives, including phenomenology, Cognitive Linguistics, and the philosophy of science. My overall approach is to,

[1] Henceforth I will talk about sentences as proxy for linguistic utterances (or written discourse segments) in general.

rather than treat natural language as a self-contained system, theorize language as a bridge between multiple "ontological" and scientific registers: social action and private cognition; practical embodied-enactive engagements and structurally analyzable cerebral routines; consciously mediated rationality and neurophysical substrata. Linguistics itself spans a subdisciplinary tableau which stretches from the social/quotidian to the mathematical or microscale — trying to uncover the formal underpinnings of syntactic and semantic systems at the neurocognitive level (or at least via formalizations we can see as potentially realizable at the neurophysical scale) or at a computational level where we try to establish language's functional organization and schematic regularities.

Intrinsic to this disciplinary spread is the question of what qualifies as a scientific theory of language. Ideally linguistics would take us to a causally closed and complete account of language as a phenomenon in the world, analogous to how biology provides a theory of life, disease, and reproduction grounded in phyical and chemical explanations. On this analogy we can then debate whether the best scientific theory would be ultimately reducible to neurocognitive principles — taking brain activity as the physical realization of linguistic processes akin to cells and organic molecules as the realization of biological phenomena — or whether language is best treated, in the scientific vein, more as a structured system; i.e., that the system-properties constituting language which our language-using brains must instantiate are more scientifically salient than their neurocognitive implementation. But whether on a neurophysical or computational track, this philosophy implies that the essential goal of linguistic *science* is to strip it, at least for explanatory purposes, of its human and societal context. The distinctly human qualities of language are perhaps an "emergent property" of structured neurophysical systems, and linguistics needs to bring us to the threshold of explaining the laws governing the reductive base of that emergence, as opposed to itemizing the rules of the emergent system on its own terms.

I believe similar metatheoretical intuitions have buttressed the intuitive appeal of truth-theoretic semantics, because excavating the logical rules of language can seem like a path for us to understand language on the terms by which it manifests at the neurocognitive level (as opposed to how it appears to us consciously and intersubjectively). However, while I agree that on some level a scientifically complete theory of language (and of all human reason) needs to explain down to neurophysical substrata (on pain of implying some sort of *elan vitale*-like rational essentialism), I believe it is erroneous to site this reduction *inside linguistics itself*. Our world-view may call for an overall reduction of *all* reason and consciousness to neurophysical substrata; but I question whether linguistically inflected cognition has a reductive analysis separate and apart from this ambient, metaphysical reductionism. Thus, I will argue that logico-mathematical analyses of language, even if they are motivated by an understandable commitment to physicalism or functionalism as an overarching mind-body paradigm, are inappropriately reductionistic vis-à-vis *language* as such. Our reductionistic commitments should not compel us toward reductive theories of syntax and semantics within the confines of the study of language itself.

In short, I will try to outline a theory of language which would be a philosophical complement to the "nonreductive physicalism" of John Searle or David Woodruff Smith: we can take mind-body reductionism as an ideological axiom but not a humanistic *methodology*. This includes critiquing paradigms in *computational* linguistics, and the larger "AI" trend of "mind as computer"; the assumption that cognitive processes are reproducible or can be modeled via computer software. I think there is a role for computational models which can shed some light on linguistic structures, but not to the extent that language understanding can be fully replicated on a computer (AI systems right now evince *some* realistic language-behavior but hardly reveal a human-like competence). I will therefore consider what class of computer models *can* be useful.

Overall, I dispute the assumption that linguistic analysis needs to be a self-contained science; or to engender self-contained "Natural Language Processing" software. Instead, it is appropriate for practitioners to understand linguistics in federation with other fields and sciences, both in the humanities and natural or mathematical sciences. The proper metatheoretical role for linguistic analysis is to isolate properly *linguistic* (syntactic, semantic, and pragmatic) structures as theoretical targets, strategically defering to other sciences outside the circle of language proper (whether in the sociological or neurocognitive direction). In this guise linguistics can act as a "bridge" theory, connecting sociology to neu-

rophysics, for example, by analogy to biology bridging medicine and chemistry. If linguistics' proper metascentific role is to serve as a social-to-natural science (and humanities-to-mathematics) bridge, I will argue that truth-theoretic perspectives are less than ideal for this role, and will propose an alternative more grounded in Cognitive Semantics and Cognitive Grammar.

1 Truth-Theoretic Semantics and Enaction

I will start by reviewing illocutionary pragmatics, to identify some of the contextual and interpretive transformations that pertain to mapping surface language to propositional contents. My point is to establish what should be a common theory of logicality that can be shared by both critics and defenders of "truth-theoretic" paradigms, on which basis their legitimate disputes can be investigated.

Many linguists (on both sides, I would say, of my central truth-theoretic pro/con), seem to analyze hedges like "could you please" as merely dressing over crude commands: we don't want to come across as giving people orders, but sometimes we do intend to ask pople to do specific things. As a result, we feel obliged to couch the request in conversational gestures that signal our awareness of how bald commands may lie outside the conversational norms. These ritualistic "could you please"-like gestures may have metalinguistic content, but — so the theory goes — they do not *semantically* alter the speech-act's directive nature.

The problem with this analysis is that sometimes directive and "inquisitive" dimensions can overlap:

- (11) Do you have almond milk?
- (12) Can you get MsNBC on your TV?
- (13) This isn't a screw-cap bottle: I need a corkscrew.

These *can* be read as bare directives, and would be interpreted as such if the hearer believed the speaker already knew that yes, he has almond milk, and yes, he gets MsNBC. In (13), if both parties know there's one corkscrew in the house, the statement implies a directive to fetch *that* corkscrew. But, equally, (11)-(13) can *also* be read as bare questions with no implicature: say, as fans of almond milk and MsNBC endorsing those selections, or pointing out that opening the bottle will need *some* corkscrew. And, meanwhile, (11)-(13) can *also* be read as a mixture of the two, as if people expressed themselves like this:

- (14) I think the window is open, can you close it?
- (15) I see you have almond milk, can I have some?
- (16) If you get MsNBC, can you turn on Rachel Maddow?
- (17) If there is a corkscrew in the house, can you get it?

I think the mixed case is the most prototypical, and pure directives or inquiries should be treated as degenerate structures where either directive or inquisitive content has dropped out. After all, even a dictatorial command includes the implicit assumption that the order both makes sense and is not impossible. On the other hand, we don't ask questions for no reason: "do you have almond milk" may be a suggestion rather than a request, but it still carries an implicature (e.g., that the addressee *should* get almond milk).

Ordinary requests carry the assumption that addressees can follow through without undue inconvenience, which includes a package of assumptions about both what is currently the case and what is possible. "Close the window" only has literal force if the window is open. So, when making a request, speakers have to signal that they recognize the request involves certain assumptions and are rational enough to accept modifications of these assumptions in lieu of literal compliance. This is why interrogative forms like "can you" or "could you" are both semantically nontrivial and metadiscursively polite: they leave open the possibility of subsequent discourse framing the original request just as a belief-assertion. Developments like *can you open the window — no, it's closed* are not ruled out. At the same time, interrogative forms connote that the speaker assumes the addressees can fulfill the request without great effort: an implicit assumption is that they *can* and also *are willing to* satisfy the directive. This is an assumption, not a presumption: the speaker would seem like a bully if he acted as if he gave no thought to his demands being too much of an imposition — as if he were taking the answer to "can you" quesions for granted. This is another reason why requests should be framed as questions. So, in short, "commands" are framed as questions because the speaker literally does not know for sure whether the command is

possible; given this uncertainty a command *is* a question, and the interrogative form is not just a non-semantic exercise in politesse.

Sometimes the link between directives and belief assertions is made explicit. A common pattern is to use *I believe* or *I believe that* as an implicature analogous to interrogatives:

- (18) I believe you have a reservation for Jones?
- (19) I believe this is the customer service desk?
- (20) I believe we ordered a second basket of garlic bread?
- (21) I believe you can help me find computer acessories in this section?

These speakers are indirectly signaling what they want someone to do by openly stating the requisite assumptions — *I believe you can* in place of *can you?*. The implication is that such assumptions translate clearly to a subsequent course of action — the guest who *does* have that reservation should be checked in; the cashier who *can* help a customer find accessories should do so. But underlying these performances is recognition that illocutionary force is tied to background assumptions, and conversants are reacting to the propositional content of those assumptions as well as the force itself. If I *do* close the window I am not only fulfilling the request but also confirming that the window *could* be closed (a piece of information that may become relevant in the future).

In sum, when we engage pragmatically with other language-users, we tend to do so cooperatively, sensitive to what they wish to achieve with language as well as to the propositional details of their discourse. But this often means that I have to interpret propositional content in light of contexts and implicatures. Note that both of these are possible:

- (22) Do you have any milk?
- (23) Yes, we have almond milk.
- (24) No, we have almond milk.

A request for milk in a vegan restaurant could plausibly be interpreted as a request for a vegan milk-substitute. So the concept *milk* in that context may actually be interpreted as the concept *vegan milk*. Responding to the force of speech-acts compels me to treat them as not *wholly* illocutionary — they are in part statements of belief (like ordinary assertions). One reason I need to adopt an epistemic (and not just obligatory) attitude to illocutionary acts is that I need to clarify what meanings the speaker intends, which depends on what roles she is assigning to constituent concepts.

Suppose my friend says this, before and after:

- (25) Can you put some almond milk in my coffee?
- (26) Is there milk in this coffee?

Between (25) and (26) I do put almond milk in his coffee and affirm "yes" to (26). I feel it proper to read (26)'s "milk" as really meaning "almond milk", in light of (25). Actually I should be *less* inclined to say "yes" if (maybe as a prank) someone had instead put real (cow) milk in the coffee. In responding to his question I mentally substitute what he almost certainly *meant* for how (taken out of context) (26) would usually be interpreted. In this current dialog, the *milk* concept not only includes vegan milks, apparently, but *excludes* actual milk.

It seems — on the evidence of cases like this one — as if when we are dealing with illocutionary force we are obliged to subject what we hear to extra interpretation, rather than resting only within "literal" meanings of sentences, conventionally understood. This point is worth emphasizing because it complicates our attempts to link illocution with propositional content. Suppose grandma asks us to close the kitchen window. Each of these are plausible and basically polite responses:

- (27) It's not open, but there's still some cold air coming through the cracks.
- (28) It's not open, but I closed the window in the bedroom.
- (29) I can't — it's stuck.

In each case I have not fulfilled her request vis-à-vis its literal meaning, but I *have* acted benevolently in terms of conversational maxims.

Part of reading propositional content is syncing our conceptual schemas with our fellow conversants. The illocutionary dimension of a request like *can I have some milk?* makes this interpretation especially important, because the addressee wants to make a good-faith effort to cooperate with the pragmatic intent of the speech-act. But cooperation requires the cooperating parties' conceptual schemas to be properly aligned. I therefore have to suspend the illocutionary force of a directive

temporarily and treat it as locutionary statement of belief, interpret its apparent conceptual underpinnings in that mode, and then add the illocutionary force back in: if I brought *real* milk to a vegan customer who asked for "milk" I would be *un*-cooprative.

The upshot is that conversational implicatures help us contextualize the conceptual negotiations that guarantee our grasping the correct propositional contents, and vice-versa. This means that propositionality is woven throughout both assertive and all other modes of language, but it also means that propositional content can be indecipherable without a detailed picture of the current context (including illocutionary content). The proposional content of, say, *there is milk in this coffee* has to be judged sensitive to contexts like *milk* meaning *vegan milk* — and this propagates from a direct propositional to any propositional attitudes which may be directed towards it, including requsts like *please put milk in this coffee*.

Suppose the grandkids close grandma's bedroom window when she asks them to close the kitchen window. The propositional content at the core of grandma's request is that the kitchen window be closed; the content attached to it is an unstated belief that this window is open. Thus, the truth-conditions satisfying her implicit understanding would be that the kitchen window went from being open to being closed. As it happens, that window is already closed. So the truth-conditions that would satisfy grandma's initial belief-state do not obtain — her beliefs are false — but the truth conditions satisfying her desired result *do* obtain. The window *is* closed. Yet the grandkids should not thereby assume that her request has been properly responded to; it is more polite to guess at the motivation behind the request, e.g., thay she felt a draft of cold air. In short, they should look outside the truth conditions of her original request taken literally, and *interpret* her request, finding different content with different truth-conditions that are both consistent with fact and address whatever pragmatic goals grandma had when making her request. They might infer her goal is to prevent an uncomfortable draft, and so a reasonable "substitute content" is the proposition that *some* window is open, and they should close *that* one.

So the grandkids should reason as if translating between these two implied meanings:

- (30) I believe the kitchen window is open — please close it!
- (31) I believe some window is open — please close it!

They have to revise the simplest reading of the implicit propositional content of grandma's *actual* request, because the actual request is inconsistent with pertinent facts. In short, they feel obliged to explore propositional alternatives so as to find an alternative, implicit request whose propositional content *is* consistent with fact and also meets the original request's illocutionary force cooperatively.

In essence, we need to express a requester's desire as itslf, in its totality, a specific propositional content, thinking to ourselves (or even saying to others) things like

- (32) Grandma wants us to close the window.
- (33) He wants a bottle opener.

But to respond politely we need to modify the parse of their requests to capture the "essential" content:

- (34) Grandma wants us to eliminate the cold draft.
- (35) He wants something to open that bottle.

We have to read outside the literal interpretation of what they are saying. This re-reading is something that may be appropriate to do with respect to other forms of speech also; but our conversational responsibilty to infer some unstated content is especially pronounced when we are rsponding to an explicit request for something.

Certainly, in many cases, meanings are not literal. But how then do we understand what people are saying? Trying to formulate a not-entirely-haphazard account of this process, we can speculate that interpreting what someone is "really" saying involves systematically mapping their apparent concepts and references to some superimposed inventory designed to mitigate false beliefs or conceptual misalignments among language users in some context. That means, we are looking for mappings like *milk* to *almond milk* in (36) from a vegan restaurant, or *kitchen window* to *bedroom window* in (37) if it is the latter that is open:

- (36) Can I have some milk?
- (37) Can you close the kitchen window?

The point of these "mappings" is that they preserve the possibility of modeling the *original* propositional content

by identifying truth conditions for that content to be satisfied.

A *literal* truth-condition model doesn't work in cases like (36) and (37): the diner's request is *not* satisfied if it is the case that there is now (real) milk in her coffee; and grandma's request is not necessarily satisfied if it is the case that the kitchen window is closed. The proposition "the kitchen window is closed" only bears on grandma's utterance insofar as she believes that this window is open and causing a draft. So if we want to interpret the underlying locutionary content of (36) and (37) truth-theoreticaly, we need to map the literal concepts appearing in these sentences to an appropriate translation, a kind of "coordinate transformation" that can map concepts onto others, like milk/almond milk and kitchen window/bedroom window.

In sum, a theory of sentences' logical nexus can only be complete with some model of discursive context *structured in such a way* that we can repesent the interpretations and concept-transforms internal to parsing sentences to their propositional core. I will now consider what such a "theory of context" might look like.

1.1 *The co-framing system and the doxa system*

Illucutionary acts expressly signify our desire for something to change in our environment (with the help of our addressees), but similar implications of pragmatic desire are evident even when sentences are more directly assertorial, or less directly illocutionary. Compare between:

- (38) Remember that wine we tasted on the Niagara Peninsula last summer? Can you find it in our local liquor store?
- (39) Remember that wine we tasted on the Niagara Peninsula last summer? What varietal was that again?

The first sentence in each pair attempts to establish a common frame of reference between addresser and addressee — it does not, in and of itself, request any practical (extramental) action. The second sentence in (38) *can* be read as requesting that the addressee buy a bottle, though an alternate interpretation is to learn for *future reference* whether someone *could* buy that bottle. The second sentence in (39) carries no directive implicature at all, at least with any directness; it asks for more information.

Despite these variations, it seems reasonable to say that language is always performed in an overarching setting where concrete (extralinguistic) activity will *eventually* take place. If in (39) I intend to recommend that grape variety to a friend, I may not be making a direct request of him, but I *am* proposing an eventual action that he might take. If in (38) I am not issuing a directive, I am however establishing (and reserving the future possibility) that such a directive would be reasonable. As a result, some extralinguistic state change seems to be lurking behind the linguistic content: I want my friend to go from having never tasted that varietal to having tasted it. Or I want to go from not having a bottle of that wine to having one. Or, if I do not want these things at the moment, I want to confirm intellectually that these wishes are plausible. We seem to use language to set up the interpersonal understandings needed to *eventually* engage in (usually collective) practical activity, which means effectuating some (extralinguistic) change.

That is, most expressions are not direct requests or suggestions of the "close the window" or "let's get some wine" variety, but they are stiches in the thread of coorinated human actions. Often however we use language to *prepare*, *negotiate*, and *decide upon* joint actions. We may have a *holistic* sense that meanings orbit around extralinguistic and extramental state-change, but at the level of particular sentences most changes that occur, or are proposed, tend to be changes in our conceptualization of situations. Accordingly, we can pursue a semantic theory based on *change of state* if we accept that such changes run the gambit from changes *internal* to language — to conversants' appraisal of dialogic context — to changes effectuated by human activity inspired by language. Dialogs themselves change: the first sentences in (38) and (39) modify the discursive frame so that, for example, a particular wine becoms available as the anaphoric target for *that* and *that wine* — and also, metonymically, *that varietal*, *that grape*, *that winery*. Conceptual frames can change: if we are discussing a visit to Ontario and I mention one specific winery, one effect is to (insofar as the conversation follows my lead) refigure our joint framing to something narrower and more granular that the prior frame (but still contained in it; I am not changing the subject entirely). We can pull a frame out as well as in — e.g., switch from talking about one winery visit to the whole trip, or one Leafs

game to the entire season. Moreover, our beliefs can change/evolve: if you tell me the wine was Cabernet Franc, I have that piece of info in my arsenal that I did not have before.

So I will argue and assume in this paper that linguistic manings are grounded in state-changes, with the stipulation that the "register" where the changes occur can vary over several cognitive and extramental options: actual change in our environment (the window closed, milk in the coffee, the bottle opened); changes to the dialog structure (for anaphoric references, pronoun resolution, metalinguistic cues like *can you say that again*, etc.); changes to conceptual framings (zoom in, zoom out, add detail); changes to beliefs. Each of these kinds of changes deserve their own analysis, but we can imagine the totality of such analyses forming an umbrella theory of meanings.

During the course of a conversation — and indeed of any structured cognitive activity — we maintain conceptual frames representing relevant information; what other people know or believe; what are our goals and plans (individually and collectively); and so forth. We update these frames periodically, and use language to compel others to modify their frames in ways that we can (to some approximation) anticipate and encode in linguistic structure.

In the simplest case, we can effectuate changes in others' frames by making assertions they are likely to believe to be true (assuming they deem us reliable). In general, it is impossible to extricate the explicit content of the relevant speech-acts from the relevant cognitive, linguistic, and real-world situational contexts:

- (40) That wine was a Cabernet Franc.
- (41) Those dogs are my neighbor's. They are very sweet.

Although there is a determinate propositional content being asserted and although there is no propositional attitude other than bald assertion to complicate the pragmatics, still the actual words depend on addressees drawing from the dialogic conext in accord with how I expect them to (as manifest in open-ended expressions like *that wine*, *those dogs*, *they*). Moreover, the open-ended components can refer outward in different "registers": in *that wine* I may be referencing a concept previously established in the conversation, while *those dogs* may refer to pets we saw or heard but had not previously talked about. Of course, the scenarios could be reversed: I could introduce *that wine* into the conversation by gesturing to a bottle you had not noticed before, and refer via *those dogs* to animals you have never seen or heard but had talked about, or heard talk about, in the recent past. These dialog steps need to be resolved via a mixture of linguistic and extra-linguistic cues: surface-level language is not always clear as to whether referring expressions are to work "deictically" (drawing content from the ambient context, signified by gestures, rather than from any linguistic meaning proper), "discursively" (referring within chains of dialog, e.g. anaphora), or "descriptively" (using purely semantic means to establish a designation, like "my next-door neighbor's dogs" or "Inniskillin Cabernet Franc Icewine 2015").

Let's agree to call the set of entities sufficiently relevant to a discourse or conversation context the *ledger*. By "sufficiently relevant" I mean whatever is already established in a discourse so it can be referenced with something less that full definite description (and without the aid of extralinguistic gestures). I assume that gestures and/or descriptions are communicative acts which "add" to the ledger. The purely linguistic case — let's say, *descriptive additions* — can themselves be distinguished by their level of grounding in the current context. A description can be "definitive" in a specific situation without being a *definite description* in Russell's sense (see "that wine we tasted last summer").

So, descriptive additions to the ledger are one kind of semantic side-effect: we can change the ledger via language acts. I will similarly dub another facet of cognitive-linguistic frames as a *lens*: the idea that in conversation we can "zoom" attention in and out and move it around in time. "That wine we tasted last summer in Ontario" both modifies the *ledger* (adding a new referent for convenient designation) and might alter the *lens*: potentially compelling subsequent conversation to focus on that time and/or place. Finally, I will identify a class of frame-modifications which do directly involve propositional content: the capacity for language to promote shared beliefs between people whose cognitive frames are in the proper resonance, by adding dtails to conceptual pictures already established: *those dogs are Staffordshires*, *that wine is Cabernet Franc*, *we have almond milk*, etc.

For sake of discussion, I will call this latter part of the

"active" cognitive frame, for some discussion — the part concerning shared beliefes or asserted facts — the *doxa inventory*. This "database"-like repository stands alongside the "ledger" and "lens" to track propositional content asserted, collectively established, or already considered as background knowledge, vis-à-vis some discourse. Manipulations of the lens and ledger allow spakers to designate (using referential cues that could be ambiguous out-of-context) propositional contents which they wish to add to the "doxa inventory". I'll also say that modifying this inventory *can* be done through language, but participants in a discourse are entitled to assume that everyone formulates certain beliefs which are observationally obvious, and can therefore be linguistically presupposed rather than reported (the likes of that a traffic light is red, or a train has pulled into a station, or that it's raining).

So, I will assume that the machinery of frames is cognitive, not just linguistic. We have analogous faculties for "refocusing" attention and adding conceptual details via interaction with our environment, both alone and with others, and both via language and via other means. Some aspects of *linguistic* cognitive framing — like the "ledger" of referents previously established in a conversation — may be of a purely linguistic character, but these are the exception rather than the rule. In the typical case we have a latent ability to direct attention and form beliefs by direct observation *or* by accepting others' reports as proxies for direct observation.

When we are told that two dogs are male, for instance, we may not perceptually encounter the dogs but we understand what sorts of preceptual disclosures could serve as motivation for someone believing that idea. We therefore assume that such belief was initially warranted by observation and subsequently got passed through a chain of language-acts whose warrants are rooted in the perceived credibility of the speaker. Internal to this process is our prior knowledge of the parameters for judging statements like *this dog is male* observationally.

True, sometimes such observational warrants are less on display. If I had never heard of Staffies (Staffordshire pit bulls), I would be fuzzier about observational warrants and could end up in conversations like:

- (42) Those dogs are Staffordshires.
- (43) What's a Staffordshire?
- (44) It's a breed of dog.

Here I still don't really have a picture of what it is like to tell observationally that a dog is a Staffordshire. There may not be any visual cues — at least none I know of — which announce to the world that some dog's a Staffy (compared to those announcing that it is male, say). But insofar as I am acquainted with the concept *dog breed*, I also understand the general pattern of these observations. For instance I may know breeds like poodles or huskies and be able to identify *these* by distinctive visual cues. I also understand that dogs' parentage is often documented, allowing informed parties to know their breeds via those of their forebearers. That is, I am familiar with how beliefs about breeds are formed based on observation rather than just accepting others' reports, so I know the extralinguistic epistemology anchoring chains of linguistic reports in this area to originating observations — even if I cannot in this case initiate such a chain myself.

My overall point is that language enables us to formulate beliefs based on the beliefs of others, but this is possible because we also realize what it is like to formulate *our own* beliefs, and envision that sort of practice at the origin of reports that later get circulated via language. If we can't sufficiently picture the originating observations, we don't feel like we are grasping the linguistic simulacrum of those reports with enough substance. If I never learn what Stafforshire is, an assertion that some dogs are Staffordshires has no real meaning for me — even if I trust the asserter and do indeed thereby believe that the dogs are Staffordshires. Notice that merely knowing Staffordshire is a breed of dog does not expand my conceptual repertoire very much — it does not tell me how to recognize a Staffordshire or what I can do with the knowledge that a dog is one (it cannot, for instance, help me anticipate his behavior). Nevertheless even (only) knowing that Staffordshire is a breed of dog seems to fundamentally change the status of sentences like *those dogs are Staffies* for me: I do not *have* the conceptual machinery to exploit that knowledge, but I understand what *sort* of machinery is involved.

In short, the *linguistic* meaning of concepts is tightly bound to how concepts factor in perceptual observations anterior to linguistic articulation. As a result, during any episode wherein conversants use language to compel others' beliefs, an intrinsic dimension of the unfolding

conversation is that people will form their own (extralinguistic) beliefs — and can also imagine themselves in the role of originating the reports they hear via language, whether or not they can actually test out the reports by their own observations.

This extralinguistic epistemic capacity is clearly exploited by the form of language itself. If a tasting organizer hands me a glass and says "This is Syrah", she clearly expects me to infer that I should take the glass from her and taste the wine (and know that the glass contains wine, etc.). These conventions may be *mediated* by language — we are more likely to understand "unspoken" norms by asking questions, until we gain enough literacy in the relevant practical domain to understand unspoken cues and assumptions. But many situational assumptions are extralinguistic because they are (by convention) not explicitly stated, even if they accompany content that *is* explicitly stated. *This is Syrah* acccompanied by the gesture of handing me a glass is an indirect invitation for me to drink it (compare to *Please hold this for a second?* or *Please hand this to the man behind you?*).

I bring to every linguistic situation a capacity to make extralinguistc observations, and to understand every utterance in the context of hypothetical extralinguistc observations from which is originates. My conversation peers can use language to trigger these extralinguistic observations. Sometimes the "gap" — the conceptual slot which extralinguistic reasoning is expected to fill — is direcly expressed, as in *See the dog over there?*. But elsewhere the "extralinguistic implicature" is more indirect, as in *This is Syrah* and my expected belief that I should take and taste from the glass. But in any case the phenomenon of triggering these extralinguistic observation is one form of linguistic "side effect", initiating a change in my overall conceptualization of a situation by compeling me to augment beliefs with new observations.

All told, then, the language which is presented to me has the effect of initiating changes in what I believe — partly via signifying propositional content that I could take on faith, but partly also via directing my attention and my interpretive dispositions to guide me towards extralinguistic observations. Here I will argue that side-effects like these are not side-effects *of* linguistic meaning, but are in some sense *constitutive* of meaning.

1.2 *Signifying Propositional Content*

Let us agree that — beneath surface-level co-framing complexity — many language acts have a transparent content as "doxa" that gets conveyed between people with sufficiently resonant cognitive frames. So *in the overall course of communication* we have propositional contents that converge among discourse partners, suspended between the various cognitive and pragmatic units which contextualize a given, unfolding dialog. There is in short a *holistic* mapping between units of discourse and "units" of propositionality, or "doxa". This general observation leaves unstated, however, *how* language elements map to corresponding doxic particulars. I will argue that focusing on the *logical structures* of propositions can lead us astray if we seek to find concordant formations on the language side.

Consider our attempts to close grandma's kitchen window. My analysis related to conceptual "transforms" assumed that we can find, substituting for *literal* propositional content, some *other* (representation of a) proposition that fulfills a speaker's unstated "real" meaning. Sometimes this makes sense: the proposition "that the *bedroom* window is closed" can neatly, if the facts warrant, play the role of the proposition that *the kitchen window is closed*. But we can run the example differently: there may be *no* window open, but instead a draft caused by non-airtight windows (grandma might ask us to put towels by the cracks). Maybe there is no draft at all (if grandma is cold, we can fetch her a sweater). Instead of a single transform, we need a a system of potential transforms that can adapt to the facts as we discover them. Pragmatically, the underlying problem is that *grandma is cold*. We can address this — if we want to faithfully respond to her request, playing the role of cooperative conversation partners (and grandkids) — via a matrix of logical possibilities:

- (45) If the kitchen window is closed, we can see if other windows are open.
- (46) If no windows are open, we can see if there is a draft through the window-cracks.
- (47) If there is no draft, we can ask if she wants a sweater.

This is still a logical process: starting from an acknowledged proposition (grandma is cold) we entertain various other propositional possibilities, trying to rationally determine what pragmas we should enact to alter that

case (viz., to instead make true the proposition that *grandma is warm*). Here we are not just testing possibilities against fact, but strategically acting to modify some facts in our environment.

But the kind of reasoning involved here is not logical reasoning per se: abstract logic does not tell us to check the bedroom window if the kitchen window is closed, or to check for gaps and cracks if all windows are closed. This all solicits practical, domain-specific knowledge (about windows, air, weather, and houses). Yet we are still deploying our practical knowledge in logical ways — there is a logical structure underpinning grandma's request and our response to it. In sum: we (the grandkids) are equipped with some practical knowledge about houses and a faculty to logically utilize this knowledge to solve the stated problem, reading beyond the *explicit* form of grandma's discourse. We use a combination of logic and background knowledge to reinterpret the discourse as needed. By making a request, grandma is not expressing one attitude to one proposition, so much as *initiating a process*. This is why it would be impolite to simply do no more if the kitchen window is closed: our conversational responsibility is to enact a process trying to redress grandma's discomfort, not to entertain the truth of any one proposition.

For all that, there is still an overarching logical structure here that language clearly marshals. We read past grandma's explicit request to infer what she is "really saying" — e.g., *that she is cold* — but we still regard her speech act in terms of its (now indirect) propositional content. However, notice how our ascertaining this content only one step toward legitimate understanding of the original speech-act (even accounting for its illocutionary dimensions). The doxa are *factors* in understanding but, given these cases, are not straightforward *designata* of linguistic compounds. This implies a critique of truth-theoretic paradigms from a semiotic and compositional perspective: language is not *composed* to convey doxa through semantic reference and grammatic form internally (without the mediation of extralinguistic cognition); propositional content does not *fall out* of syntax and semantics. I will expand on this critique in the next section.

To summarize my current arguments, then, I believe that most sentences have an accompanying propositional content, and that during conversations we interpret this content as a factor in sentence meanings, becoming aware of what our partners believe, desire, or inquire to be the case. We retain this awareness in a cumulative model of conversational context — a "doxa inventory" — alongside other referential and deictic axes establishing each dialogic setting.

For the remainder of this paper I grant that this doxic layer is central to linguistic performance in general — but given this very centrality I will argue that the logical substratum of language cannot be *separated* from the totality of syntactic, semantic, and pragmatic processing such that models based on formal logic could be curated in isolation from the overarching interconnectedness of language as a cognitive system.

2 The Illogic of Syntax

As I understand it, a non-trivial truth-theoretic semantics requires more than a holistic association between sentences and propositional content: it requires that this association be established *by linguistic means* and *on linguistic grounds* (syntax, semantics, pragmatics). I will present several arguments against this possibility, in the general cases — that is, against the possibility that for *typical* sentences we can analyze syntactic form through the lens of the logical structure of propositions signified via a sentence; or analyze natural-language semantics through a logically well-structured semantics of propositions. I will emphasize two issues: first, that the architecture of linguistic performances *does not*, in the general case, *recapitulate propositional structure*; and, second, that language acts work through gaps in logical specificity that complicate how we should theorize the triangular relation between surface language, propositional content, and side-effect meanings.

2.1 *Syntax and Holistic Meaning*

Since it is widely understood that the essence of language is compositionality, the clearest path to a truth-theoretic semantics would be via the "syntax of semantics": a theory of how language designates propositional content by emulating or iconifying propositional structure in its own structure (i.e., in grammar). This would be a

theory of how linguistic connectives reciprocate logical connectives, phrase hierarchies reconstruct propositional compounds, etc. It would be the kind of theory motivated by cases like

- (48) This wine is a young Syrah.
- (49) My cousin adopted one of my neighbor's dog's puppies.

where morphosyntactic form — possessives, adjective/noun links — seems to transparently recapitulate predicate relations. Thus the wine is young *and* Syrah, and the puppy if the offspring of a dog who is the pet of someone who is the neighbor of the speaker. These are well-establishd logical forms: predicate conjunction, here; the chaining of predicate operators to form new operators, there. Such are embedded in language lexically as well as grammatically: the conjunction of husband and "former, of a prior time" yields ex-husband; a parent's sibling's daughter is a cousin.

The ineteresting question is to what extent "morphosyntax recapitulates predicate structure" holds in general cases. This can be considered by examining the logical structure of reported assertions and then the structures via which they are expressed in language. I'll carry out this exercise vis-à-vis several sentences, such as these:

- (50) The majority of students polled were opposed to tuition increases.
- (51) Most of the students expressed disappointment about tuition increases.
- (52) Many students have protested the tuition increases.

There are several logically significant elements here that seem correspondingly expressed in linguistic elements — that is, to have some model in both prelinguistic predicate structure and in, in consort, semantic or syntactic principles. All three of (50)-(52) have similar but not identical meanings, and the differences are manifest both propositionally and linguistically (aside from the specific superficial fact that they are not the same sentence). I will review the propositional differences first, then the linguistic ones.

One obvious predicative contrast is that (50) and (51) ascribes a certain *quality* to students (e.g., disappointment), whereas (51) and (52) indicate *events*. As such the different forms capture the contrast between "bearing quality Q" and "doing or having done action A": the former a predication and the latter an event-report. In the case of (51), both forms are available because we can infer from *expressing* disappointment to *having* disappointment. There may be logics that would map one to the other, but let's assume we can analyze language with a logic expressive enough to distinguish events from quality-instantiations.

Other logical forms evident here involve how the subject noun-phrases are constructed. "A majority" and "many" imply a multiplicity which is within some second multiplicity, and numerically significant there. The sentences differ in terms of how the multiplicities are circumscribed. In the case of *students polled*, an extra determinant is provided, to construct the set of students forming the predicate base: we are not talking about students in general or (necessarily) students at one school, but specifically students who participated in a poll.

Interrelated with these effects are how the *tuition increases* are figured. Using the explicit definite article suggests that there is *some specific* tuition hike policy raising students' ire. This would also favor a reading where "students" refers collectively to those at a particular school, who would be directly affected by the hikes. The *absence* of an article on "tuition increases" in (51) leaves open an interpretation that the students are not opining on some specific policy, but on the idea of hikes in general.

Such full details are not explicitly laid out in the sentences, but it is entirely possible that they are clear in context. Let's take as given that, in at least some cases where they would occur, the sentences have a basically pristine logical structure given the proper contextual framing — context-dependency, in and of itself, does not weaken our sense of language's logicality. In particular, the kind of structures constituting the sentences' precise content — the details that seem context-dependent — have bona fide logical interpretations. For example, we can consider whether students are responding to *specific* tuition hikes or to hikes in general. We can consider whether the objectionable hikes have already happened or are just proposed. Context presumably identifies whether "students" are drawn from one school, one governmental jurisdiction, or some other aggregating criteria (like, all those who took a poll). Context can also determine whether aggregation is more set- or type-

based, more extensional or intensional. In (50)-(52) the implication is that we should read "students" more as a set or collection, but variants like *students hate tuition hikes* operates more at the level of students as a *type*. In "students polled" there is a familiar pattern of referencing a set by marrying a type (students in general) with a descriptive designation (e.g., those taking a specific poll). The wording of (50) does not mandate that *only* students took the poll; it does however employ a type as a kind of operator on a set: of those who took the poll, focus on students in particular.

These are all essentially logical structures and can be used to model the propositional content carried by the sentences — their "doxa". We have operators and distinctions like past/future, set/type, single/multiple, subset/superset, and abstract/concrete comparisons like tuition hikes *qua* idea vs. *fait accompli*. A logical system could certainly model these distinctions and accordingly capture the semantic differences between (50)-(52). So such details are all still consistent with a truth-theoretic paradigm, although we have to consider how linguistic form actually conveys the propositional forms carved out via these distinctions.

Ok, then, to the linguistic side. My first observation is that some logically salient structures have fairly clear analogs in the linguistic structure. For instance, the logical operator for deriving a set from criteria of "student" merged with "taking a poll" is brought forth by the verb-as-adjective formulation *students polled*. Subset/superset arrangements are latent as lexical norms in senses like *many* and *majority*. Concrete/abstract and past/future distinctions are alluded to by the presence or absence of a definite article. So "*the* tuition increases" connotes that the hikes have already occurred, or at least been approved or proposed, in the past relative to the "enunciatory present" (as well as that they are a concrete policy, not just the idea), whereas articleless "tuition increases" can be read as referring to future hikes and the idea of hikes in general: past and concrete tends to contrast with future and abstract.

A wider range of logical structures can be considered by subtly varying the discourse, like:

- (53) Most students oppose the tuition increase.
- (54) Most students oppose a tuition increase.

These show the possibility of *increase* being singular (which would tend to imply it refers to a concrete policy, some *specific* increase), although in (54) the *in*definite article *may* connote a discussion about hikes in general.

But maybe not; cases like these are perfectly plausible:

- (55) Today the state university system announced plans to raise tuition by at least 10%. Most students oppose a tuition increase.
- (56) Colleges all over the country, facing rising costs, have had to raise tuition, but most students oppose a tuition increase.

In (55) the definite article could also be used, but saying "*a* tuition increase" seems to reinforce the idea that while plans were announced, the details are not finalized. And in (56) the plural "increases" could be used, but the indefinite singular connotes the status of tuition hikes as a general phenomenon apart from individual examples — even though the sentence also makes reference to concrete examples. In other words, these morphosyntactic cues are like levers that can fine-tune the logical designation more to abstract or concrete, past or future, as the situation warrants. Again, context should clarify the details. But morphosyntactic forms — e.g., presence or absence of articles (definite or indefinite), and singular/plural — are vehicles for language, through its own forms and rules, to denote propositional-content structures like abstract/concrete and past/future.

So these are my "concession" examples: cases where language structures *do*, in their compound architectonics, signifying propositional contents — and moreover the lexical and morphosyntactic cues (like singular/plural or the choice of articles) drive this language-to-logic mapping in an apparently rule-bound and replicable fashion. These are potential case-studies of how a truth theory of language, without neglecting contextual and semantic subtelties, *could* work: capturing granular semantic constasts via sufficiently nuanced logics, and theorizing word-senses and morphology through the aegis of a structural reduction between surface language and predicate structure. My tactic for critiquing truth-theoretic paradigms is to argue that many sentences *fail* to display a mapping between lexico/morphosyntactic details and predicate structure *in this relatively mechanical fasion*. By pointing out examples where morphosytax *does* rather seamlessly recapitulate propositional content (e.g. *the tuition hike* plural/definite), we can appreciate

the more circuitous hermeneutics for examples I will present wherein the morphosytax-to-logic translation, while present, is not *sui generis*.

Varying the current examples yields cases where logical implications are be more circuitous. For instance, describing students as *disappointed* implies that the disliked hikes have already occured, whereas phraseology like "students are gearing for a fight" would imply, conversely, that they are sill only planned or proposed. The mapping from propositional-content structure to surface language here is less mechanical than, for instance, merely using the definite article on *the tuition increases*. Arguably "dissapointment" — rather than just, say, "opposition" — implies a specific timeline and concreteness, an effect analogous to the definite article. The semantic register of "dissapointment" bearing this implication is a more speculative path of conceptual resonances, compared to the brute morphosyntactic "the". There is subtle conceptual calculation behind the scenes in the former case. Nonetheless, it does seem as if via this subtlety linguistic resources are expressing the constituent units of logical forms, like past/future and abstract/concrete.

So, I am arguing (and conceding) that there are units of logical structure that are conveyed by units of linguistic structure, and this is partly how language-expressions can indicate propositional content. The next question is to explore this correspondance compositionally — is there a kind of aggregative, hierarchical order in terms of how "logical modeling elements" fit together, on one side, and linguistic elements fit together, on the other? There is evidence of compositional concordance to a degree, examples of which I have cited. In *students polled*, the compositional structure of the phrase mimics the logical construct — deriving a set (as a predicate base) from a type crossed with some other predicate. Another example is the phraseology *a/the majority of*, which directly nominates a subset/superset relation and so reciprocates a logical quantification (together with a summary of relative size; the same logical structure, but with different ordinal implications, is seen in cases like *a minority of* or *only a few*). Here there is a relatively mechanical translation between propositional structuring elements and linguistic structuring elements.

However, varying the examples — for instance, varying how the subject noun-phrases are conceptualized — points to how the synchrony between propositional and linguistic composition can break down:

- (57) Student after student came out against the tuition hikes.
- (58) A substantial number of students have come out against the tuition hikes.
- (59) The number of students protesting the tuition hikes may soon reach a critical mass.
- (60) Protests against the tuition hikes may have reached a tipping point.

Each of these sentences says something about a large number of students opposing the hikes. But in each case they bring new conceptual details to the fore, and I will also argue that they do so in a way that deviates from how propositional structures are composed.

First, consider *student after student* as a way of designating *many students*. There is a little more rhetorical flourish here than in, say, *a majority of students*, but this is not just a matter of eloquence (as if the difference were stylistic, not semantic). "Student after student" creates a certain rhetorical effect, suggesting via how it invokes its multiplicity a certain recurring or unfolding phenomenon. One imagines the speaker, time and again, hearing or encountering an angry student. To be sure, there are different kinds of contexts that are consistent with (57): the events could unfold over the course of a single hearing or an entire semester. Context would foreclose some interpretations — but it would do so in any case, even with simpler designations like *majority of students*. What we *can* say is that the speaker's chosen phraseology cognitively highlight a dimension in the events that carries a certain subjective content, invoking their temporality and repetition. The phrasing carries an effect of cognitive "zooming in", each distinct event figured as if temporally inside it; the sense of being tangibly present in the midst of the event is stronger here than in less temporalized language, like "many students". And then at the same time the temporalized event is situated in the context of many such events, collectively suggesting a recurring presence. The phraseology zooms in and back out again, in the virtual "lens" our our cognitively figuring the discourse presented to us — all in just three or four words. Even if "student after student" is said just for rhetorical effect — which is contextually possible — *how* it stages this effect still introduces a subjective coloring to the report.

Another factor in (57) and (58) is the various pos-

sible meanings of "come out against". This could be read as merely expressing a negative opinion, or as a more public and visible posturing. In fact, a similar dual meaning holds also for "protesting". Context, again, would dictate whether *protesting* means actual activism or merely voicing displeasure. Nonetheless, the choice of words can shade how we frame situations. To *come out against* connotes expressing disapproval in a public, performative forum, inviting the contrast of inside/outside (the famous example being *come out of the closet* to mean publicly identifying as LGBTQ). Students may not literally be standing outside with a microphone, but — even if the actual situation is just students complaining rather passively — using *come out against* paints the situation in an extra rhetorical hue. The students are expressing the *kind* of anger that can goad someone to make their sentiments known theatrically and confrontationally. Similarly, using "protest" in lieu of, say, "criticize" — whether or not students are actually marching on the quad — impugns to the students a level of anger commensurate with politicized confrontation.

All these sentences are of course *also* compatible with literal rioting in the streets; but for sake of argument let's imagine (57)-(60) spoken in contexts where the protesting is more like a few comments to a school newspaper and hallway small-talk. The speakers have still chosen to use words whose span of meanings includes the more theatrical readings: "come out against" and "protest" overlap with "complain about" or "oppose", but they imply greater agency, greater intensity. These lexical choices establish subtle conceptual variations; for instance, to *protest* connotes a greater shade of anger than to *oppose*.

Such conceptual shading is not itself unlogical; one can use more facilely propositional terms to evoke similar shading, "like very angry" or "extremely angry". However, consider *how* language like (57)-(60) conveys the relevant facts of the mater: there is an observational, in-the-midst-of-things staging at work in these latter sentences that I find missing in the earlier examples. "The majority of" sounds statistical, or clinical; it suggests journalistic reportage, the speaker making an atmospheric effort to sound like someone reporting facts as established knowledge rather than observing them close-at-hand. By contrast, I find (57)-(60) to be more "novelistic" than "journalistic". The speaker in these cases is reporting the facts by, in effect, *narrating* them. She is building linguistic constructions that describe propositional content through narrative structure — or, at least, cognitive structures that exemplify and come to the fore in narrative understanding. Saying "a substantial number of students", for example, rather than just (e.g.) *many* students, employs semantics redolant of "force-dynamics": the weight of student anger is described as if a "substance", something with the potency and efficacy of matter.

This theme is also explicit in "critical mass", and even *tipping point* has material connotations. We can imagine different versions of what lies one the other side of the tipping point — protests go from complaining to activism? The school forced to reverse course? Or, contrariwise, the school "cracking down" on the students (another partly imagistic, partly force-dynamic metaphor)? Whatever the case, language like "critical mass" or "tipping point" is language that carries a structure of story-telling; it tries tie facts together with a narrative coherence. The students' protests grew more and more strident until ... the protests turned aggressive; or the school dropped its plans; or they won public sympathy; or attracted media attention, etc. Whatever the situation's details, describing the facts in force-dynamic, storylike, spatialized language (e.g. "come *out* against") represents an implicit attempt to report observations or beliefs with the extra fabric and completeness of narrative. It ascribes causal order to how the situation changes (a critical mass of anger could *cause* the school to change its mind). It brings a photographic or cinematic immersion to accounts of events and descriptions: *student after student* and *come out* invite us to grasp the asserted facts by *imagining* situations.

The denouement of my argument is now that these narrative, cinematic, photographic structures of linguistic reportage — signaled by spatialized, storylike, force-dynamic turns of phrase — represent a fundamentally different way of signifying propositional content, even while they *do* (with sufficient contextual grounding) carry propositional content through the folds of the narrative. I don't dispute that hearers understand logical forms via (57)-(60) similar to those more "journaslistically" captured in (50)-(52). Nor do I deny that the richer rhetoric of (57)-(60) play a logical role, capturing granular shades of meaning. My point is rather that the logical picture painted by the latter sentences is drawn via (I'll say as a kind of suggestive analogy) *narrative structure*.

I argued earlier that elements of propositional structure — for example, the set/type selective operator efficacious in *students polled* — can have relatively clean morphosyntactic manifestation in structural elements in language, like the verb-to-adjective mapping on *polled* (here denoted, in English, by unusual word position rather than morphology, although the rules would be different in other languages). Given my subsequent analysis, however, I now want to claim that the map between propositional structure and linguistic structure is often much less direct. I'm not arguing that "narrative" constructions lack logical structure, or even that their rhetorical dimension lies outside of logic writ large: on the contrary, I believe that they use narrative effects to communicate granular details which have reasonable logical bases, like degrees of students' anger, or the causative interpretation implied in such phrases as *critical mass*. The rhetorical dimension does not prohibit a reading of (57)-(60) as expressing propositional content — and using rhetorical flourishes to do so.

I believe, however, that *how* they do so unzips any neat alignment between linguistic and propositional structure. Saying that students' protests "may have reached a critical mass" certainly expresses propositional content (e.g., that enough studnts may now be protesting to effectuate change), but it does so not by mechanically asserting its propositional idea; instead, via a kind of mental imagery which portrays its idea, in some imaginative sense, iconographically. "Critical mass" compels us to read its meaning imagistically; in the present context we are led to actually visualize students protesting *en masse*. Whatever the actual, empirical nature of their protestation, this language paints a picture that serves to the actual situation as an interpretive prototype. This is not only a conceptual image, but a visual one.

Figurative language — even if it is actually metaphorical, like "anger boiling over" — has similar effect. Alongside the analysis of metaphor as "concept blending", persuasively articulated by writers like Gilles Fauconnier and Per Aage Brandt, we should also recognize how metaphor (and other rhetorical effects) introduces into discourse language that invites visual imagery. Sometimes this works by evoking an ambient spatiality (like "come out against") and sometimes by figuring phenomena that fill or occupy space (like "students protesting" — one salience of this language is that we imagine protest as a demonstrative gesture expanding outward, as if space itself were a theater of conflict: protesters arrayed to form long lines, fists splayed upward or forward). There is a kind of visual patterning to these evocations, a kind of semiotic grammar: we can analyze which figurative senses work via connoting "ambient" space or via "filling" space, taking the terms I just used. But the details of such a semiotic are tangential to my point here, which is that the linguistic structures evoking these visual, imagistic, narrative frames are not simply reciprocating propositionl structure —- even if the narrative frames, via an "iconic" or prototype-like modeling of the actual situation, *are* effective vehicles for *communicating* propositional structure.

What breaks down here is not propositionality but *compositionality*: the idea that language signifies propositional content *but also* does so compositionally, where we can break down larger-scale linguistic elements to smaller parts *and* see logical structures mirrored in the parts' combinatory maxims. In the later examples, I have argued that the language signifies propositional content by creating narrative mock-ups. The point of these imagistic frames is not to recapitulate logical structure, but to have a kind of theatrical coherence — to evoke visual and narrative order, an evolving storyline — from which we then understand propositional claims by interpreting the imagined scene. Any propositional signifying in these kinds of cases works through an intermediate stage of narrative visualization, whose structure is holistic more than logically compositional. It relies on our faculties for imaginative reconstruction, which are hereby drafted into our language-processing franchise.

This kind of language, in short, leverages its ability to trigger narrative/visual framing as a cognitive exercise, intermediary to the eventual extraction of propositional content. As such it depends on a cognitive layer of narrative/visual understanding — which, I claim, belongs to a different cognitive register than building logical models of propositional content directly.

In the absence of a compelling analysis of *compositionality* in the structural correspondance between narrative-framed language and logically-ordered propositional content, I consequently think we need a new theory of how the former signifies the latter. My own intuition is that language works by trigering *several different* cognitive subsystems. Some of these hew closely to predicate logic; some are more holistic and narrative/visual. Cognitive

processes in the second sense may be informed and refined by language, but they have an extralinguistic and prelinguistic core: we can exercise faculties of narrative imagination without explicit use of language (however much language orders our imaginations by entrenching some concepts more than others, via lexical reinforcement).

I'm not just talking here about "imagination" in the sense of fairy tales: we use imaginative cognition to make sense of any situation dscribed to us from afar. When presented with linguistic reports of not-directly-observable situations, we need to build cognitive frames modeling the context as it is discussed. In the terms I suggested earlier, we build a "doxa inventory" tracking beliefs and assertions. Sometimes this means internalizing relatively transparent logical forms. But sometimes it means building a narative/visual account, playing an imaginary version of the situation in our minds. Language could not signify in its depth and nuance without triggering this *interpretive-imaginative* faculty. Cognitively, then, language is an *intermediary* to this cognitive system, an *interface*. To put it as a slogan, *language is an interface to interpretive-imaginative cognitive capabilities*.

2.2 *Vakarelov's "Interface Theory of Meaning"*

If this claim about *language* seems plausible, it has some ramifications for *linguistics*: insofar as language has a formal articulation, it is the formality of an *interface*, which is not necessarily the same thing as the formality of a *logical system*. Insofar as linguistics is a science, it would then be the science of the intermediate space between grammatical plus lexical observations and interpretive-imaginative cognition. Framing linguistics in these terms is, I believe, analogous to describing biology as the interface from medicine to chemistry and physics — with analogous philosophical justifications and metatheortical consequences. Both can be seen as a larger metascientific exploration of what it means — as a philosophical claim, on the one hand, and as a normative proscription on scientific practice, on the other — for a *science* to be an *interface*.

In the specific context of linguistics, one consequence is that any linguistic structuring element becomes an intermediary eventually handed off to interpretive-imaginative cognitive processes. A related picture perhaps emerges from the "Interface Theory of Meeting", developed over several papers by Orlin Vakarelov. Vakarelov's theory is presented as an alternative to both "internalist" and "externalist" paradigms, the contrast addressed via (notably) Hilary Putnam's "twin earth" discussion and its descendents (for terminological clarification, Vakarelov's symbol M roughly matches what I have called "cognitive frames", and S roughly matches our environing situations):

> It follows that neither an external relation between M and S, nor an internal function of "selecting conditional readiness states" is sufficient to provide a general notion of meaning, for they don't even fix the syntax of the information system independently. To specify the meaning of a state m we must do something different. What does M really do in the information system? It acts as an *interface* between the (external) world and the control system. It structures influences to allow focused purposeful control. If any sense of significance can be given to a particular state m of M, it must be related to this interface function. The significance of m is neither that it tracks something external nor that it can affect the control mechanisms of the system, but that it can connect one to the other. ... Let us go back to the observation that the definition collapses the external and internal conception of meaning. Specifying the differential interface function of a state requires looking at the entire system/environment complex. We can think of the datum state m as participating in a process of interaction where causal effects from the environment are channeled through the internal M-P control pathway to produce actions, which actions modify the system's behavior, and which in turn changes the state of the environment (including the relations between the system and other external systems). [59, pp. 15-16]
>
> I conjecture that the canonical examples of information media that shape many of our intuitions about semantics are media that exist (within an information system) as only one of a large network of other information media that jointly control the system's behavior.

> Thus, to take correspondence theories of meaning as an example, it is tempting to say that the word 'chair' means a property of external objects. Thus, in the expression, "This is a chair", the meaning is given by some fact in the world that the object depicted by the indexical has the property of chairhood. In an information system using language we can analyze this idea in a different way. The language medium, whose datum may be some structural equivalent to the expression "This is a chair", interacts with other nonlinguistic media connected to perception, allowing the system to identify and interact with patterns in the world that can be clustered through some data state of some internal media. To make Fodor happy, we can assume that there is a single medium that gets in an information state uniquely correlated with chairhood — a kind of a concept of "chair". The language system, in this picture, is not interfaced with the world (or some abstract realm of propositions). It is interfaced with other information media. The properties of the interface relations look a lot like the properties that a correspondence semantics may have, but these interface relations do not capture the true interface roles of the language datums for the information system. To determine the true interface role, we need to link all local interfaces and see how the entire complex participates in the purposeful behavior. [59, p. 17]

Interestingly, Vakarelov speaks not of "prelinguistic" cognition but of "precognitive" systems. This is partly, I belive, because Vakarelov wants to understand cognition as adaptation: "Nature, in its nomic patterns, offers many opportunities for data systems that can be given semantic significance, it offers ubiquitous potential datums, but it does not offer any well-defined and complete data sets" [59, p. 4]. As I read it, Vakarelov conceives cognitive systems as dynamic systems that try to adapt to other dynamic systems — these latter being the environments where we (taking humans as example cognitive systems) need to act purposefully and intelligently. The "nomic patterns" are latent in our surroundings, and not created by intellect. So *this* kind of worldly order lies "outside" cognition in an ontological sense; it is not an order which exists (in itself) in our minds (though it may be mirrored there). Consciousness comports to an "extramentally" ordered world. However, "precognitive" does not necessarily mean "extramental": there is a difference between being *aware* of structural regularities in our environment, which we can perhaps deem a form of pre-cognitive mentality, and trying to *interpret* these regularities for practical benefit (and maybe a subjective desire for knowledge).

When distinguishing "cognitive" from "precognitive", however, we should also recognize the different connotations that the term "cognitive" itself has in diffrent academic communities. In the context of Cognitive Linguistics, the term takes on an interpretive and phenomenological dimension which carries noticeably different implications in the "semantics of the theory" than in, say, conventional AI research. Vakarelov's strategy is to approach *human* cognition as one manifstation of structured systems which we can visualize as concentric circle, each ring implying greater sophistication and more rigorous criteriology than its outer neighbor:

> What is the function of cognition? By answering this question it becomes possible to investigate what are the simplest cognitive systems. It addresses the question by treating cognition as a solution to a design problem. It defines a nested sequence of design problems: (1) How can a system persist? (2) How can a system affect its environment to improve its persistence? (3) How can a system utilize better information from the environment to select better actions? And, (4) How can a system reduce its inherent informational limitations to achieve more successful behavior? This provides a corresponding nested sequence of system classes: (1) autonomous systems, (2) (re)active autonomous systems, (3) informationally controlled autonomous systems (autonomous agents), and (4) cognitive systems. [60, p. 83]

> The most rudimentary design problem begins here: if there is cognition, there must be a system. Without a condition allowing a system to exist as an entity discernible from its environment and persisting sufficiently long as that same entity to allow qualification of its dynamical behavior, the question of cognition does not

> arise. The first design question that must be examined is: What allows systems to persist as individual entities? More specifically: For which of those systems that persist is a capacity of cognition relevant? [60, p. 85]

But this intuition that human cognition can thematically extend out to other "cognitive systems" and then other structured systems — out of which *cognition* emerges by adding on criteria: is the system autonomous; reactive; information-controlled — suggests we are dealing with a different concept than in Cognitive Linguistics or Cognitive Phenomenology. For Vakarelov, "cognition, like most other biological categories, defines a gradation, not a precise boundary — thus, we can at best hope to define a direction of gradation of a capacity and a class of systems for which the capacity is relevant; [and] cognition is an operational capacity, that is, it is a condition on mechanisms of the system, not merely on the behavior of the system — to say that a system is cognitive is to say something general about how the system does something, not only what it does" (p. 85). Conversely, the qualities that make "grammar", say, "Cognitive" seem uniquely human: our sociality in the complexity of social arrangements and cultural transmission; our "theory of other minds". Certainly animals can have society, culture, and emapthy, but the human mind evidently takes these to a qualitatively higher level, making language *qua* cognitive system possible.

This argument does not challenge Vakarelov's programme directly, but perhaps it shifts the emphasis. Our cognition may be only one example of cognitive systems — which in turn are examples of more general autonomous/reactive/information-controlled systems — but there may still be distinct phenomenological and existential qualities to how *we* achieve cognition, certainly including human language. I think there are several distinct features we can identify with respect to *human* "cognitive frames", which call for a distinct pattern of analysis compared to generic "M" systems, in Vakarelov's terms.

And yet, I think Vakarelov's larger point remains in force: we need to get beyond both Externalism and Internalism in the sense that we need to get beyond a debate as to whether *words* have "intramental" or "extramental" *meanings*. For instance, we need to think past an apparent choice between deciding that the word "water" has a *meaning* which is either intramental (determined by the sum of each person's beliefs and dispositions about water) or extramental (determined by how our water-experiences are structured, even beyond our knowldge, by the physical nature of water). In place of either option, we should say that the meaning of the word *water* — or *chair*, in Vakarelov's example — depends on all the cognitive systems interacting with linguistic understanding. The word or concept does not exist in our "language-processing system" in isolation; so its meaningis not just *linguistic* meaning but how word-tokens and concept-instances become passed from system to system.

Insofar as we have a token of the word *water* — presumably tied to a concept-instance — the specific fact of our hearing the word is joined in with a plethora of other perceptual and rational events. Say, we hear someone ask for water, and soon after see someone bring her a glass. We instinctively connect our perceptual apprehension of the glass of water with the word heard spoken before, and we presumably remain vaguely aware of the situation as things unfold — if we see her drink from the glass, we connect this to our memory of her asking for water, indicating thirst, and then getting a glass in response. We do not need to track these affairs very attentively — it's not like we should or need to stare at her intently while she drinks — but it fades into the background rationality that we tend to attribute to day-to-day affairs. Her glass of water — how it continues to serve a useful purpose, how she and maybe others interact withbit — becomes a stable if rather mundane part of our current situation.

In Vakarelov's words,

> To determine whether a particular macro-state of S is informationally relevant, i.e. whether it is differentially significant for the purposeful behavior of the system, we must trace the dynamical trajectories of the system and determine ... whether the microstate variation within the macro-states is insignificant for the purposeful behavior.... Let us call such macro-states *informationally stable*. [59, p. 15]

An intrinsic dimension of situational models, surely, is that they recognize the relatively stable patterns of situations: a glass placed on a table will typically remain there until someone moves it. Situations are, in this sense, large compilations of distinct quanta of relative

stability: in a dining context, every glass or plate or knife, every chair or table, every seated person, is an island of relative stability, whose state will change gradually if at all. So a large part of our cognitive processing can be seen as recognizing and tracking these stabilities. Stability is the underlying medium through which situational models are formed.

Utlimately, many cognitive systems contribute to such models: quanta of stability lie in the cross-hairs of multiple cognitive modalities. So we connect the water spoken about to water in a glass. If we have our own glass we connect both the linguistic and visual content to the tactile feel of the glass and the kinaesthetic intentionality exercised as we pick it up. We can imagine concepts like *this water* pinging between these various cognitive registers.

I have reviewed Vakarelov's theory because I think it is a good example of the metascientific reorientation which is necessary for us not to be seduced by logically reductive metalinguistic commitments despite our physicalist commitments. Physicalism as a philosophical scaffolding is not the same as believing that a theory of language is necessarily a theory of the *physical realization* of language in neurocognitive systems (whether causally materialized or abstractly modeled).

This is a theme I will pick up later; but I will now present further analyses reinforcing my claim that language structure does not *recapitulate* the propositional doxa that language (with due indirection) signifies.

3 Pragmatics and Logical Incompleteness

Another motivation for something like an Interface Theory of Meaning comes from cases where language users seem to traffic in a relative *absence* of semantic determinism, with no detrimental effects to the *telos* of language in context. This buttresses an idea that language is not targeted at doxic specificity as a precondition for meaning in general, but rather packages doxa along with other contextualizing constituents in the service of pragmatic ends. Consider:

- (61) My colleague Ms. O'Shea would like to interview Mr. Jones, who's an old friend of mine. Can he take this call?
- (62) I'm sorry, this is his secretary. Mr. Jones is not available at the moment.

It sounds like Ms. O'Shea is trying to use personal connections to score an interview with Mr. Jones. Hence her colleague initiates a process intended to culminate in Ms. O'Shea getting on the telephone with Mr. Jones. But his secretary demurs with a familiar phrase, deliberately formulated to foment ambiguity: (62) could mean that Mr. Jones is not in the office, or that he is in a meeting, or he is unwilling to talk, or even missing (like the ex-governor consummating an affair in Argentina while his aides thought he was hiking in Virginia). Or:

- (63) Mr. Jones, were you present at a meeting where the governer promised your employer a contract in exchange for campaign contributions?
- (64) After consulting with my lawyers, I decline to answer that question on the grounds that it may incriminate me.

Here Mr. Jones neither confirms nor denies his presence at a corrupt meeting.

As these examples intimate, the processes language initiates do not always result in a meaningful logical structure. But this is not necessarily a complete breakdown of language:

- (65) Is Jones there?
- (66) He is not available.

The speaker of (66) does not provide any prima facie logical content: it neither affirms nor denies Jones's presence. Nonetheless that speaker is a cooperative conversational partner (even if they are not being very cooperative in real life): (66) responds to the implicature in (65) that what the first speaker really wants is to interview Jones. So the second speaker conducts what I called a "transform" and maps *Jones is here* to *Jones is willing to be interviewed*. Responding to this "transformed" question allows (66) to be (at least) linguistically cooperative while nonetheless avoiding a response at the *logical* level to (65). (66) obeys conversational maxims but is still rather obtuse.

So one problem for theories that read meanings in terms of logically structured content — something like, the meaning of an (assertorial) sentence is what the world would be like if the sentence were true — is that the actual logical content supplied by some constructions

(like *Jones is not available*) can be pretty minimal — but these are still valid and conversationally cooperative segments of discourse. To be sure, this content does not appear to be *completely* empty: "Jones is not available" means the conjunction of several possibilities (he cannot be found or does not want to talk or etc.). So (66) does seem to evoke some disjunctive predicate. But such does not mean that this disjunctive predicate is the *meaning* of (66). It does not seem as if (66) when uttered by a bodyguard is intended first and foremost to convey the disjunctive predicate. Instead, the bodyguard is responding to the implicature in the original *Is Jones there?* query — the speaker presumably does not merely want to know Jones's location, but to see Jones. Here people are acting out social roles, and just happen to be using linguistic expressions to negotiate what they are able and allowed to do.

Performing social roles — including through language — often involves incomplete information: possibly the secretary or bodyguard themselves do not know where Jones is or why he's not available. We could argue that there is *enough* information to still ground *some* propositional content. But this is merely saying that we can extract some propositional content from what speakers are supposed to say as social acts, which seems to make the content (in these kinds of cases) logically derivative on the enactive/performative meaning of the speech-acts, whereas a truth-theoretic paradigm would need the derivational dependence to run the other way. By saying *Jones is unavailable* the speaker is informing us that our own prior speech act (asking to see or talk to him) cannot have our desired effect — the process we initiated cannot be completed, and we are being informed of that. The person saying *Jones is unavailable* is likewise initiating a *new* process, one that counters our process and, if we are polite and cooperative, will have its own effect — the effect being that we do not insist on seing Jones. The goal of "Jones is unavailable" is to create that effect, nudging our behavior in that direction. Any *logic* here seems derivative on the practical initiatives.

And moreover this practicality is explicitly marked by how the chosen verbiage is deliberately vague. The declaration "Jones is unavailable" does not *need* logical precision to achieve its effect. It needs *some* logical content, but it exploits a kind of disconnect between logicical and practical/enactive structure, a disconnect which allows "Jones is unavailable" to be at once logically ambiguous and practically clear — in the implication that we should not try to see Jones. I think this example has some structural analogs to the grandma's window case: *there* we play at logical substitutions to respond practically to grandma's request in spirit rather than *de dicto*. *Here* a secretary or bodyguard can engage in logical substitution to formulate a linguistic performance designed to be conversationally decisive while conveying as little information as possible. The logical substitution in grandma's context *added* logical content by trying alternatives for the window being closed; here, the context allows a *diminution* in logical content. We can strip away logical detail from our speech without diminishing the potency of that speech to achieve affects. And while the remaining residue of logical content suggests that some basic logicality is still essential to meaning, the fact that logical content can be freely subtracted without altering practical effects suggests that logic's relation to meaning is something other than fully determinate: effect is partially autonomous from logic, so a theory of effect would seem to be partially autonomous from a theory of logic. I can be logically vague without being conversationally vague. This evidently means that conversational clarity is not identical to logical clarity.

3.1 *Semantics and Logical Underdetermination*

I believe similar effects of underdeterminism can be found even in straightforward, locutionary speech-acts. Consider

- (67) The Maple Leafs failed to win in overtime for the first time this year.
- (68) The Maple Leafs failed for the first time this year to win in overtime.

The first can mean either that the Leafs had won *all* or *none* of their prior overtime games. From a phrase-structure perspective, we have to image that *to win in overtime* can "migrate" so we hear it as in the second version of the sentence. For more inter-word grammars, the alternation is simpler: "for", initiating the phrase *for the first time*, can be linked with either *failed* or *win* — notationally, it amounts to the presence or absence of one graph-edge, when the syntax is represented as a graph

with inter-word labels for link kinds. This could be a distinction without a real difference, since choosing which inter-word link to recognize triggers linking in the rest of the phrase along with it. But perhaps reflecting on how we process the ambiguity — realizing that there are two competing parses and deciding which is the one intended — we picture the alternatives more as "horizontal" options for connecting threads across the sentence, more so than a "vertical" organization where we hear *for the first time* as "contained" in a larger phrase. My own feeling is of exploring competing relational patterns more than exploring different ways that the phrases can be nested inside each other.

That being said, how much of our sense of ambiguity (or clarity, for that matter) is driven by meaning, not form? The "double parse" just examined does not always generalize to similar cases:

- (69) The Maple Leafs failed to win two consecutive games for the first time this year.

The reading as in "this is the first time they failed to win two consecutive games" makes no sense — unless you've won every game, but perhaps the first, you've at some point lost after a win. Is this case anomalous, where a syntactic ambiguity idiosyncratically fails to yield logically plausible readings? The ambiguity is found in *failed to make the playoffs for the first time since 2013*, and many *for the first time this season* cases, like *beat the Habs*, *sell out the arena*, *score a goal in the first period*. But "failed to score a goal" is almost surely read that they *did* score in every prior game. Do we hear the construction as intrinsically ambiguous, and reject one reading only when it is clearly flawed pragmatically?

If we believe that language understanding unfolds in a predictable operational sequence, then we should assume that both parses are deemed plausible, and semantic considerations only retroactively eschew one reading (if they do so at all). This would explain why in many cases the ambiguity persists enough to cast the practically intended meaning in doubt. But that account does not consider the temporality of language itself; the hearer does not know in advance that a trailing phrase like *for the first time this season* is coming, and starts to make sense of the sentence up to there; once then hearing or reading the addendum, the audience instinctively has to interpret the final phrase as deliberately inserted to modify an already-complete idea. On this analysis, the addendum is initially approached as a performative detail, something said for a reason to be determined — it is not structurally necessary to make the sentence well-formed. Perhaps we then try to fit the last phrase into the sentence both syntactically and semantically, together, triggered by a pragmatic phenomenon (the speaker's choice to add on to a seemingly complete thought) which then becomes logically prior to both syntax and semantics. If this is plausible, it supports an inter-word relational model because we are forming a picture of language structure relationally, assimilating new words and phrases to those already heard by linkings referring back in time, rather than waiting until we are sure we have a complete sentence and then treating it as a static structure to vertically reconstruct.

Of course, then, a host of further effects are bound to morphological details once we have a complete sentence. Case in point are plurals: for each plural usage we have a conceptual transformation of an underlying singular to a collective, but how that collective is pictured varies in context. One dimension of this variation lies with mass/count: the mass-plural *coffee* (as in "some coffee") figures the plurality of coffee (as liquid, or maybe coffee grounds/beans) in spatial and/or physical/dynamic terms. So we have:

- (70) There's coffee all over the table.
- (71) She poured coffee from an ornate beaker.
- (72) There's too much coffee in the grinder.
- (73) There's a lot of coffee left in the pot — should I pour it out?

These sentences use phrases associated with plurality (*all over*, *a lot*, *too much*) but with referents that on perceptual and operational grounds can be treated as singular — as in the appropriate pairing of *a lot* and *it* in the last sentence. With count-plurals the collective is figured more as an aggregate of discrete individuals:

- (74) There are coffees all over the far wall at the expresso bar.
- (75) She poured coffees from an ornate beaker.
- (76) There are a lot of coffees left on the table — shall I pour them out?

So mass versus count — the choice of which plural form to use — triggers an interpretation shaping how

the plurality is pictured and conceived (which is itself trigggered by the use of a plural to begin with). But if we restrict attention to just, say, count-plurals, there are still different schemata for intending collections:

- (77) New Yorkers live in one of five boroughs.
- (78) New Yorkers reliably vote for Democratic presidential candidates.
- (79) New Yorkers constantly complain about how long it takes to commute to New York City.

The first sentence is consistent with a reading applied to *all* New Yorkers — the five boroughs encompass the whole extent of New York City. The second sentence is only reasonable when applied exclusively to the city's registered voters — not all residents — and moreover there is no implication that the claim applies to all such voters, only a proportion north of one-half. And the final sentence, while perfectly reasonable, uses "New Yorkers" to name a population completely distinct from the first sentence — only residents from the metro area, but not the city itself, commute *to* the city.

These examples demonstrate that we need prelinguistic background knowledge to understand what *sort* of plurality the speaker intends. To be sure, the more subtle plurals can still be read in logical terms, and we can imagine sentences that hew more crisply to a logical articulation:

- (80) All New York City residents live in one of five boroughs.
- (81) The majority of New York voters support Democratic presidential candidates.
- (82) Many New York metro area residents complain about how long it takes to commute to New York City.

According to truth-theoretic semantics, sentences compel addressees to believe (or at least consider) logically structured propositions *by virtue of* linguistic shape replicating the architecture of the intended propositional complexes, as these would be represented in first-order logic. This view on linguistic meaning is consistent with the last three sentences, which are designed to map readily to logical notations (signaled by quasimathematical phrases like *the majority of*). But most sentences do not betray their logical form so readily: these latter sentences actually sound less fluent, more artificial, than their prior equivalents.

It is also true that the more "logical" versions are more, we might say, dialectically generalized because they do not assume the same level of background knowledge. Someone who knew little about New York geography could probably make sense of the latter sentences but might misinterpret, or at least have to consciously think over, the former ones. So we may grant that exceptionally logically-constructed sentences can be clearer for a broad audience, less subject to potential confusion, and indeed such logically cautious language is a normal stylistic feature of technical, legal, and journalistic discourse. But for this reason such discourse comes across as self-consciously removed from day-to-day language. As I argued from multiple angles earlier, in the typical case — i.e., stylistically neutral, day-to-day language — syntactic composition does not neatly recapitulate logical form.

My prior analysis demonstrated warrants for this idea by highlighting narrative and imagistic aspects of language used to convey ideas, like "come out against" providing the verb-phrases in reports of people criticizing something. Here, examples like (77)-(79) point to a similar conclusion, but from a more lexico-semantic orientation: words like *borough* and *commute* carry a space of logical details that tend to force logical interpretations one way or another (e.g., the detail that the territory of a city is fully partitioned by boroughs, *so*, it is *all* citizens who live in a borough). This part of the logic is however not reflected in sentence-structure; it is, rather, latent in lexical norms and assumed part of understanding relevant sentences only because linguistic competence is understood to include familiarity with the logical implications of the lexicalized concepts: e.g. that the quantification in "New Yorkers live in one of five boroughs" is *all*, but the quantification in "New Yorkers vote democratic" is *most*.

Here I'll also add the following: the current examples show how if addressees *have* the requisite background knowledge, linguistic structure does not have to replicate logical structure very closely to be understood. The content which addressees undrstand may have a logical form, and language evokes this form — guides addressees toward considering specific propositional content — but this does not happen because linguistic structure in any precise way mimics, replicates, reconstructs, or is otherwise organized propositionally. Instead, the relation of language to predicate structures is evidently oblique and indirect: language triggers interpretive processes

which guide us toward propositional content, but the structure of language is shaped around fine-tuning the activation of this background cognitive dynamics more than around any need to model predicate organization architecturally. In the case of plurals, the appearance of plural forms like *New Yorkers* or *coffees* compels us to find a reasonable cognitive model for the signified multitude, and this model will have a logical form — but the linguistic structures themselves do not in general model this form for us, except to the limited degree needed to activate prelinguistic interpretive thought-processes.

I make this point in terms of plural *forms*, and earlier made similar claims in terms of lexical details. A third group of triggers I outlined involved morphosyntactic *agreement*, which establishes inter-word connections which themselves trigger interpretive processing. Continuing the topic of plurals, how words agree with other words in singular or plural forms evokes schema which guide situational interpretations. So for instance:

- (83) My favorite band gave a free concert last night. They played some new songs.
- (84) There was some pizza earlier, but it's all gone.
- (85) There were some slices of pizza earlier, but it's all gone.
- (86) There were some slices of toast earlier, but there's none left.
- (87) There was some toast earlier, but they're all gone.
- (88) That franchise had a core of talented young players, but it got eroded by trades and free agency.
- (89) That franchise had a cohort of talented players, but they drifted away due to trades and free agency.
- (90) Many star players were drafted by that franchise, but it has not won a title in decades.
- (91) Many star players were drafted by that franchise, but they failed to surround them with enough depth.
- (92) Many star players were drafted by that franchise, but they were not surrounded with enough depth.
- (93) Many star players were drafted by that franchise, but they did not have enough depth (around them).

Plurality here is introduced not only by isolated morphology (like *slices*, *players*, *songs*), but via agreements marked by word-forms in syntactically significant pairings: was/were, it/they, there is/there are. Framing all of these cases is how we can usually schematize collections both plurally and singularly: the same set can be cognized as a collection of discrete individuals one moment and as an integral whole the next. This allows language some flexibility when designating plurals (as extensively analyzed by Ronald Langacker: see his discussion of examples like *Three times, students asked an interesting question*). A sentence discussing *slices of pizza* can schematically shift to treating the pizza as a mass aggregate in *it's all gone*. Here the antecedent of *it* is *slices* (of pizza). In the opposite direction, the mass-plural "toast" can be refigured as a set of individual pieces in *they're all gone*. The single *band* becomes the group of musicians in the band. In short, how agreements are executed invites the addressee to reconstruct the speaker's conceptualization of different referents discussed by a sentence, at different parts of the sentence: linking *it* to *slices* or *cohort*, or *they* to *the band* or *the toast*, evokes a conceptual interpretation shaped in part by how morphosyntactic agreement overlaps with "semantic" agreement. Matching *they* to *the band* presents agreement in terms of how we conceive the aggregate (as a collection of musicians); using "it" would also present an agreement, but one schematizing other aspect of the band conecpt.

In the last five above cases, *it* similarly binds (being singular) to *the franchise* seen as a single unit — here basic grammar and conceptual schema coincide — but *it* also binds to the *core of young players*. The players on a team can be figured as a unit or a multiple. The franchise itself can be treated as a multiple (the various team executives and decision-makers), as in *they failed to surround the stars with enough depth*. The last sentence is ambiguous between both readings: "they" could designate either the players or the franchise. Which reading we hear alters the sense of "have": asserting that the star *players* lack enough depth implies that they cannot execute plays during the game as effectively as with better supporting players; asserting that the *franchise* lacks depth makes the subtly different point that there is not enough talent over all. The variant which would include "around them" nudges toward the second reading; but it is still permissible to, according to speaker intent, parse the last *they* as designating the *franchise* and the last *them* as the *players* — i.e., that final *they/them* pair having different antecedents.

The unifying theme across these cases is that when forming sentences we often have a choice of how we figure plurality, and moreover these choices can be expressed

not only in individual word-forms but in patterns of agreement. Choosing to pronominalize *slices of pizza* or *cohort of players* as *it*, or alternatively *they*, draws attention to either the more singular or more multitudinal aspects of the aggregate in question. But this effect is not localized to the individual *it*/*they* choice; it depends on tracing the pronoun to its antecedent and construing how the antecedent referent has both individuating and multiplicity-like aspects. Thus both individuation and plurality are latent in phrases like *slices of* or *cohort of*, and this singular/plural co-conceiving is antecedently figured by how subsequent morphosyntax agrees with the singular or, alternatively, the plural.

Moreover, these patterns of agreement invoke new layers of interpretation to identify the proper conceptual scope of plurals. In *The band planned a tour, where they debuted new songs* we hear the scope of "they" as narrower than its antecedent "the band", because only the band's *musicians* (not stage crew, managers, etc.) typically actually perform:

- (94) The band planned a tour, where they debuted new songs.
- (95) The team flew to New York and they played the Yankees.
- (96) The city's largest theater company will perform "The Flies".

Likewise in (95), only the athletes are referenced via *they played*; but presumably many other people (trainers, coaches, staff) are encompassd by "the team flew". And in (96) we do not imply that the Board of Directors will actually take the stage (the President as Zeus, say). Even in the course of one sentence, plurals are reinterpreted and redirected:

- (97) The city's largest theater company performed "The Flies" in French, but everyone's accent sounded Quebecois.
- (98) The city's largest theater company performed "The Flies"; then they invited a professor to discuss Sartre's philosophy when the play was over.

In the first sentence, the "space" built by the sentence is wider initially but narrows to encompass only the actual actors on stage. In the second, the "space" narrows in a different direction, since we hear a programming decision like pairing a performance with a lecture as made by a theater's administrators rather than its actors. I discussed similar modulation in conceptual schemas related to plurality and pluralization earlier; what is distinct in these last examples is how the interpretive processes for cognizing plurality are shaped by agreement-patterns (like *it* or *they* to a composite antecedent) as much as by lexical choice, or morphology, in isolation.

I have accordingly outlined a theory where lexical, morphological, and morphosyntactic layers all introduce "triggers" for cognitive processes, and it is these procsses which (via substantially prelinguistic perception and conceptualization) ultimately deliver linguistic meaning. What is *linguistic* about these phenomena is how specifically linguistic formations — word choice, word forms, inter-word agreements in form — trigger these (in no small measure pre- or extra-linguistic) interpretations. But as I suggested this account is only preliminary to analysis of how multiple interpretive processes are *integrated*. Linguistic *structure* contributes the arrangements through which the crossing and intersecting between interpretive "scripts" are orchestrated. Hence at the higher linguistic scales and levels of complexity, the substance of linguistic research, on this view, should gravitate toward structural intgration of interpretive processes, even more than individual interpretive triggers themslves.

3.2 *Interpretive Processes and Triggers*

We can, indeed, find certain analogs between formal logic and Natural Language — for example, singular/plural *can* be a basically straightforward translation of the individual/set distinction in symbolis logic. Such formal intuitions are limited in the sense that (to continue this example) the conceptual mapping from single to plural can reflect a wide range of residual details beyond just quantity and multitudes. Compare *I sampled some chocolates* (where the count-plural suggests *pieces* of chocolate) and *I sampled some coffees* (where the count-plural implies distinguishing coffees by virtue of grind, roast, and other differences in preparation) (note that both are contrasted to mass-plural forms like *I sampled some coffee* where plural agreement points toward material continuity; there is no discrete unit of coffee qua liquid). Or compare *People love rescued dogs* with *People fed the rescued dogs* — the second, but not the first, points toward an interpretation that certain *specific* people fed the dogs (and they did so *before* the dogs were rescued).

The assumption that logical modeling can capture all the pertinent facets of Natural-Language meaning can lead us to miss the amount of situational reasoning requisite for commonplace understanding. In *People fed the rescued dogs* there is an exception to the usual pattern of how tense and adjectival modification interact: we read "people fed" in *People fed the rescued dogs* as occurring *before* the rescue; because we assume that *after* being rescued the dogs would be fed by veterinarians and other professionals (who would probably not be designated with the generic "people"), and also we assume the feeding helped the dogs survive. We also hear the verb as describing a recurring event; compare with *I fed the dog a cheeseburger*.

To be sure, there are patterns and templates governing scope/quantity/tense interactions that help us build logical models of situations described in language. Thus *I fed the dogs a cheeseburger* can be read such that there are multiple cheeseburgers — each dog gets one — notwithstanding the singular form on *a cheeseburger*: the plural *dogs* creates a scope that can elevate the singular *cheeseburger* to an implied plural; the discourse creates multiple reference frames each with one cheeseburger. Likewise the morphosyntax is quite correct in: *All the rescued dogs are taken to an experienced vet; in fact, they all came from the same veterinary college* — the singular on *vet* is properly alligned with the plural *they* because of the scope-binding (from a syntactic perspective) and space-building (from a semantic perspective) effects of the "dogs" plural. Or, in the case of *I fed the dog a cheeseburger every day* there is an implicit plural because "every day" builds multiple spaces: we can refer via the spaces collectively using a plural (*I fed the dog a cheeseburger every day — I made them at home with vegan cheese*) or refer within one space more narrowly, switching to the singular (*Except Tuesday, when it was a turkey burger*).

Layers of scope, tense, and adjectives interact in complex ways that leave room for common ambiguities: *All the rescued dogs are [/were] taken to an experienced [/specialist] vet* is consistent with a reading wherein there is exactly one vet, and she has or had treated every dog. It is *also* consistent with a reading where there are multiple vets and each dog is or was treated by one or another. Resolving such ambiguities tends to call for situational reasoning and a "feel" for situations, rather than brute-force logic. If a large dog shelter describes their operational procedures over many years, we might assume there are multiple vets they work or worked with. If instead the conversation centers on one specific rescue we would be inclined to imagine just one veterinarian. Lexical and tense variation also guides these impressions: the past-tense form (*...the rescued dogs were taken...*) nudges us toward assuming the discourse references one rescue (though it could also be a past-tense retrospective of general operations). Qualifying the vet as *specialist* rather than the vaguer *experienced* also nudges us toward a singular interpretation.

What I am calling a "nudge", however, is based on situational models and arguably flows from a conceptual stratum outside of both semantics and grammar proper; maybe it is even prelinguistic. Consider

- (99) People fed the rescued dogs.
- (100) Vets examined the rescued dogs.

There appears to be no explicit principle either in the semantics of the lexeme *to feed*, or in the relevant tense agreements, stipulating that the feeding in (99) was prior to the rescue — or conversely that (100) describes events *after* the rescue. Instead, we interpret the discourse through a narrative framework that fills in details not provided by the language artifacts explicitly (that abandoned dogs are likely to be hungry; that veterinarians treat dogs in clinics, which dogs have to be physically brought to). For a similar case-study, consider the sentences:

- (101) Every singer performed two songs.
- (102) Everyone performed two songs.
- (103) Everyone sang along to two songs.
- (104) Everyone in the audience sang along to two songs.

The last of these examples strongly suggests that of potentially many songs in a concert, exactly two of them were popular and singable for the audience. The first sentence, contrariwise, fairly strongly implies that there were multiple pairs of songs, each pair performed by a different singer. The middle two sentences imply either the first or last reading, respectively (depending on how we interpret "everyone"). Technically, the first two sentences imply a multi-space reading and the latter two a single-space reading. But the driving force behind these implications are the pragmatics of *perform* versus *sing along*: the latter verb is bound more tightly to its subject,

so we hear it less likely that *many* singers are performing *one* song pair, or conversely that every audience member *sings along* to one song pair, but each chooses a *different* song pair.

The competing interpretations for *perform* compared to *sing along*, and *feed* compared to *treat*, are grounded in lexical differences between the verbs, but I contend the contrasts are not laid out in lexical specifications for any of the words, at least so that the implied readings follow just mechanically, or on logical considerations alone. After all, in more exotic but not implausible scenarios the readings would be reversed:

- (105) The rescued dogs had been treated by vets in the past (but were subsequently abandoned by their owners).
- (106) Every singer performed (the last) two songs (for the grand finale).
- (107) Everyone in the audience sang along to two songs (they were randomnly handed lyrics to different songs when they came in, and we asked them to join in when the song being performed onstage matched the lyrics they had in hand).

In short, it's not as if dictionary entries would specify that *to feed* applies to rescued dogs before they are rescued, and so forth; these interpretations are driven by narrative construals narrowly specific to given expressions. The appraisals would be very different for other uses of the verbs in (lexically) similar (but situationally different) cases: to "treat" a wound or a sickness, to "perform" a gesture or a play. We construct an interpretive scaffolding for resolving issues like scope-binding and space-building based on fine-tuned narrative construals that can vary alot even across small word-sense variance: As we follow along with these sentences, we have to build a narrative and situational picture which matches the speaker's intent, sufficiently well.

And that requires prelinguistic background knowledge which is leveraged and activated (but not mechanically or logically constructed) by lexical, semantic, or grammatical rules and forms: *rescued dogs* all alone constructs a fairly detailed mental picture where we can fill in many details by default, unless something in the discourse tells otherwise (we can assume such dogs are in need of food, medical care, shelter, etc., or they would not be describd as "rescued"). Likewise *sing along* carries a rich mental picture of a performer and an audience and how they interact, one which we understand based on having attended concerts rather than by any rule governing *along* as a modifier to "sing" — compare the effects of *along* in *walk along*, *ride along*, *play along*, *go along*. Merely by understanding how *along* modifies *walk*, say (which is basically straightforward; to "walk along" is basically to "walk alongside") we would not automatically generalize to more idiomatic and metaphorical uses like "sing along" or "play along" (as in *I was skeptical but I played along (so as not to start an argument)*).

We have access to a robust collection of "mental scripts" which represent hypothetical scenarios and social milieus where language plays out. Language can activate various such "scripts" (and semantic as well as grammatical formations try to ensure that the "right" scripts are selected). Nonetheless, we can argue that the conceptual and cognitive substance of the scripts comes not from language per se but from our overall social and cultural lives. We are disposed to make linguistic inferences — like the timeframes implied by *fed the rescued dogs* or the scopes implied by *sang along to two songs* — because of our enculturated familiarity with events like dog rescues (and dog rescue organizations) and concerts (plus places like concert halls). These concepts are not produced by the English language, or even by any dialect thereof (a fluent English speaker from a different cultural background would not necessarily make the same inferences — and even if we restrict attention to, say, American speakers, the commonality of disposition reflects a commonality of the relevant cultural anchors — like dog rescues, and concerts — rather than any homogenizing effects of an "American" dialect). For these reasons, I believe that trying to account for situational particulars via formal language models alone is a dead end. This does not mean that formal language models are unimportant, only that we need to picture them resting on a fairly detailed prelinguistic world-disclosure.

There are interesting parallels in this thesis to the role of phenomenological analysis, and the direct thematization of issues like attention and intentionality: analyses which are truly "to the things themselves" should take for granted the extensive subconscious reasoning that undergirds what we consciously thematize and would be aware of, in terms of what we deliberately focus on and are conscious of believing (or not knowing), for a first-personal exposé. Phenomenological analysis should not consider itself as thematizing every small quale, every little patch of color or haptic/kinasthetic sensation

which by some subconscious process feeds into the logical picture of our surroundings that props up our conscious perception. Analogously, linguistic analysis should not thematize every conceptual and inferential judgment that guides us when forming the mental, situational pictures we then consult to set the groundwork for linguistic understanding proper.

These comments apply to both conceptual "background knowledge" and to situational particulars of which we are cognizant in reference to our immediate surroundings and actions. This is the perceptual and operational surrounding that gets linguistically embodied in deictic reference and other contextual "groundings". Our situational awareness therefore has both a conceptual aspect — while attending a concert, or dining at a restaurant, say, we exercise cultural background knowledge to interpret and participate in social events — and also our phenomenological construal of our locales, our immediate spatial and physical surroundings. Phenomenological philosophers have explored in detail how these two facets of situationality interconnect (David Woodruff Smith and Ronald McIntyre in *Husserl and Intentionality: A Study of Mind, Meaning, and Language*, for instance). Cognitive Linguistics covers similar territory; the "cognitive" in Cognitive Semantics and Cognitive Grammar generally tends to thematize the conception/perception interface and how both aspects are merged in situational understanding and situationally grounded linguistic activity (certainly more than anything involving Artificial Intelligence or Computational Models of Mind as are connoted by terms like "Cognitive Computing"). Phenomenological and Cognitive Linguistic analyses of situationality and perceptual/conceptual cognition (cognition as the mental synthesis of preception an conceptualization) can certainly enhance and reinforce each other.

But in addition, both point to a cognitive and situational substratum underpinning both first-person awareness and linguistic formalization proper — in other words, they point to the thematic limits of phenomenology and Cognitive Grammar and the analytic boundary where they give way to an overarching Cognitive Science. In the case of phenomenology, there are cognitive structures that suffuse consciousness without being directly objects of attention or intention(ality), just as sensate hyletic experience is part our consciousness but not, as explicit content, something we in the general case are conscious *of*. Analogously, conceptual and situational models permeate our interpretations of linguistic forms, but are not presented explicitly *through* these forms: instead, they are solicited obliquely and particularly.

What phenomenology *should* explicate is not background situational cognition but how attention, sensate awareness, and intentionality structure our orientation *vis-à-vis* this background: how variations in focus and affective intensity play strategic roles in our engaged interactions with the world around us. Awareness is a scale, and the more conscious we are of a sense-quality, an attentional focus, or an epistemic attitude, reflects our estimation of the importance of that explicit content compared to a muted experiential background. Hence when we describe consciousness as a stream of *intentional* relations we mean not that the intended noemata (whether perceived objects or abstract thoughts) are sole objects of consciousness (even in the moment) but are that within conscious totality which we are most aware of, and our choice to direct attention here and there reflcts our intelligent, proactive interacting with the life-world. Situational cognition forms the background, and phenomenology addresses the structure of intentional and attentional modulations constituting the conscious foreground.

Analogously, the proper role for linguistic analysis is to represent how multiple layers or strands of prelinguistic understanding, or "scripts", or "mental spaces", are woven together by the compositional structures of language. For instance, *The rescued dogs were treated by an experienced vet* integrates two significantly different narrative frames (and space-constructions, and so forth): the frame implied by "rescued dogs" is distinct from that implied by "treated by a veterinarian". Note that both spaces are available for follow-up conversation:

- (108) The rescued dogs were treated by an experienced vet. One needed surgery and one got a blood transfusion. We went there yesterday and both looked much better.
- (109) The rescued dogs were treated by an experienced vet. One had been struck by a car and needed surgery on his leg. We went there yesterday and saw debris from another car crash — it's a dangerous stretch of highway.

In the first sentence *there* designates the veterinary clinic, while in the second it designates the rescue site. Both of these locales are involved in the original sentence (as

locations and also "spaces" with their own environments and configurations: consider these final three examples).

- (110) The rescued dogs were treated by an experienced vet. We saw a lot of other dogs getting medical attention.
- (111) The rescued dogs were treated by an experienced vet. It looked very modern, like a human hospital.
- (112) The rescued dogs were treated by an experienced vet. We looked around and realized how dangerous that road is — for humans as well as dogs.

What these double space-constructions reveal is that accurate language understanding does not only require the proper activated "scripts" accompanying words and phrases, like "rescued dogs" and "treated by a vet". It also requires the correct integration of each script, or each mental space, tieing them togther in accord with speaker intent. So in the current example we should read that the dogs *could* be taken to the vet *because* they were rescued, and *needed* to be taken to the vet *because* they needed to be rescued. Language structures guide us toward how we should tie the mental spaces, and the language segments where they are constructed, together: the phrase "*rescued* dogs" becomes the subject of the passive-voice *were treated by a vet* causing the two narrative strands of the sentence to encounter one another, creating a hybrid space (or perhaps more accurately a patterning between two spaces with a particular temporal and causal sequencing; a hybrid narration bridging the spaces). It is of course this hybrid space, this narrative recount, which the speaker intends via the sentence. This idea is what the sentence is crafted to convey — not just that the dogs were rescued, or that they were taken to a vet, but that a causal and narrative thread links the two events.

I maintain, therefore, that the analyses which are proper to linguistics — highlighting what linguistic reasoning contributes above and beyond background knowledge and situational cognition — should focus on the *integration* of multiple mental "scripts", each triggered by different parts and properties of the linguistic artifact. The *triggers* themselves can be individual words, but also morphological details (like plurals or tense marking) and morphological agreement. On this theory, analysis has two distinct areas of concerns: identification of grammatical, lexical, and morphosyntactic features which trigger (assumedly prelinguistic) interpretive scripts, and reconstructing how these scripts interoprate (and how language structure determines such integration).

In the case of isolating triggers, a wide range of linguistic features can trigger interpretive reasoning — including base lexical choice; word-senses carry prototypical narrative and situational templates that guide interpretation of how the word is used in any given context. *Rescued*, for example, brings on board a network of likely externalities: that there are rescuers, typically understood to be benevolent and intending to protect the rescuees from harm; that the rescuees are in danger prior to the rescue but safe afterward; that they need the rescuers and could not have reachd safety themselves. Anyone using the word "rescue" anticipates that their addressees will reason through some such interpretive frame, so the speaker's role is to fill in the details descriptively or deictically: who are the rescuees and why they are in danger; who are the rescuers and why they are benevolent and able to protect the rescuees. The claim that the word *rescue*, by virtue of its lexical properties, triggers an interpretive "script", is a proposal to the effect that when trying to faithfully reconstruct speaker intentions we will try to match the interpretive frame to the current situation.

The "script" triggered by word-choice is not just an interpretive frame in the abstract, but the interpretive *process* that matches the frame to the situation. This process can be exploited for metaphorical and figurative effect, broadening the semantic scope of the underlying lexeme. In the case of "rescue" we have less literal and more humorous or idiomatic examples like:

- (113) The trade rescued a star athlete from a losing team.
- (114) New mathematical models rescued her original research from obscurity.
- (115) Discovery of nearby earth-like planets rescued that star from its reputation as ordinary and boring and revealed that its solar system may actually be extraordinary.

Each of these cases subverts the conventional "rescue" script by varying some of the prototypical frame details: maybe the "danger" faced by the rescuee is actually trivial (as in the first three), or the rescuee is not a living thing whose state we'd normally qualify in trms of "danger" or "safety", or by overturning the benevolence we typically attribute to rescue events. But in these uses subverting the familiar script does not weaken the lexical

merit of the word choice; instead, the interpretive act of matching the conventional "rescue" script to the matter at hand reveals details and opinions that the speaker wishes to convey. The first sentence, for instance, uses "rescue" to connote that being stuck on a losing team is an unpleasant (even if not life-threatening) circumstance. So one part of the frame (that the rescuee needs outside intervention) holds while the other (that the rescue is in danger) comes across as excessive but (by this very hyperbole) communicating speaker sentiment. By both invoking the "rescue" script and exploiting mismactches between its template case and the current context, the speaker conveys both situational facts and personal opinions quite economically. Similarly, *rescue a paper from obscurity* is an economical way of saying that research work has been rediscovered in light of new science; and "rescued from a reputation" is a clever way of describing, with rhetorical force, how opinion of changed about someone or something.

All of these interpretive effects — both conventional and unconventional usages — stem from the interpretive scripts bound to words (and triggered by word-choice) at the underlying lexical level — we can assess these by reference to lexical details alone, setting aside syntactic and morphological qualities. When morphosyntactic details *are* considered — e.g. plurals, as in (70)-(73) — we then have a spectrum of other linguistic "triggers", involving perceptual and enactive figurations (e.g. how plurality/multiplicities are conceived), alongside interpretive "scripts". My essential point however is that language needs to *trigger* certain interpretive, perceptual, and enactive/operational processes.

I contend, moreover, that these cognitive processes are not *themselves* linguistic: while they may overlap with some language-relevant concerns (like conceptualization, and doxic specificity) they are not woven from the cloth of syntactic, semantic, or pragmatic elements internal to language. It is not within the purview of linguistics then to analyze interpretive scripts (except as a subsidiary case-study), or perceptual understanding, or situationally-mediated action. What *can* be left for linguistics proper is identifying the *triggers* to these cognitive realities — insofar as content or formations in language, within our goal-directed attempt to understand others' linguistic performances, compels us toward these extra-linguistic registers.

Linguistics on this perspective is necessarily and properly incomplete: we should not look to linguistic analysis to materially or structurally explain the cognitive processes triggered by language. But we *can* analyze the triggers themselves — potentially via formal and even computational methods. So in the next section I will consider how relatively formal grammar and semantic approaches — e.g. Link Grammar and Type-Theoretic Semantics — can be adopted insofar as we ascribe to the global picture of language as an "interface" or "trigger" to extralinguistic cognition.

4 Channel Hypergraph Grammar and Cognitive State Semantics

In my opinion, a well-motivated philosophy of language will be oriented to other sciences, both formal and humanistic — language as a "bridge" between multiple disciplines. Linguistics should not aspire to analytic completeness, or explanatory autonomy: language understanding requires many cognitive faculties which are *not* governed by linguistic theories; and the pragmatic and situational contexts surrounding discourse likewise need extra-linguistic sociological treatments. So a valid goal for a philosophy of language is to establish which theories *are* proper to language. Ideally, these theories should engender both philosophical analysis and formal models: there is a systematic, structural dimension to language whose properties can be revealed through rigorous (even computational) representations. At the same time, there is also a subtlety and intersubjectivity to language which call for analyses grounded in philosophy rather than any computational or logicomathematical commitments.

Having presented objections and, I believe, counterexamples to "truth-theoretic" semantics, I now want to present some ideas for an alternative theory which retains some formal or logical (or at least mathematical) structuration — but not so as to "reduce away" linguistic nuances; nor structures in language whose semiotic foundation draws from a spectrum of cognitive (perceptual, situational, narrative, empathic) facilities, which cannot be reduced to deterministic logic. My plan is to describe a grammar framework which integrates such perspectives as Link Grammar, Combinatory-Applicative Grammar, and Type Logical Grammar, but with a dis-

tinct underlying formal model. Like other theories, this model proposes a broad categorization for semantics by identifying a small set of primitive types, and defining other types as functional or combinatory derivates on those base types (from which the type system overall is "generated").

A common paradigm is to consider natural-language types as generated by just two bases — a noun type N and a proposition type $\mathcal{P}rop$, the type of sentences and of sentence-parts which are complete ideas — having in themselves a propositional content (see e.g. [5] or [33]). Different models derive new types on this basis in different ways. One approach, inspired by mathematical "pregroups", establishes derivative types in terms of word pairs — an adjective followed by a noun yields another noun (a noun-phrase, but N is the phrase's *type*) — e.g., *rescued dogs*, like *dogs*, is conceptually a noun. Adjectives themselves then have the type of words which form nouns when paired with a following noun, often written as N/N. Pregroup grammars distinguish left-hand and right-hand adacency — *bark loudly*, say, demonstrates an adverb *after* a verb, yielding a verb phrase: so "loudly" here has the type of a word producing a verb in combination with a verb to its *left* (sometimes written $V\backslash N$); by contrast adjectives combine with nouns to their *right*.

A related formalization, whose formal analogs lie in Typed Lambda Calculus, abstracts from left-or-right word order to models derived types as equivalent (at least for purposes of type attribution) to "functions". So an adverb becomes a function which takes a verb and produces another verb; an adjective takes a noun and produces another noun; and a verb takes a noun and produces a proposition (see *students complained*). By "function" we can consider some kind of conceptual tranformation: *loudly* transforms the concept *bark* into the concept *loud bark*. Another feature of this "function type" interpretation is that words can be treated as functions taking multiple arguments — a verb, for example, can have as many as three "inputs" (subject, direct object, and indirect object).

Instead of pregroups or lambda calculus, the type system I propose here is inspired by computer programming languages, and specifically by frameworks for assigning types to computational procedures. Implemented "functions" in this sense are different than functions in mathematical contexts, like the lambda calculus. Mathematical functions have input and output parameters, but *procedures* (functions implemented in computer code) have different *kinds* of input and output. Procedures can draw information from many sources — e.g. files, databases, and network resources — and likewise can produce many sorts of effects (changing the state of some software or physical component; e.g., writing text to a monitor). These sources and effects lie alongside explicit inputs and outputs, as in x as input to f (and y carrying f's output) in $y = fx$. Modern programming languages also have special features, like "objects" and exceptions (special kinds of inputs and outputs respectively) which complicate the picture of functions "mapping" inputs to outputs. One strategy for analyzing computer code is to take all procedural inputs and outputs — including any means by which a procedure can obtain data or cause effects outside its own internal execution environment — as "channels of communication", so the *type* of a procedure is defined by the types of data carried in each of its channels. A formal model of channels can then play a role analogous to input-to-output maps in lambda-calculus inspired grammars, and to adjacent-word left-or-right pairs in pregroup grammars.

Complementary to a "channel-oriented" theory of procedures is the idea of channel *states*, representing procedural effects on any data accessed or modified by procedures. The data in an output channel, for instance, is in a "pre-initialized" state until the procedure terminates and control returns to a calling procedure, where that output data is then typically used as input data to other procedures and/or held in a "carrier", embodied by a source-code symbol like y in $y = fx$. Channels as such can be formally defined as higher-scale structures on (labeled and directed) hypergraphs (where procedures are expressed via hypernodes, making this a variation on "hypergraph grammars" as in [24] or [23]). Transforms in channel state are, in this framework, informally analogous to "beta-reduction" in the lambda calculus and to "identity laws" in pregroup grammars.

A detailed outline of channels is beyond the scope of this paper (I have written about "channel algebra" in [14] and [15]). Briefly, though, I believe that this "Channel Hypergraph Grammar" (formulated in particular to analyze *computer* languages) can be applied to *natural* language because of how the entirety of a sentence can influence our interpretation of specific word-pairs and inter-word relations. Assuming we accept the intu-

itive analogy of words as *procedures* (maybe scripts or conceptualizing operations in some cognitive processing space), then "non-local" semantic effects correspond to alternative procedural channels.

For this model, assume we have a baseline lamba-calculus-like functional summary of sentences and derived types. That is, any sentence can be rewritten as if a sequence of "function calls", assuming an underlying representational vocabulary of a typed lambda calculus, with sentences having overall $\mathcal{P}rop$ types:

- (116) I believe that he is at school.
  (believe I (that (is he (at school))))
- (117) Student after student complained about tuition hikes.
  ((about (tuition hikes) complained) (after student student))
- (118) Three times, students asked an interesting question.
  ((three times) (asked students (an (interesting question))))

In this representation "function-like" types (verbs, adjectives, adverbs, and so on) are notated preceding one or more words or expressions which are functional "arguments" (sometimes the "functions" are expressions with their own inner function-argument structure, as in *(about (tuition hikes) complained)* qua verb-phrase). This reconstruction presents one layer of structure — for example, the connection of verbs to their one, two, or three arguments — which can then be overlaid with Link-Grammar style pairs, like verb-to-subject and verb-to-direct-object.

These word-links are then "local" connections in that they nest within a functionally reconstructed phrase hierarchy. We can call them *local* channels. Meanwhile, semantic effects outside the local phrase structure — like anaphora or "space-building" insofar as it influences non-local morphosyntax — can then be modeled via *nonlocal* channels. To clarify these claims I will demonstrate this style of analysis with respect to examples like I have just cited.

My overall goal is to embrace a hybrid methodology — accepting formal analyses when they shed light on linguistic processes, but not going so far as to treat logical, mathematical, or computational models as full explanations for linguistic rationality qua scientific phenomenon. The path toward such a hybrid methodology, as I will sketch it here, takes its inspiration and orientation from Cognitive Grammar. This perspective, in particular, challenges our assumption that grammar and semantics are methodologically separate. Received wisdom suggests that grammar concerns the "form" of sentences whereas semantics considers the meaning of words — implicitly assuming that *word combinations* produce new meanings, and that the *order* by which words are combines determines how new meanings are produced. This notion, in turn, is allied with the essentially logical or propositional picture of signifying via doxa: the idea that inter-word relations cue up different logically salient transformations of an underlying predicate model. Thus *many students* as a phrase is more significatorily precise than *students* as a word, because the phrase (with intimations of quantitative comparison) has more logical detail. Similarly *many students complained* is more logically complete because, provisioning both a verb-idea and a noun-idea, it represents a whole proposition.

In general, then, phrases are more complete than words because they pack together more elements which have some logical role, establishing individuals, sets, spatiotemporal setting, and predicates which collectively establish sufficiently completed propositional attitudes. On this account the key role of phrase-structure is to establish phrases as signifying units on a logical level analogous to how lexemes are signifying units on a referential or conceptual level. Moreover, phrases' internal structure are understood to be governed by rule defining *how* word-combinations draw in extra logical detail. A link between words is not a random synthesis of concepts, but rather implies a certain logical connective which acts as a de facto "third party" in a double-word link, proscribing with orientation to predicate structures *how* the words' semantic concepts are to be joined. In *many students* the implied connector is the propositional act of conceiving a certain quantitative scale to a conceptualized set; in *students complained* the implied connector is a subject-plus-verb-equals-proposition assertiveness. Phrases acquire logical specificity by building up word-to-word connections into more complex aggregates.

One implication of this model is that phrases are semantically substitutable with individual lexemes that carry similar meanings, having been entrenched by convention to capture a multipart concept which would otherwise be conveyed with the aggregation of a phrase: consider "MP" for *member of parliament*, or "primaried" for *subject without your own party to a primary challenge*. Conversely, phrases can be repeatedly used in a specific context until they function as quasi lexical units in their

own right. These pattern of entrenchment imply that we hear language in term of phrases bearing semantic content; and insofar as we are comfortable with how we parse a sentence, each word sited in its specific phrasal hierarchy, we do not tend to consider individual words semantically outside of their constituent phrases.

This theory of the syntax-to-semantic relationship is a paradigmatic partner, at the grammatic level, to truth-theoretic semantics and as such, I maintain, is subject to similar critiques as I developed semantically in the last two sections. A critique of grammatic theories based on, let's say, "*proprositional semantics of phrase-structure*" can address two concerns: first, the idea that lexemes retain some syntactic and semantic autonomy even within clearly defined phrases where they are included; and, second, that the shape of phrases insofar as they are perceived as holistic signifying units is often driven by figurative or "gestalt" principles rather than neat logical structuration. I'll call the former the issue of "phrasal isolation" (or lack thereof): syntactic and semantic effect often cross phrasal boundaries, even outside the overarching hierarchy whose apex is the whole sentence. Both of these lines of reasoning — arguably especially the second — are developed in Cognitive Grammar literature.

4.1 *Cognitive Grammar and Type Theoretic Semantics*

In Ronald Langacker's *Foundations of Cognitive Grammar*, the sentence

▾ (119) Three times, students asked an interesting question.

is used to demonstrate how grammatical principles follow from cognitive "construals" of the relevant situations, those which language seeks to describe or takes as presupposed context.[2] In particular, Langacker argues that "students" and "question" can both be either singular or plural: syntax is open-ended here, with neither form more evidently correct. Langacker uses this example to make the Cognitive-Linguistic point that we assess syntactic propriety relative to cognitive frames and conversational context. In this specific case, we are actually working with two different cognitive frames which are interlinked — on the one hand, we recognize distinct events consisting of a student asking a question, but the speaker calls attention, too, to their recurrence, so the events can also be understood as part of a single, larger pattern. There are therefore two different cognitive foci, at two different scales of time and attention, a "split focus" which makes both singular and plural invocations of "student" and "question" acceptable.

Supplementing this analysis, however, we can additionally focus attention directly on grammatical relations. The words *student* and *question* are clearly linked as the subject and object of the verb *asked*; yet, contrary to any simple presentation of rules, no agreement of singular or plural is required between them (they can be singular and/or plural in any combination). Moreover, this anomaly is only in force due to the context established by an initial phrase like *three times*; absent some such framing, the singular/plural relation would be more rigid. For example, "A student asked interesting questions" would (in isolation) strongly imply *one* student asking *several* questions. So the initial "Three times" phrase alters how the subsequent phrase-structure is understood while remaining structurally isolated from the rest of the sentence. Semantically, it suggests a "space builder" in the manner of Gilles Fauconnier or Per Aage Brandt [22]; [12], but we need to supplement Mental Space analysis with a theory of how these spaces influence syntactic acceptability, which would seem to be logically prior to the stage where Mental Spaces would come in play.

The mapping of (119) to a logical substratum would be more transparent with a case like:

▾ (120) Three students asked interesting questions.

(120) is a more direct translation of the facts which the original sentence conveys. But this "more logical" example has different connotations than the sentence Langacker cites; (119) places the emphasis elsewhere, calling attention more to the idea of something temporally drawn-out, of a recurrence of events and a sense of time-scale. The "more logical" sentence lacks this direct invocation of time scale and temporal progression.

We can say that the "Three students" version is a more direct statement of fact, whereas Langacker's version is more speaker-relative, in the sense that it elaborates more on the speaker's own acknowledgment of belief. The speaker retraces the steps of her coming to appreci-

[2] For example, [36, pp. 119 and 128], discussed by [11, p. 189], and [44, p. 9].

ate the fact — of coming to realize that the "interesting questions" were a recurrent phenomenon and therefore worthy of mention. By situating expressions relative to cognitive processes rather than to the facts themselves, the sentence takes on a structure which models the cognition rather than the states of affairs. But this shift of semantic grounding from the factual to the cognitive also apparently breaks down the logical orderliness of the phrase structure. "Three times", compared to "three students", leads to a morphosyntactic choice-space which is "underdetermined" and leaves room for speakers' shades of emphasis.

This is not an isolated example. Many sentences can be provided with similar phrase-structure complications, particularly with respect to singular/plural agreement.

- (121) Time after time, tourists (a tourist) walk(s) by this building with no idea of its history.
- (122) The streets around here are confusing; often people (someone) will ask me for directions.
- (123) Student after student came with their (his/her) paper to compain about my grade(s).
- (124) Student after student — and their (his/her) parents — complained about the tuition increase.

On a straightforward phrase-structure reading, *student after student* reduces to an elegant equivalent of *many students*, with the rhetorical flourish abstracted away to a logical form. But our willingness to accept both singular and plural agreements (his/her/their parents, grades, papers) shows that clearly we don't simply substitute *many students*; we recognize the plural as a logical gloss on the situation but engage the sentence in a more cogntively complex way, recognizing connotations of temporal unfolding and juxtapositions of cognitive frames. The singular/plural underdeterminism is actually a signification in its own right, a signal to the listener that the sentence in question demands a layered cognitive attitude. Here again, syntactic structure (morphosyntactic, in that syntactic allowances are linked with variations in the morphology of individual words, such as singular or plural form) serves to corroborate conversants' cognitive frames rather than to model logical form.

The contrast between the phrases *Student after student* and *Many students* cannot be based on "abstract" semantics alone — how the evident temporal implications of the first form, for example, are concretely understood, depends on conversants' mutual recognition of a relevant time frame. The dialog may concern a single day, a school year, many years. We assume that the speakers share a similar choice of time "scale" (or can converge on one through subsequent conversation). *Some* time-frame is therefore presupposed in the discursive context, and the first phrase invokes this presumed but unstated framing. The semantics of the phrase are therefore somewhat open-ended: the phrase "hooks into" shared understanding of a temporal cognitive framing without referring to it directly. By contrast, the second phrase is less open-ended: it is consistent with both a more and less temporally protracted understanding of *many*, but leaves such details (whatever they may be) unsignified. The factual circumstance is designated with a level of abstraction that sets temporal considerations outside the focus of concern. The second ("*Many students*") phrase is therefore both less open-ended and also less expressive: it carries less detail but accordingly also relies less on speaker's contextual understanding to fill in detail.[3]

One consequence of these analyses is that grammar needs to be approached holistically: the grammatic structure of phrases cannot, except when deliberate oversimplification is warranted, be isolated from surrounded sentences and still larger discourse units. Semantic roles of phrases have some effect on their syntax, but phrases are nonetheless chosen from sets of options, whose variations reflect subtle semantic and syntactic maneuvers manifest at super-phrasal scales. The constituent words of phrases retain some autonomy, and can enter into inter-word and phrasal structures with other words outside their immediate phrase-context. We can still apply

[3] The examples I have used so far may also imply that a choice of phrase structure is always driven by semantic connotations of one structure or another; but seemingly the reverse can happen as well — speakers choose a semantic variant because its grammatic realization lends a useful organization to the larger expression. There are many ways to say "many", for example: *a lot of*, *quite a few*, not to mention "time after time" style constructions. Whatever their subtle semantic variations, these phrases also have different syntactic properties: *Quite a few* is legitimate as standalone (like an answer to a question); *A lot of* is not, and *A lot* on its own is awkward. On the other hand the "of" in *A lot of* can "float" to be replicated further on: "A lot of students, of citizens, believe education must be our top priority" sounds more decorous than the equivalent sentence with the second "of" replaced by "and". If the cadence of that sentence appeals to the speaker, then such stylistic preference will influence taking "A lot of" as the "many" variant of choice. So speakers have leeway in choosing grammatic forms that highlight one or another aspect of situations; but they also have leeway in choosing rhetorical and stylistic pitch. Both cognitive framings and stylistic performance can be factored when reconstructing what compels the choice of one sentence over alternatives.

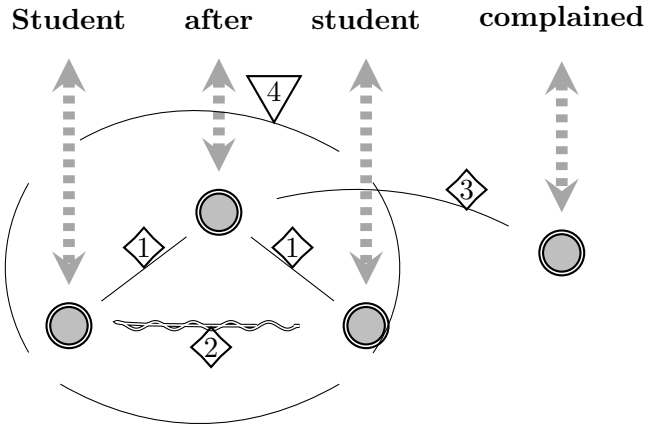
formal models to phrase structure — for example, Cognitive and Applicative Grammar (CAG) considers phrases as "applications" of (something like) linguistic or cognitive "functions", in the sense that (say) an adjective is like a *function* applied to a noun, to yield a different noun (viz., something playing a noun's conceptual role) [21]. But we should not read these transformations — like *rescued dogs* from *dogs* — too hastily as a purely semantic correlation within a space of denotable concepts — *such that* the new concept wholly replaces the contained parts, which then cease to have further linguistic role and effect. Instead, applicative structures represent shifts or evolutions in mental construal, which proceed in stages as conversants form cognitive models of each others' discourse. Even if phrase structure sets landmarks in this unfolding, phrases do not wholly subsume their constituents; the parts within phrases do not "vanish" on the higher scale, but remain latent and may be "hooked" by other, overlapping phrases.

Consider the effect of "Many students complained". Propositionally, this appears to say essentially that *students* complained; but, on hermeneutic charity, the speaker had *some* reason to say "many". The familiar analysis is that "many" suggests relative size; but this is only half the story. If the speaker chose merely *students complained*, we would hear an assertion that more than one student did, but we would also understand that there were several occasions when complaints happened. Adding "many" does not just imply "more" students, but suggests a mental shift away from the particular episodes. In the other direction, saying *a student complained* is not just asserting how at least one student did so, but apparently reports one specific occasion (which perhaps the speaker wishes to elaborate on). In other words, we cannot really capture the singular/plural semantics, or different varieties of plural, just by looking at the relative size of implied sets; we need to track how representations of singleness or multitude imply temporal and event-situational details.

Against this backdrop, *Student after student complained* captures both dimensions, implying both a widespread unrest among the student body and also temporal recurrence of complainings. By way of illustration, Figure 1 shows a destructuring in the fashion of Dependency Grammar, along with implicit type annotations. As this shows, the "Student after Student" idiom can be notated as, say, `after` $:: N^{\odot} \dashrightarrow N^{\odot} \dashrightarrow N^{+}$ (using $N^{\odot}$ and N^{+} to mean singular and count-plural nouns, respectively), but with the special case that the "argument" to *after* is repeated in both positions, suggesting an unusual degree of repetition, something frustratingly recurrent: *He went on and on*; *Car after car passed us by*; *Time after time I got turned down.* Although I have no problem treating these constructions as idiomatic plurals, I also contend (on the premise of phrase-overlap) that the dependent constituents in the ——`after`—— construction can be hooked to other phrases as well (which is why "and [their/his/her] parents" can also be singular, in this case). I dwell on this example because it shows how type/functional accounts of phrase structure can be useful even if we treat phrases more as frames which overlay linguistic structure, not as rigid compositional isolates. Each "students" variation uses morphology to nudge cognitive attention in one direction or another, toward events or the degree to which events are representative of some global property (here of a student body), or both. The $N^{\odot} \dashrightarrow N^{+}$ transformation is not *the* morphosyntactic meaning, but instead the skeleton on which the full meaning (via cognitive schema) is designed.

If this analysis has merit, it suggests that a CAG or type-logical approach to phrases like *many students* or *student after student* (singular-to-plural or plural-to-plural mappings) should be understood not just as functions among Part of Speech (POS) types but as adding cognitive shading, foregrounding or backgrounding cognitive elements like events or typicality in some context. In other words, *many students* is type-theoretically $N \dashrightarrow N$ or $N^{+} \dashrightarrow N^{+}$; but, in more detail, it adds a kind of cognitive rider attached to the mapping which focuses cognition in the subsequent discourse onto events (their recurrence and temporal distribution); similarly "student after student" has a "rider" suggesting more of a temporal unfolding. The second form implies not only that many students complained, but that the events of these complainings were spread out over some stretch of time. Each such functional application (mappings between POS understood as linguistic types) produces not only a resulting POS "type", but also a reconfiguration of cognitive attitudes toward the relevant situation and context. Language users have many ways to craft a sentence with similar meanings, and arguably one task for linguistic analysis is to model the space of choices which are available in a given situation and represent what specific ideas and effects are invoked by one choice

Figure 1: Dependency-style graph with argument repetition



- ♦ 1 Head/dependent relation
- ♦ 2 Argument repetition (——`after`—— idiom)
- ♦ 3 Propositional completion ($V :: N \twoheadrightarrow \mathcal{P}rop$)
- ▼ 4 Phrase (modeled as applicative structure), typed as N^{+}

over others.

4.2 *Types, Sets, and Concepts*

In formal/computational contexts, types can be defined as sets of both values and "expectations" [10] (meaning assumptions which may be made about all values covered by the type); alternatively, we can (perhaps better) consider types as *spaces* of values. Types' extensions have internal structure; there can be "null" or "invalid" values, default-constructed values, and so forth, which are "regions" of the conceptual space spanned or encompassing types.[4] There is definitional interdependence between types and functions: a function is defined in terms of the types it accepts as parameters and returns — rather than its entire set of possible inputs and outputs, which can vary across computing environments. [5] These are some reasons why in theoretical Computer Science types are not "reduced" to underlying sets; instead, extensions are sometimes complex spaces that model states of, or internal organization of comparisons among, type instances.

An obvious paradigm is organizing type-extensions around prototype/borderline cases — there are instances which are clear examples of types and ones whose classification is dubious. I contend, however, that common resemblance is not always a good marker for types being well-conceived — many useful concepts are common precisely because they cover many cases, which makes defining "prototypes" or "common properties" misleading. Also, sometimes the clearest "representative" example of a type or concept is actually not a *typical* example: a sample latter or model home is actually not (in many cases) a real letter or home. So resemblance-to-prototype is at best one kind of "inner organization" of concepts' and types' spaces of extension.

Sets, concepts, and types represent three different primordial thought-vehicles for grounding notions of logic and meaning. To organize systems around *sets* is to forefront notions of inclusion, exclusion, extension, and intersection, which are also formally essential to mathe-

[4] Conceptual Space theory is outside the scope of this paper, but I'll note that it suggests a promising link between natural linguistics and formal/computational type theory, as suggested by computational or scientific expositions of the original Conceptual Space account developed by Peter Gärdenfors: cf. [25], [1] [2], [?]. Meanwhile, projects to develop formal models for Cognitive Grammar have also adopted Conceptual Space theory as an underlying semantics: [27], [28], [53], [16].

[5] Moreover, expectations in a particular case may be more precise than what is implied by the type itself — it is erroneous to assume that a proper type system will allow a correct "set of values" to be stipulated for each point in a computation (the kind of contract enforced via by documentation and unit testing). So state-space in a given context may include many "unreasonable" values, implying that within the overall space there is a "reasonable" subspace, except that this subspace may not be crisply defined.

matical logic and undergird the classical interdependence of sets, logic, and mathematics. To organize systems around *concepts* is to forefront practical engagement and how we mold conceptual profiles, as collections of ideas and pragmas, to empirical situations. To organize systems around *types* is to forefront "functions" or transformations which operate on typed values, the interrelationships between different types (like subtypes and inclusion — a type can itself encompass multiple values of other types), and the conceptual abstraction of types themselves from the actual sets of values they may exhibit in different environments. Sets and types are formal, abstract phenomena; whereas concepts are characterized by gradations of applicability, and play flexible roles in thought and language. The cognitive role of concepts can be discussed with some rigor, but there is a complex interplay of cognitive schema and practical engagements which would have to be meticulously sketched in many real-world scenarios, if our goal were to translate conceptual reasoning to formal structures on a case-by-case basis. We can, however, consider in general terms how type-theoretic semantics can capture conceptual structures as part of the overall transitioning of thoughts to langauge.

A concept does not merely package up a definition, like "restaurant" as "a place to order food"; instead concepts link up with other concepts as tools for describing and participating in situations. Concepts are associated with "scripts" of discourse and action, and find their range of application through a variegated pragmatic scope. We should be careful not to overlook these pragmatics, and assume that conceptual structures can be simplistically translated to formal models. Cognitive Linguistics critiques Set-Theoretic or Modal Logic reductionism (where a concept is just a set of instances, or an extension across different possible worlds) — George Lakoff and Mark Johnson, prominently, argue for concepts' organization around prototypes ([34, p. 18]; [29, p. 171, or p. *xi*]) and embodied/enactive patterns of interaction ([34, p. 90]; [29, p. 208]). Types, by contrast, at least in linguistic applications of type theory, are abstractions defined in large part by quasi-functional notions of phrase struture. Nevertheless, the *patterns* of how types may inter-relate (mass-noun or count-noun, sentient or non-sentient, and so forth) provide an infrastructure for conceptual understandings to be encoded in language — specifically, to be signaled by which typed articulations conversants choose to use. A concept like *restaurant* enters language with a collection of understood qualities (social phenomena, with some notion of spatial location and being a "place", etc.) that in turn can be marshaled by sets of allowed or disallowed phrasal combinations, whose parameters can be given type-like descriptions. Types, in this sense, are not direct expressions of concepts but vehicles for introducing concepts into language.

Concepts (and types also) are not cognitively the same as their extension — the concept *restaurant*, I believe, is distinct from concepts like *all restaurants* or *the set of all restaurants*. This is for several reasons. First, concepts can be pairwise different not only through their instances, but because they highlight different sets of attributes or indicators. The concepts "American President" and "Commander in Chief" refer to the same person, but the latter foregrounds a military role. Formal Concept Analysis considers *extensions* and "properties" — suggestive indicators that inhere in each instance — as jointly (and co-dependently) determinate: concepts are formally a synthesis of instance-sets and property-sets [68], [6], [66]. Second, in language, clear evidence for the contrast between *intension* and *extension* comes from phrase structure: certain constructions specifically refer to concept-extension, triggering a mental shift from thinking of the concept as a schema or prototype to thinking of its extension (maybe in some context). Compare:

- (125) Rhinos in that park are threatened by poachers.
- (126) Young rhinos are threatened by poachers.

Both sentences focus a conceptual lens in greater detail than *rhino* in general, but the second does so more intensionally, by adding an extra indicative criterion; while the former does so extensionally, using a phrase-structure designed to operate on and narrow our mental construal of "the set of all rhinos", in the sense of *existing* rhinos, their physical place and habitat, as opposed to the "abstract" (or "universal") type. So there is a familiar semantic pattern which mentally transitions from a lexical type to its extension and then extension-narrowing — an interpretation that, if accepted, clearly shows a different mental role for concepts of concepts' *extension* than the concepts themselves.[6]

[6] There is a type-theoretic correspondence between intension and extension — for a type $\mathfrak{t}$ there is a corresponding "higher-order" type of *sets* whose members are $\mathfrak{t}$ (related constructions are the type of *ordered se-*

Concepts, in short, do not mentally signify sets, or extensions, or sets-of-shared-properties. Concepts, rather, are cognitive/dialogic tools. Each concept-choice, as presentation device, invites its own follow-up. *Restaurant* or *house* have meaning not via idealized mental pictures, or proto-schema, but via kinds of things we do (eat, live), of conversations we have, of qualities we deem relevant. Concepts do not have to paint a complete picture, because we use them as part of ongoing situations — in language, ongoing conversations. Narrow concepts — which may best exemplify "logical" models of concepts as resemblance-spaces or as rigid designators to natural kinds — have, in practice, fewer use-cases *because* there are fewer chances for elaboration. Very broad concepts, on the other hand, can have, in context, too *little* built-in *a priori* detail. (We say "restaurant" more often than *eatery*, and more often than *diner*, *steakhouse*, or *taqueria*). Concepts dynamically play against each other, making "spaces" where different niches of meaning, including levels of precision, converge as site for one or another. Speakers need freedom to choose finer or coarser grain, so concepts are profligate, but the most oft-used trend toward middle ground, neither too narrow nor too broad. *Restaurant* or *house* are useful because they are noncommittal, inviting more detail. These dynamics govern the flow of inter-concept relations (disjointness, subtypes, partonymy, etc.).

Concepts are not rigid formulae (like instance-sets or even attributes fixing when they apply); they are mental gadgets to initiate and guide dialog. Importantly, this contradicts the idea that concepts are unified around instances' similarity (to each other or to some hypothetical prototype): concepts have avenues for contrasting different examples, invoking a "script" for further elaboration, or for building temporary filters. In, say,

▾ (127) Let's find a restaurant that's family-friendly.

allowing such one-off narrowing is a feature of the concept's flexibility.

In essence: no less important, than acknowledged similarities across all instances, are well-rehearsed ways vis-à-vis each concept to narrow scope by marshaling lines of *contrast*, of *dissimilarity*. A *house* is obviously different from a *skyscraper* or a *tent*, and better resembles other houses; but there are also more nontrivial *comparisons* between houses, than between a house and a skyscraper or a tent. Concepts are not only spaces of similarity, but of *meaningful kinds of differences*.

To this account of conceptual breadth we can add the conceptual matrix spanned by various (maybe overlapping) word-senses: to *fly*, for example, names not a single concept, but a family of concepts all related to airborn travel. Variations highlight different features: the path of flight (*fly to Korea*, *fly over the mountain*); the means (*fly Korean air*, *that model flew during World War II*); the cause (*sent flying (by an explosion)*, *the bird flew away (after a loud noise)*, *leaves flying in the wind*). Words allow different use-contexts to the degree that their various *senses* offer an inventory of aspects for highlighting by *morphosyntactic* convention. Someone who says *I hate to fly* is not heard to dislike hand-gliding or jumping off mountains.[7] Accordant variations of cognitive construal (attending more to mode of action, or path, or motives, etc.), which are elsewhere signaled by grammatic choices, are also spanned by a conceptual space innate to a given word: senses are finer-grained meanings availing themselves to one construal or another.

So situational construals can be signaled by word- and/or syntactic form choice (locative, benefactive, direct and indirect object constructions, and so forth). Whereas conceptual organization often functions by establishing classifications, and/or invoking "scripts" of dialogic elaboration, cognitive structure tends to apply more to our attention focusing on particular objects, sets of objects, events, or aspects of events or situations. So the contrast between singular, mass-multiples, and count-multiples, among nouns, depends on cognitive construal of the behavior of the referent in question (if singular, its propensity to act or be conceived as an integral whole; if

quences of t; unordered collections of t allowing repetition; and stacks, queues, and deques — double-ended queues — as t-lists that can grow or shrink at their beginning and/or end). If we take this (higher-order) type gloss seriously, the extension of a concept is not its *meaning*, but a different, albeit interrelated concept. Extension is not definition. *Rhino* does not mean *all rhinos* (or *all possible rhinos*) — though arguably there are concepts *all rhinos* and *all restaurants* (etc.) along with the concepts *rhino* and *restaurant*.

[7] People, unlike birds, do not fly — so the verb, used intransitively (not flying *to* somewhere in particular or *in* something in particular), is understood to refer less to the physical motion and more to the socially sanctioned phenomenon of buying a seat on a scheduled flight on an airplane. The construction highlights the procedural and commercial dimension, not the physical mechanism and spatial path. But it does so *because* we know human flight is unnatural: we can poetically describe how the sky is filled with flying leaves or birds, but not "flying people", even if we are nearby an airport.

multiple, its disposition to either be divisible into discrete units, or not). Or, events can be construed in terms of their causes (their conditions at the outset), or their goals (their conditions at the conclusion), or their means (their conditions in the interim). Compare *attaching* something to a wall (means-focused) to *hanging* something on a wall (ends-focused); *baking* a cake (cause-focus: putting a cake in the oven with deliberate intent to cook it) to *burning* a cake (accidentally overcooking it).[8] These variations are not random assortments of polysemous words' senses: they are, instead, rather predictably distributed according to speakers' context-specific knowledge and motives.

I claim therefore that *concepts* enter language complexly, influenced by conceptual *spaces* and multi-dimensional semantic and syntactic selection-spaces. Concepts are not simplistically "encoded" by types, as if for each concept there is a linguistic or lexical type that just disquotationally references it — that the type "rhino" means the concept *rhino* ("type" in the sense that type-theoretic semantics would model lexical data according to type-theoretic rules, such as *rhino* as subtype of *animal* or *living thing*). Cognitive schema, at least in the terms I just laid out, select particularly important gestalt principles (force dynamics, spatial frames, action-intention) and isolate these from a conceptual matrix. On this basis, we can argue that these schemata form a precondition for concept-to-type association; or, in the opposite logical direction, that language users' choices to employ particular type articulations follow forth from their prelinguistic cognizing of practical scenarios as this emerges out of collections of concepts used to form a basic understanding of and self-positioning within them.

In this sense I called types "vehicles" for concepts: not that types *denote* concepts but that they (metaphorically) "carry" concepts into language. "Carrying" is enabled by types' semi-formal rule-bound interactions with other types, which are positioned to capture concepts' variations and relations with other concepts.

To express a noun in the benefactive case, for example, which can be seen as attributing to it a linguistic type consistent with being the target of a benefactive, is to capture the concept in a type-theoretic gloss. It tells us, I'm thinking about this thing in such a way that it *can* take a benefactive (the type formalism attempting to capture that "such a way"). A concept-to-type "map", as I just suggested, is mediated (in experience and practical reasoning) by cognitive organizations; when (social, embodied) enactions take linguistic form, these organizing principles can be encoded in how speakers apply morphosyntactic rules.

So the linguistic structures, which I propose can be formally modeled by a kind of type theory, work communicatively as carriers and thereby signifiers of cognitive attitudes. The type is a vehicle for the concept because it takes part in constructions which express conceptual details — the details don't emerge merely by virtue of the type itself. I am not arguing for a neat concept-to-type correspondence; instead, a type system provides a "formal substrate" that models (with some abstraction and simplification) how properties of individual concepts translate (via cognitive-schematic intermediaries) to their manifestation in both semantics and syntax.

Continuing with declention as a case study, consider how an "ontology" of word senses can interrelate with the benefactive. A noun as a benefactive target most often is a person or some other sentient/animate being; an inanimate benefactive is most likely something artificial and constructed (cf., *I got the car new tires*). How readily hearers accept a sentence — and the path they take to construing its meaning so as to make it grammatically acceptable — involves interlocking morphological and type-related considerations; in the current example, the mixture of benefactive case and which noun "type" (assuming a basic division of nouns into e.g. animate/constructed/natural) forces a broader or narrower interpretation. A benefactive with an "artifact" noun, for example, almost forces the thing to be heard as somehow disrepaired:

▼ (128) I got glue for your daughter.

[8] We can express an intent to bake someone a cake, but not (well, maybe comedically) to *burn* someone a cake ("burn", at least in this context, implies something not intended); however, we *can* say "I burnt your cake", while it is a little jarring to say "I baked your cake" — the possessive implies that some specific cake is being talked about, and there is less apparent reason to focus on one particular stage of its preparation (the baking) once it is done. I *will* bake a cake, in the future, uses "bake" to mean also other steps in preparation (like "make"), while, in the present, "the cake *is* baking" emphasizes more its actual time in the oven. I *baked your cake* seems to focus (rather unexpectedly) on this specific stage even after it is completed, whereas *I baked you a cake*, which is worded as if the recipient did not know about the cake ahead of time, apparently uses "bake" in the broader sense of "made", not just "cooked in an oven". Words' senses mutate in relation to the kinds of situations where they are used — why else would *bake* mean "make"/"prepare" in the past or future tense but "cook"/"heat" in the present?

- (129) I got glue for your coffee mug.

We gather (in the second case) that the mug is broken — but this is never spelled out by any lexical choice; it is implied indirectly by using benefactive case. It is easy to design similar examples with other cases: a locative construction rarely targets "sentient" nouns, so in

- (130) We're going to Grandma!
- (131) Let's go to him right now.
- (132) Let's go to the lawyers.
- (133) Let's go to the press.

we mentally substitute the person with the place where they live or work.

Morphosyntactic considerations are also at play: *to the lawyers* makes "go" sound more like "consult with", partly because of the definite article (*the* lawyers implies conversants have some prior involvement with specific lawyers or else are using the phrase metonymically, as in "go to court" or "to the courts", for legal institutions generally; either reading draws attention away from literal spatial implications of "go"). *Go to him* implies that "he" needs some kind of help, because if the speaker just meant going to wherever he's at, she probably would have said that instead.

Similarly, the locative in *to the press* forces the mind to reconfigure the landmark/trajector structure, where *going* is thought not as a literal spatial path and *press* not a literal destination — in other words, the phrase must be read as a metaphor. But the "metaphor" here is not "idiomatic" or removed from linguistic rules (based on mental resemblance, not language structure); here it clearly works off of formal language patterns: the landmark/trajector relation is read abstracted from literal spatial movement because the locative is applied to an expression (*the press*) which does not (simplistically) meet the expected interpretation as "designation of place".

In short, there are two different levels of *granularity* where we can look for agreement requirements: a more fine-grained level where e.g. *locative* draws in a type-specification of a *place* or *location*; and a coarser level oriented toward Parts of Speech, and typologies of phrasal units. On the finer scale, what linguistics can draw from type theory gravitates toward type-coercions, "dependent types", and topics based on programming language type systems, like "monads" — [37], [38], [13], [3], [4], [50], [51]. On the coarser scale, on the other hand, analyses can focus on the interconnections between types and functions: most top-level linguistic types fit the formal model of (in computational contexts) "functional" types, associated with types of "inputs" and "outputs". For instance, assuming we have a primordial *noun* type and a *proposition* type (the type assigned to complete sentences), a *verb* is then at some abstract reading a "function" from nouns to propositions — insofar as verbs produce propositions when combined with nouns. Similarly an adjective maps nouns to other nouns (in a conceptual sense; noun-phrases, literally speaking); adverbs map verbs to other verbs, and so forth.

The proposition type (say, "$\mathcal{P}rop$") provides a type attribution for sentences, but also for sentence parts: *he is at school*, for example, presents a complete idea, either as its own sentence or part of a larger one. In the latter case, a $\mathcal{P}rop$ phrase would typically be preceded with a word like *that*; *syntactically*, "that" is essentially a connector, helping sentence-parts link with each other:

- (134) I think he is at school.
- (135) I believe that he is at school.

Type-theoretically, however, we may want to assign types to every word, even those — like *that* in (135) which seem auxiliary and lacking much or any semantic content of their own. Arguably, *that* serves to "package" an assertion, encapsulating a proposition as a presumed fact designated as one idea, for the sake of making further comments, as if "making a noun" out of it: $\mathcal{P}rop \dashrightarrow N$. Perhaps our intuitions are more as if *that he is at school* is also a proposition, maybe a subtly different kind, by analogy to how questions and commands are also potentially $\mathcal{P}rop$ variants. Since THAT-phrases are "arguments" for verbs, the choice then becomes whether it is useful to expand our type picture of verbs so that they may act on propositions as well as nouns, or rather type "encapsulated" propositions as just nouns (maybe special kinds of nouns).

In either case, *I know that …* clearly involves a verb with subject and direct object: so either $V :: N \dashrightarrow N \dashrightarrow \mathcal{P}rop$ or $V :: N \dashrightarrow \mathcal{P}rop \dashrightarrow \mathcal{P}rop$. In Link Grammar, the connection between a verb and its assertorial direct object is labeled TS.[9] Consider the role of a TS-link

[9] Link Grammar models parses via interword relations classified according to some four dozen recognized syntactic and semantic connectors;

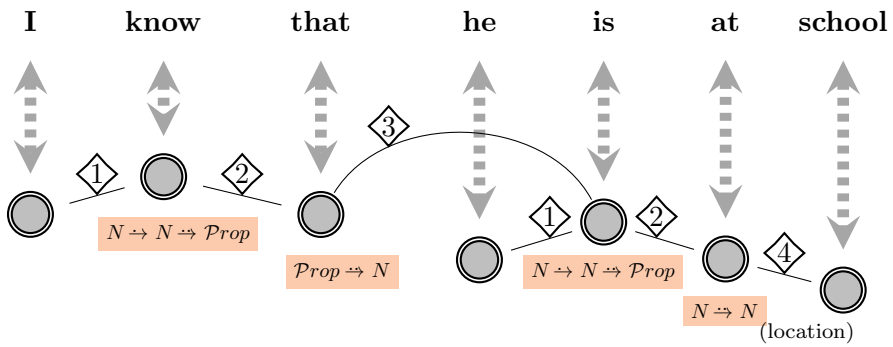
here — the purely formal consideration is ensuring that types are consistent: either the TS target is $\mathcal{P}rop$, with the verb type modified accordingly; or the TS target is a noun, though here it is fair to narrow scope. For this particular kind of link, the target must express a proposition: either typed directly as such or typed as, say, a noun "packaging" a proposition, which would then be a higher-order type relation (just as "redness" is a noun "packaging" an adjective, or "running" is an adjective packaging a verb). In other words, it is difficult to state the type restrictions on the link-pair without employing more complex or higher-order type formations.

On the other hand, this is another example of the fuzzy boundary between syntax and semantics: given a sentence which seems to link a verb calling for a belief or assertion (like "know", "think", "suggest", "to be glad") to something that is not proposition-like, is such a configuration ungrammatical, or just hard to understand? Clearly, the *semantic* norms around verbs like "know" is that their *subject* has some quality of sentience (or can be meaningfully attributed belief-states, even if speakers know not to take it literally: "The function doesn't know that this number will never be zero"); and their *object* should be somehow propositional. But applying type theory (or type theory in conjunction with Dependency Grammar) leaves open various analytic preferences: these requirements can be presented as rigid grammatic rules or as "post-parsing" semantic regulations. How to model the qualities of sentience (or at least of having propositional attitudes broadly conceived), for the noun, and of propositionality, for the direct object, are again at the discretion of the analysis (subtypes, quality-associations, or etc.) — Figure 2 shows one potential, rather simplified unpacking of the sentence; from this structure details can be added perhaps as extra syntax constraints or perhaps more as cues to interpretation. If these requirements are seen as more syntactic, so qualities are incorporated into data like Part of Speech (say, a noun designating something with propositional attitudes being a subtype of of a generic N type), then we are more likely to analyze violations as simply incorrect (recall "The tree wants to run away from the dog" — ungrammatical or just somehow "exotic"?). Some examples suggest less incorrectness as clever or poetic usage — so a richer analysis may recognize expressions as type- and link-wise acceptable, but showing incongruities (which is not the same as impropriety) at a more fine-grained type level. That *to want* takes a subject *associated* with sentience does not force type annotations to inscribe this in grammatic or lexical laws; instead, these associations can be introduced as potential "side effects", *triggering* re-associations such as forcing hearers to ascribe sentience to something (like a tree) where such ascription is not instinctive. The type effect in this case lies more at the conceptual level, the language-user sifting conceptual backgrounds to find a configuration proper to the type requirements (in what sense can a tree "want" something?). In this "tree" case we probably appeal to concepts of "as if": if the tree *were* sentient, it would be nervous of the dog sniffing around — a humorous way of calling attention to the dog's actions (obliquely maybe alluding to people's background knowledge that dogs sometimes do things, like pee, in inconvenient places, from humans' perspectives).

In brief, it is certainly possible — though by no means mandatory — to model type requirements with greater flexibility at a provisional grammatical layer, and then narrow in on subtypes or extra accumulations of qualifications on type-instances in a transition from grammar to semantics. Perhaps cognitive schema occupy an intermediary role: progressing from basic recognition of grammaticality, through cognitive schema, to conceptual framing, with type machinery capturing some of the thought-processes at each "step" (not that such "steps" are necessarily in a temporal sequence). The basic verb-subject-direct object articulation sets up an underlying cognitive attitude (represented by a basic type-framing of verb, noun, and proposition, like the $V :: N \dashrightarrow N \dashrightarrow \mathcal{P}rop$ signature). Cognitive ascriptions fill this out by adding detail to the broader-hewed typing, associating sentience with the subject and propositionality with the object (sub- or higher-order typing modeling this stage). And how the actual lexical choices fit these cognitive expectations — I call them cognitive because they are intrinsically tied to structurational schema in the type, morphology, and word-order givens in the encountered

a complete parse yields a labeled "graph" of each sentence, similar to graphs derived from Depenency Grammars, with link-kinds notated via labels like "TS" (the exact vocabulary of link kinds establishes specific grammars for specific natural languages) — cf. [54]; [18], [19], [20], [43]. Link Grammar is distinguished from Depenency Grammar in that the former does not directly model head/dependent relations within word-pairs, but it *does* develop a theory of individual words carrying incompleteness or expectations which define "compatibility" between words, allowing links to be formed; the link/dependency comparison is investigated in [32], [26]; and other writings compare both grammatic schools to more hierarchical phrase-structure grammars: [52], [67].

Figure 2: Dependency-style graph with type annotations



- 1 Verb's subject argument
- 2 Verb's direct object argument
- 3 Propositional "packaging" ("typed" as $\mathcal{P}rop \dashrightarrow N$)
- 4 Locative auxiliary link
  (may be typed as converting nouns to place-designations)

language — compels conversants to dip into background beliefs, finding concepts for the signified meanings that hew to the intermediary cognitive manipulations (finding ways to conceptualize the subject as sentient, for example). This also has a potential type model, perhaps as forcing a type conversion from a lexical element which does not ordinarily fit the required framing (such as giving inanimate things some fashion of sentience). Type theory can give a window onto unfolding intellection at these multiple stages, although we need not conclude that the mind subconsciously doing this thinking mimics a computer that churns through type transformations mechanically and exactly.

I envision the unfolding that I have just sketched out as something Phenomenological — it arises from a unified and subjective consciousness, one marked by embodied personal identity and social situation. If there are structural stases that can be found in this temporality of experience, these are not constitutive of conscious reality but a mesh of rationality that supports it, like the veins in a leaf. Stuctural configurations can be lifted from language insofar as it is a conscious, formally governed activity, and lifted from the ambient situations which lend language context and meaning intents. So any analytic emphasis on structural fixpoints threaded through the lived temporality of consciousness is an abstraction, but one that is deliberate and necessary if we want to make scientific or in any other manner disputatable claims about how language and congition works. In that spirit, then, I will try to condense the three "layers" of unfolding understanding, which as I have sketched them are posited in the metaphysical order of temporal experience — "unfolding" in likely overlapping, blending ways — I will "read into" them a more static and logically stacked meta-structure. Where I have sketched three layers or stages of unfolding language understanding, I will transition to proposing three "tiers" of language organization, in particular three levels where type-theoretic models can be applied.

4.3 *Three tiers of linguistic type theory*

From one perspective, grammar is just a most top-level semantics, the primordial Ontological division of language into designations of things or substances (nouns), events or processes (verbs), qualities and attributes (adjectives), and so forth. Further distinctions like count, mass, and plural nouns add semantic precision but arguably remain in the orbit of grammar (singular/plural agreement rules, for example); the question is whether semantic detail gets increasingly fine-grained and somewhere therein lies a "boundary" between syntax and semantics. The mass/count distinction is perhaps a topic in grammar more so than semantics, because its primary manifestation in language is via agreement (*some* wine in a glass;

a wine that won a prize; *many* wines from Bordeaux). But are the distinctions between natural and constructed objects, or animate and inanimate kinds, or social institutions and natural systems, matters more of grammar or of lexicon? Certainly they engender agreements and propriety which appear similar to grammatic rules. *The tree wants to run away from the dog* sounds wrong — because the verb *want*, suggestive of propositional attitudes, seems incompatible with the nonsentient *tree*. Structurally, the problem with this sentence seems analogous to the flawed *The trees wants to run away*: the latter has incorrect singular/plural linkage, the former has incorrect sentient/nonsentient linkage, so to speak. But does this structural resemblance imply that singular/plural is as much part of semantics as grammar, or sentient/nonsentient as much part of grammar as semantics? It is true that there are no morphological markers for "sentience" or its absence, at least in English — except perhaps for "it" vs. "him/her" — but is this an accident of English or revealing something deeper?

I will argue that type-related observations can be grouped (not necessarily exclusively or exhaustively) into three "tiers" of linguistic organization — three different levels of granularity, distinguished by relative scales of resolution, amongst the semantic implications of putative type representations for linguistic phenomena. These tiers I term *macrotypes* — relating mostly to Parts of Speech and the functional treatment of phrases as applicative structures; *mesotypes* — engaged with existential/experiential qualities and "Ontological" classifications like sentient/nonsentient, rigid/nonrigid, and others I have discussed; and *microtypes* — related to lexemes and word-senses. This lexical level can include "microclassification", or gathering nouns and verbs by the auxiliary prepositions they allow and constructions they participate in (such as, different cases), and especially how through this they compel various spatial and force-dynamic readings; their morphosyntactic resources for describing states of affairs; and, within semantics, when we look toward even more fine-grained classifications of particular word-senses, to reason through contrasts in usage.[10] Microclasses can point out similarities in mental "pictures" that explain words' similar behaviors, or study why different senses of one word succeed or fail to be acceptable in particular phrases. There are *stains all over the tablecloth* and *paint splattered all over the tablecloth*, but not (or not as readily) *dishes all over the tablecloth*. While "stains" is count-plural and "paint" is mass-aggregate, they work in similar phrase-structures because both imply extended but not rigid spatial presence; whereas "dishes" can work for this schema only by mentally adjusting to that perspective, spatial construal shifting from visual/perceptual to practical/operational (we might think of dishes "all over" the tablecloth if we have the chore of clearing them). Such observations support microclassification of nouns (and verbs, etc.) via Ontological and spatial/dynamic/configuration criteria.

Type-theoretic semantics can also apply Ontological tropes to unpack the overlapping mesh of word-senses, like *material object* or *place* or *institution*. This mode of analysis is especially well illustrated when competing senses collide in the same sentence. Slightly modifying two examples:[11]

- (136) The newspaper you are reading is being sued.
- (137) Liverpool, an important harbor, built new docks.

Both have a mid-sentence shift between senses, which is analyzed in terms of "type coercions". The interesting detail of this treatment is how it correctly predicts that such coercions are not guaranteed to be accepted:

- (138) The newspaper fired the reporter and fell off the table (?).
- (139) Liverpool beat Tottenham and built new docks (?).

(again, slightly modifying the counter-examples). Type coercions are *possible* but not *inevitable*. Some word-senses "block" certain coercions — that is, certain sense combinations, or juxtapositions, are disallowed. These preliminary, motivating analyses carry to more complex and higher-scale types, like plurals (the plural of a type-coercion works as a type-coercion of the plural, so to speak). As it becomes structurally established that type rules at the simpler levels have correspondents at more complex levels, the use of type notions *per se* (rather than just "word senses" or other classifications) becomes more well-motivated.

[10] So, conceiving microclasses similar in spirit to Steven Pinker in Chapter 2 of [49], though I'm not committing to using the term only in the way Pinker uses it. Cf. also [61], which combines a microclass theory I find reminiscent of *The Stuff of Thought* with formal strategies like Unification Grammar.

[11] [13, p. 40] (former) and [41, p. 4] (latter).

Clearly, for example, only certain kinds of agents may have beliefs or desires, so attributing mental states forces us to conceive of their referents in those terms:

- (140) Liverpool wants to sign a left-footed striker.
- (141) That newspaper plans to fire its editorial staff.

This *can* be analyzed as "type coercions"; but the type-theoretic machinery should contribute more than just obliquely stating linguistic wisdom, such as maintaining consistent conceptual frames or joining only suitably related word senses. The sense of *sign* as in "employ to play on a sports team" can only be linked to a sense of Liverpool as the Football Club; or *fire* as in "relieve from duty" is only compatible with newspapers as institutions. These dicta can be expressed in multiple ways. But the propagation of classifications (like "inanimate objects" compared to "mental agents") through complex type structures lends credence to the notion that type-theoretic perspectives are more than just an expository tool; they provide an analytic framework which integrates grammar and semantics, and various scales of linguistic structuration. For instance, we are prepared to accept some examples of dual-framing or frame-switching, like thinking of a newspaper as a physical object and a city government (but we reject other cases, like *Liverpool voted in a new city government and signed a new striker* — purporting to switch from the city to the Football Club). The rules for such juxtapositions appear to reveal a system of types with some parallels to those in formal settings, like computer languages.

In short, "Ontological" types like *institution* or *place* serve in some examples to partition senses of one multi-faceted word. Here they reveal similar cognitive dynamics to reframing-examples like *to the press*, where Ontological criteria (like reading something as a place) are triggered by phrase-scale structure. But there are also interesting contrasts: the *newspaper* and *Liverpool* examples imply that some words have multiple framings which are well-conventionalized; newspaper-as-institution feels less idiomatic and metaphorical than press-as-place. So these examples suggest two "axes" of variation. First, whether the proper Ontological framing follows from other word-choices (like "fire" in *the newspaper fired the reporter*, which has its own semantic needs), or from morphosyntax (like the locative in *to the press*); and, second, whether triggered framings work by selecting from established word senses or by something more metaphorical. Metaphors like *to the press* do have an element of standardization; but apparently not so much so to be distinct senses: note how *the press* as metaphorical place does not work in general: ?*at the press*, ?*near the press* (but *at the newspaper*, *near the newspaper* — imagine two journalists meeting outside the paper's offices — sound quite reasonable).

The "type coercion" analysis works for mid-sentence frame-shifts; but other examples suggest a more gradual conceptual "blending". For example, the place/institution dynamic is particularly significant for *restaurant* (whose spatial location is, more so, an intrinsic part of its identity). Being a *place* implies both location and extension; most places are not single points but have an inside where particular kinds of things happen. I am not convinced that restaurant as place and as institution are separate word senses; perhaps, instead, conversations can emphasize one aspect or another, non-exclusively. As I have argued, we need not incorporate all framing effects via "subtypes" (restaurant as either subtype of hypothetical "types of all" places or institutions, respectively). But "placehood", the Ontological quality of being a place — or analogously being a social institution — identify associations that factor into cognitive frames; types can then be augmented with criteria of tolerating or requiring one association or another. So if "restaurant" is a type, one of its properties is an institutionality that *may* be associated with its instances. In conversation, a restaurant may be talked about as a business or community, foregrounding this dimension. Or (like in asking for directions) its spatial dimension may be foregrounded. The availability of these foregroundings is a feature of a hypothetical restaurant type, whether or not these phenomena are modeled by subtyping or something more sophisticated. The "newspaper" examples suggest how Ontological considerations clearly partition distinct senses marked by properties like objecthood or institutionality (respectively). For "newspaper" the dimensions are less available for foregrounding from a blended construal, than "unblended" by conventional usage; that is why reframings evince a type *coercion* and not a gentler shift of emphasis. The example of *restaurant*, in contrast, shows that competing routes for cognitive framing need not solidify into competing senses, though they trace various paths which dialogs may follow. But both kinds of examples put into evidence an underlying cognitive-Ontological dynamic which has potential type-oriented

models.

At the most general level — what I called *macrotype* modeling — a type system recognizes initially only the grammatical backbone of expressions, and then further type nuances can be seen as shadings and interpretations which add substance to the syntactic form. So in type-theoretical analysis at this more grammatic level, to which I now turn, we can still keep the more fine-grained theory in mind: the relation of syntax to semantics is like the relation of a spine to its flesh, which is a somewhat different paradigm than treating syntax as a logical or temporal stage of processing. Instead of a step-by-step algorithm where grammatical parsing is followed by semantic interpretation, the syntax/semantics interface can be seen as more analogous to stimulus-and-response: observation that a certain grammatic configuration appears to hold, in the present langauge artifact, triggers a marshaling of conceptual and cognitive resources so that the syntactic backbone can be filled in. Perhaps a useful metaphor is grammar as gravitation, or the structure of a gravitational field, and semantics is like the accretion of matter through the interplay of multiple gravitational centers and orbits. For this analogy, imagine typed lambda reductions like $\mathcal{P}rop \dashrightarrow N \twoheadrightarrow N$ taking the place of gravitational equations; and sentences' grammatic spine taking the place of curvature pulling mass into a planetary center.

Parts of speech have "type signatures" notionally similar to the signatures of function types in programming languages: a verb needing a direct object, for example, "transforms" two nouns (Subject and Object) to a proposition, which I have been notatating with something like $N \dashrightarrow N \dashrightarrow \mathcal{P}rop$. At the most basic level, the relation of Parts of Speech to "type signatures" seems little more than notational variants of conventional linguistic wisdom like a sentence requiring a noun and a verb (`S = NP + VP`). Even at this level, however, type-theoretic intuitions offer techniques for making sense of more complex, layered sentences, where integrating link and phrase structures can be complex. Even the most broadly scoped analysis of type signatures, dealing only with generic Parts of Speech like nouns and verbs, can lead to surprising complications. One example I have alluded to several times, and will return to shortly: the problem of applying Dependency Grammar where phrases do not seem to have an obviously "most significant" word for linkage with other phrases.

My earlier analysis of phrasal units like *student after student* argued that phrases cannot be treated, in general, as one-to-one replacements for semantic units. Incorporating type theory, we can instead model phrases through the perspective of type signatures: given Part of Speech annotations for phrasal units and then for some of their parts, the signatures of other parts, like verbs or adjectives linked to nouns, or adverbs linked to verbs, tend to follow automatically. A successful analysis yields a formal tree, where if (in an act of semantic abstraction) words are replaced by their types, the "root" type is something like $\mathcal{P}rop$ and the rest of a tree is formally a reducible structure in Typed Lambda Calculus: $N \dashrightarrow N \dashrightarrow \mathcal{P}rop$ "collapses" to $\mathcal{P}rop$, $\mathcal{P}rop \dashrightarrow N$ collapses to N, and so forth, with the tree "folding inward" like a fan until only the root remains — though a more subtle analysis would replace the single $\mathcal{P}rop$ type with variants that recognize different forms of speech acts, like questions and commands. In Figure 2, this can be seen via the type annotations: from right to left $N \dashrightarrow N$ yields the N as second argument for *is*, which in turn yields a $\mathcal{P}rop$ that is mapped (by *that*) to N, finally becoming the second argument to *know*. This calculation only considers the most coarse-grained classification (noun, verb, proposition) — as I have emphasized, a purely formal reduction can introduce finer-grained grammatical or lexico-semantic classes (like *at* needing an "argument" which is somehow an expression of place — or time, as in *at noon*). Even with such refinements the macrotype-level "lambda reduction" remains however a useful summary of the structural core of a sentence.

In either case, Parts of Speech are modeled as (somehow analogous to) functions, but the important analogy is that they have *type signatures* which formally resemble functions'. Phrases are modeled via a "function-like" Parts of Speech along with one or more additional words whose own types match its signature; the type calculations "collapsing" these phrases can mimic semantic simplifications like *many students* to *students*, but here the theory is explicit that the simplification is grammatic and not semantic: the collapse is acknowledged at the level of *types*, not *meanings*. In addition, tree structures can be modeled purely in terms of inter-word relations (this is an example of embedding lambda calculii in process algebras), so a type-summary of a sentence's phrase structure can be notated and analyzed without leaving the Link Grammar paradigm.

As a concrete example, in the case of "many students", both "students" and the semantic role of the phrase are nouns (count-plural nouns, for where that's relevant). Accordingly, "many" has a signature $N \dashrightarrow N$ (or $N^{+} \dashrightarrow N^{+}$, dependending on how narrowly we want to notate the types in context). Once we assign types and signatures to all words in a sentence, we can also see a natural hierarchy resembling an expression in typed lambda calculus, where some words appear as "functions" and others as "arguments". Often the less semantically significant words appear as "higher" in the structure, because they serve to modify and lend detail to more significant words. The kind of structure or *Charpente* which falls out of a sentence — adopting a term from Tesnière (cf. [58, p. 181]) — is typically different from a link-grammar "linkage", although the two structures can be usefully combined.

To return to the example of *Student after student*, where designating one word to "represent" the phrase seemed arbitrary, we can analyze the situation via type-signatures. I have teased a proposed solution repeatedly; here's what I had in mind. Insofar as *after* is the only non-noun, the natural conclusion is that "after" should be typed $N \dashrightarrow N \dashrightarrow N$ (which implies that "after" is analogous to the "functional" position, and in a lambda-calculus style reconstruction would be considered the "head" — Figure 1 is an example of how the sentence could be annotated, for sake of discussion). This particular idiom depends however on the two constituent nouns being the same word (a pattern I've also alluded to with idioms like *time after time*), which can be accommodated by invoking the (computationally rather complex and topical) concept of *dependent types* [8], [57] — in other words the parameters for *after* are a dependent type pair satisfied by an identity comparison between the two nouns. The signature for "after" has this added complication, but the nuances of this example can still be accommodated within the overall architecture of type theory. I would pair this argument with my earlier analysis of "many" variations which suggested how apparent complications can be accommodated largely within the extant theoretical resources of Link Grammar, and in combination suggest that the union of Link Grammar with Type-Theoretic Semantics seems poised to accommodate many complex real-world linguistic cases with a coherent abstract perspective.

Consider alternatives for "many students". The phrase as written suggests a type signature (with "many" as the "function-like" or derivative type) $N^{+} \dashrightarrow N^{+}$, yielding a syntactic interpretation of the phrase; this interpretation also suggests a semantic progression, an accretion of intended detail. From *students* to *many students* is a conversion between two plural nouns (at the level of concepts and semantic roles); but it also implies relative size, so it implies some *other* plural, some still larger group of students from which "many" are selected. While rather abstract and formal, the $N^{+} \dashrightarrow N^{+}$ representation points toward a more cognitive grounding which considers this "function" as a form of thought-operation; a refinement of a situational model, descriptive resolution, and so forth. If we are prepared to accept a cognitive underpinning to semantic classification, we can make the intuition of part of speech signatures as "functions" more concrete: in response to what "many" (for example) is a function *of*, we can say a function of propositional attitude, cognitive schema, or attentional focus. The schema which usefully captures the sense and picture of *students* is distinct (but arguably a variation on) that for *many students*, and there is a "mental operation" triggered by the *many students* construction which "maps" the first to the second. Similarly, *student after student* triggers a "scheme evolution" which involves a more explicit temporal unfolding (in contrast to how *many students* instead involves a more explicit quantitative *many/all* relation). What these examples show is that associating parts of speech with type signatures is not just a formal fiat, which "works" representationally but does not necessarily capture deeper patterns of meaning. Instead, I would argue, type signatures and their resonance into linkage acceptability structures (like singular/plural and mass/count agreement) *point toward* the effects of cognitive schema on what we consider meaningful.

In *Student after student came out against the proposal*, to *come out*, for/against, lies in the semantic frame of attitude and expression (it requires a mental agent, for example), but its reception carries a trace of spatial form: to come out *to* a public place, to go on record with an opinion (I analyzed this case in Section 2). Usually "come out [for/against]", in the context of a policy or idea, is similarly metaphorical. But the concrete spatial interpretation remains latent, as a kind of residue on even this abstract rendition, and the spatial undercurrent is poised to emerge as more literal, should the context warrant. However literally or metaphorically the "space"

of the "coming out" is understood, however explicit or latent its cogitative figuration, is not something internal to the language; it is a potentiality which will present in different ways in different circumstances. This is not to say that it is something apart from linguistic meaning, but it shows how linguistic meaning lies neither in abstract structure alone, nor contextual pragmatics, but in their cross-reference.

5 Conclusion

Of the three type levels I have proposed, the macrotype "functional" level is the most quasi-mathematical; for other levels, formal type theory may provide interpretive tools and methodological guides, but formally representable framings and transformations may be only approximations of how people actually think, while they are understanding language. From this perspective, we are left with the metatheoretical question of clarifying how different kinds of analyses, which put different degrees of weight on formal or on interpretive argumentation, are to be joined in overarching theories. In particular, are the linguistic phenomena which seem to demand more "interpretive" treatment actually beyond formalization, or is it just impractical (but possible in theory) to provide formal analysis of each individual case-study, each real-world language formation? Is Natural Language actually no less formal than (for example) computer programming languages, except that the former have a much larger set of semantic and syntactic rules such that any analysis can uncover them only partially? Or is any rule-based model of language, no matter how complete, necessarily partial relative to real language?

We can consider at what point formal and computational methods reach a limit, beyond which they fail to capture the richess and expressiveness of Natural Language, or whether this limit itself is an illusion — whether even fully human language competence is (perhaps in principle if not in practice) no less reducible to formalizable patterns. Whatever one's beliefs on this last question, a progression of subdisciplines — from formal-logical semantics through programming langauges and computational Natural Langauge Processing — is a reasonable scaffolding for a universe of formal methods that can build up, by progressive theoretical sophistication or assembly of distinct analyses which piece together jigsaw-like, to model real-world language understanding. Perhaps real language is an "emergent property" of many distinct algorithms that run and combine in the mind; or perhaps the relevant algorithms are a precondition, presenting cognition with essential signifying givens but fleshed out in other, more holistic ways, as we become conscious of language not just as a formal system but an interactive social reality.

I have (in the last two sections) sketched a similar theoretical progression, starting with a theory of grammar (Link Grammar), transitioning to a form of semantics (a type-theoretic semantics defining type hierarchies and signatures over linkage graphs), and finally proposing a cognitive interpretation of the resulting semantics. I will refer to this *interpretation* as "Cognitive State Semantics", meaning that such a theory adopts its *formal* structures from Link Grammar and type-theory but also attempts to *motivate* these structures by appeal to cognitive considerations. Both Link Grammar (through its specific Category of labeled graphs modeling sentence linkage-structures) and Type-Theoretic Semantics work with rigorous, algebraically formal models satisfying criteria I referenced at the end of the last section: translation of language content into these formats and subsequent review or transformation of the target structures can be programmed as a purely mechnical space of operations.

By itself, the superposition of type-theoretic semantics on link-grammar graphs does not cross a hypothetical "barrier" between the formal and the cognitive. But I intend here to suggest a cognitive *interpretation* for the formal structures; that they represent an outline of cognitive schema, or progressions, or represent linguistic "triggers" that a cognitive language ability (taking language as part of an environing world and produced by others, in rule-bound social situations, to communicate ideas and sentiments) responds to. This range of interpretations is deliberately open-ended: we can say that a formal infrastructure grounds the cognitive reception of language givens, without arguing specifically that formal structures identified in language therefore model cognitive operations directly, or that these are instead patterns identified in language that trigger a cognitive response, or any other paradigm for mapping cognition as process and activity to language structure as model and prototype. Leaving these options open, however, I will focus in the remainder of this paper on one interpre-

tation, considering formal structures as "triggers" which get absorbed into language understanding via observatory propensities: as language users (on this proposal) we are disposed to identify certain formal structurations operating in language as we encounter it, and respond to these observations by building or refining mental models of the situations and signifying intentions we believe have been implied by the discourse, in evolving and intersubjective dialogic settings that involve joint practical activity as well as communication.

In this sense, I believe natural language reveals mutually-modifying juxtapositions of concepts whose full semantic effects are probably not "computable": I would work on the assumption that language *as a whole* and as human social phenomena are the precinct of a cultural fluency *beyond* Natural Language Processing. The aforementioned "linguistic side effects" can be *modeled* by tracing our reception of linguistic meaning through syntactic and semantic formations, like Link Grammar and Type Theory, but I argue for such models not as models *of* cognitive processes, but rather models of *observations* which trigger cognitive follow-up. Even if we believe in and practice a rigorous formalization of morphosyntactic structure, where the *pattern* of conceptual "side-effects" can be seen as unfolding in algorithmic ways, the cognitive *details* of these effects are too situational, and phenomenologically rich, for computability as ordinarily understood.

But the formal structure is not wholly irrelevant: to call up nuanced cognitive schema — or so I submit for consideration — may not be possible without algorithmically reproducible lexicosemantic and morphosyntactic triggers, at least modulo some approximation. A (perhaps non-computable) space of cognitive schema may be projected onto a (perhaps computable) set of affiliated morphological patterns, using notations like link-grammar pairs and type signatures to catalog them. For example, there may be a non-computable expanse of possible construals of pluralization; but any such construal, in context, is called into focus in conversants' minds by morphosyntactic invitations, by speakers' choices of, say, $N^{\odot} \dashrightarrow N^{+}$-pattern phrases. The important balance is to take formalization as far as is reasonable without being seduced into logico-symbolic reductionism — a methodological pas de deux I will explore further in the next section, a brief concluding coda to this paper.

Any word or usage invites various facets to either emphasize or deemphasize, and these subsumed concepts or foci are latent in potential meanings, brought into linguistic space by the play of differentiation [12] : *baked*, not *made*; *flew*, not *traveled*; *spill*, not *pour*. These undercurrents of subsidiary concepts and foci are selectively hooked onto by morphosyntactic selection, so in analyzing phrase structure we also have to consider how using syntax which constructs a given structure also brings to the forefront certain nested concepts and construals, which are latent in word-sense options; in the topos of lexicosemantic possibilia.

So, any talk about "side effects" of morphosyntactic functions — mapping verb-space to adjective-space, noun-space to proposition-space, singularity to plurality, and so forth — should consider a type-theoretic gloss like $N \dashrightarrow N$ as sketching just the motivating scaffold around an act of cognitive refocusing. The interesting semantics lies with *how* a sense crosses over, in conversants' minds, to some other sense or concept, wherein other aspects are foregrounded — for example, within temporal event plurality: multiplicity as frequency, or episodic distribution relative to some time span; or suggesting something that is typical or predominant; or relative count against some other totality — each such refocusing triggered by a phrasal construction of the form $N \dashrightarrow N^{+}$ or $N^{+} \dashrightarrow N^{+}$. Or we can map singulars, or count plurals, to mass nouns, and vice-versa (*shrubs* become *foliage*; *water* becomes *a glass of water*). The plural and the singular are a coarse-grained semantic that has not yet arrived as *meaning*. Conceptual spaces guide attention to classes and properties, defining a path of ascending precision as speakers add descriptive detail; cognitive construals negotiate relations between different kinds of aggregates/individuals; individuality, aggregation and multiplicity as phenomena and disposition. These construals are practical and embodied, *and* phenomenological — they direct attention (*qua* transcendental universal of mentality, if we like), to and fro, but in the course of intersubjective and goal-driven practical action (and in that sense particular, world-bound, historicized).

Linguistically, the "effects" of language "functions" are mutations/modifications in cognitive state, respondant to concrete or abstract scenarios which are topics

[12] Alluding, in part, to Sausurrean "system of differences" [45, p. 15] — to choose a reference which introduces Sausurre in a rather unexpected context.

of dialog. Sometimes, effects may tolerate mathematical analysis; but such analytical thematics tend to peter out into the ambient, chaotic worldliness of human consciousness.

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