Witnesses

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Abstract

The meaning of definite descriptions (like 'the King of France', 'the girl', etc.) has been a central topic in philosophy and linguistics for the past century. Indefinites ('Something is on the floor', 'A child sat down', etc.) have been relatively neglected in philosophy, under the assumption that they can be unproblematically treated as existential quantifiers. However, an important tradition in linguistic semantics, drawing from Stoic logic, draws out patterns which suggest that indefinites are not well treated simply as existential quantifiers.

There are two broad classes of response to puzzles like this, *e-type* and *dynamic*. These approaches raise deep foundational questions. Inter alia, both require revisionary notions of sentential content and non-classical treatments of the connectives. The proper treatment of (in)definites is thus of crucial importance to philosophical questions about the nature of content, the meaning of (in)definites, and the logic of natural language.

In this paper I develop a new approach to (in)definites. On my theory, contents are static, and indefinites have the truth-conditions of existential quantifiers. But they also have a secondary role: they have a *witness presupposition* which requires that, if the indefinite's truth is witnessed by any individual, then some such individual is assigned to their variable. This means that indefinites license subsequent anaphora to their witnesses. Crucially, the connectives in this system are classical. This shows that we can account for the behavior of (in)definites with resources that are much more conservative than those deployed by e-type or dynamic theories—and in particular, with a classical notion of content and connectives.

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1 Introduction

The meaning of definite descriptions (like 'the King of France', 'the girl', etc.) has been a central topic in philosophy and linguistics for the past century. Indefinites ('Something is on the floor', 'A child sat down', etc.) have been relatively neglected by philosophers, under the assumption that they can be unproblematically treated as existential quantifiers.

However, an important tradition in linguistic semantics, drawing from Stoic logic,[1] draws out patterns which suggest that indefinites are not well treated simply as existential quantifiers—with important corresponding upshots for definites, and, more generally, for the logic and semantics of natural language in general. To see the basic issue, compare (1-a) and (1-b):

(1) a. Everyone who has a child loves the child.
 b. Everyone who is a parent loves the child.

(1-a) is naturally interpreted as saying that every parent loves their child; while (1-b) can only be naturally interpreted as saying that some salient child is loved by every parent. But if indefinites are just existential quantifiers, then 'has a child' and 'is a parent' should mean exactly the same thing: for under that assumption, y has a child iff for some x, y stands in the parent relation to x, iff y is a parent. But, if 'has a child' and 'is a parent' mean the same thing, it is hard to see how we can account for differences in how they embed, as in the pair in (1).

There are two broad classes of response to puzzles like this. *E-type* approaches argue that indefinites are existential quantifiers after all; contrasts like (1) are explained by syntactic/pragmatic differences between them. The difference between (1-a) and (1-b) stems from the fact that (1-a) makes salient a predicate ('child') missing from (1-b), which can be recruited to license subsequent anaphora.[2] *Dynamic* approaches instead argue that the behavior of definites and indefinites shows that meanings are more fine-grained than truth-conditions. In particular, they are *functions from contexts*

1 See Egli 1979 for some history of the topic.
2 See e.g. Geach 1962, Evans 1977, Parsons 1978, Cooper 1979, Neale 1990, Heim 1990, Ludlow 1994, Büring 2004, Elbourne 2005; see Lewis 2012, 2019, Mandelkern and Rothschild 2020, Lewerentz 2020 for more recent developments and criticism.

to contexts. And 'has a child' and 'is a parent' update contexts differently: only the first yields a context which supports subsequent anaphora to a child.[3]

Both of these approaches raise deep foundational questions. Both require revisionary notions of sentence contents: in the dynamic approach, they are functions from contexts to contexts rather than sets of indices; in the e-type approach, they are sets of situations events. And, most importantly, both approaches must adopt non-classical treatments of the connectives, and hence non-classical logics.[4] The proper treatment of patterns like those in (1) is thus of crucial importance to philosophical questions about the nature of content, the meaning of (in)definites, and the logic of natural language.

In this paper I develop a new approach to (in)definites. On my *pseudo-dynamic* theory, contents are static (sets of indices), connectives are classical, and indefinites have the truth-conditions of existential quantifiers. But they also have a secondary role: they have a *witness presupposition* which requires that, if the indefinite's truth is witnessed by any individual, then some such individual is assigned to their variable. This means that indefinites license subsequent anaphora to their witnesses. Definites, as in dynamic semantics, have the main content of variables, plus a presupposition that the variable in question is *familiar*—that is, that it has been introduced by a corresponding indefinite.

The pseudo-dynamic approach aims to incorporate insights from both the dynamic and the classical/e-type approach. Like the classical and e-type approach, we say that indefinites have the truth-conditions of existential quantifiers. This accounts for the existential import of indefinites—whether something like 'There is a cat' is true or false intuitively depends just on whether cats exist. But, like the dynamic approach, we say that indefinites do something more than assert existence: they also enable subsequent anaphora to witnesses of their truth. Unlike in dynamic semantics, however, we locate this secondary role in a separate, presuppositional dimension of meaning. This means

3 E.g. Karttunen 1976, Kamp 1981, Heim 1982, Groenendijk and Stokhof 1991, Dekker 1993, 1994, van den Berg 1996, Muskens 1996, Aloni 2001, Beaver 2001, Nouwen 2003, Brasoveanu 2007, Charlow 2014. It's a subtle question what exactly counts as a dynamic semantics; indeed, the semantics I give below, though very different in obvious ways from standard dynamic theories, could be counted as a dynamic semantics. See van Benthem 1996, Rothschild and Yalcin 2015, 2016 for criteria of dynamicness.

4 This is manifest in the dynamics literature; in the e-type literature, the connectives have not been much discussed, but Mandelkern and Rothschild (2020) show that e-type approaches must likewise adopt non-classical connectives.

that, from a logical and foundational perspective, pseudo-dynamics is more conservative than dynamic or e-type approaches, and in particular avoids a variety of problems that arise from the revisionary logic of dynamic semantics.

2 Problems for the classical picture

I begin by summarizing the basic motivations and ideas behind dynamic semantics, which will provide ingredients for my own theory. I will then highlight an important problem with dynamic semantics, which stems from its non-classical treatment of connectives, and which I will use to motivate my theory, which I present in §5; those familiar with this literature may want to skip to that section.

Recall the classical treatment of (in)definites, due to Frege/Russell/Strawson/Quine. On that account, an indefinite sentence like ⌜Something is F⌝ is equivalent to $\exists x F x$, where $\exists$ is the classical existential quantifier.[5] Definite descriptions have the same meaning plus a uniqueness inference: so ⌜The F is G⌝ says that something is both F and G, and also says (or presupposes) that there is exactly one (relevant) F-thing. Pronouns (which are generally classed as a kind of 'definite') are treated as variables.

Given these assumptions, and given the intuitive meaning of 'parent' and 'child', 'Sue is a parent' and 'Sue has a child' will mean exactly the same thing. But they seem to pattern differently in terms of their interaction with subsequent definites (descriptions and pronouns). We have already seen this in the context of quantifiers in (1) (so-called *donkey sentences*). We can also see this in a simpler way by comparing (2-a) and (2-b):

(2) a. Sue has <u>a child</u>. <u>She</u> is at boarding school.
    b. Sue is <u>a parent</u>. <u>She</u> is at boarding school.

Only (2-a) has a natural interpretation which says that Sue has a child at boarding school; (2-b) is naturally interpreted as saying that Sue herself is at boarding school. (This is not to say (2-b) is impossible to interpret in the same way as (2-a); the key observation is that there is a striking *contrast* in the availability of these interpretations between (2-a) and (2-b) which needs to be accounted for.)

5 (Corner) quotes are omitted around expressions of the formal language.

Note that the basic contrast in (2) cannot be accounted for simply by saying that the indefinite takes wide-scope over the two sentences and binds 'she'. First of all, the idea that indefinites can take scope over whole discourses—sequences of sentences—would be very strange (to bring this out, we can imagine the two sentences in each case being spoken by different people). Second, more importantly, this would just be a very local solution to a very global problem. In particular, it would do nothing to help explain the persistence of contrasts like those in (2) in other embedded environments, like the donkey sentences in (1). It is hard to see how the classical picture could account for the stark divergence in meaning that we find in the pair there. Consider in particular what the classical account predicts about the meaning of a donkey sentence like (3):

(3) Everyone who <u>has a child</u> loves <u>them</u>.

The classical assumptions above would yield (4) as the gloss for (3) (with $\forall$ the classical universal quantifier and $\rightarrow$ the material conditional):

(4) $\forall x((\exists y\ \textit{child of}\ (y,x)) \rightarrow \textit{loves}(x,y))$

The problem with (4) is that the variable y in the consequent is unbound, so we don't get the intended covariation between 'a child' and 'them'. A natural thought is that we could give the existential quantifier wide scope over the material conditional, but that doesn't help: while y ends up bound, we get absurdly weak truth-conditions for (3) (which would end up being true provided that no one is everyone's parent!). So it is not at all obvious how to derive the intended meaning of (3) given the classical assumptions above.[6]

This gives a sense of the motivations for departing from classical assumptions about (in)definites.

3 Dynamic semantics

To illustrate the basic ideas of dynamic semantics, I will informally sketch a slightly simplified version of Heim 1982's dynamic system. (Heimian) dynamic semantics treats

6 Donkey sentences with definite descriptions rather than pronouns raise slightly different, but equally serious, issues; see Heim 1982 for discussion.

sentence meanings as functions from contexts to contexts. A context, in turn, is a set of pairs of partial variable assignments and worlds. The set of worlds involved is the set of worlds treated as live in the conversation: the conversation's context set, in the sense of Stalnaker 1974. The variable assignments serve to keep track of anaphoric relations between indefinites and definites.

The role of indefinites is to extend the contextual variable assignments so they are defined on a new variable; the role of definites is to pick up on a variable that has been introduced this way. So 'There is a$_x$ cat(x)' denotes the function that takes any context c to the context that results from extending every variable assignment in c to an assignment which assigns x to a cat. (The indefinite presupposes that the indexed variable x is novel in c, i.e. that no assignment in any pair in c is defined on x.) More precisely, the resulting context will be the set of pairs $\langle g, w\rangle$ such that $g(x)$ is a cat in w, and for some pair $\langle g', w'\rangle \in c$, $w = w'$, and g' and g agree everywhere except on x, where g' is undefined.

This captures the idea that indefinites 'open a new file card', in Heim's metaphor: indefinites extend a context c so that every variable assignment is defined on x, thus making possible subsequent anaphora with definites indexed to x.

Definites are used to talk about variables that have already been introduced (in the Heimian metaphor: they are used to add information to 'file cards' that have already been opened). So, for instance, 'The$_x$ cat(x)' presupposes that x is a 'familiar' variable in the sense of being everywhere defined in c; and, further, that x is assigned to a cat through c. Where this presupposition is satisfied, 'The$_x$ cat(x)', at a pair $\langle g, w\rangle$, just denotes $g(x)$. (Pronouns are treated analogously, but with only the requirement that x is familiar: so for instance 'He$_x$' presupposes that x is defined throughout c.)

Putting these pieces together: updating with an indefinite sentence sets the stage for subsequent sentences containing definites. So, to work through an example, suppose we have updated our context with 'There is a$_x$ cat(x)'. As we have seen, this guarantees that, at every point $\langle g, w\rangle$ in the context, $g(x)$ is a cat in w. So the familiarity presupposition of a definite like 'The$_x$ cat(x)' is satisfied, and so 'The$_x$ cat(x)' just denotes $g(x)$. So, if we update with 'The$_x$ cat(x) is brown', we just keep those pairs $\langle g, w\rangle$ from the context where $g(x)$ is brown. So consecutive update with 'There is a$_x$ cat(x)' and then 'The$_x$

cat(x) is brown' results in a context comprising pairs $\langle g, w\rangle$ such that $g(x)$ is a brown cat in w.

With this in hand, let's return to the contrast that we saw in (2) above, repeated here in the form of conjunctions rather than sequences for variety:

(5) a. Sue has a child, and she is at boarding school.
    b. Sue is a parent, and she is at boarding school.

Consider a context c where x is novel. Updating with either 'Sue has a_x child(x)' or 'Sue is a_x parent(x)' will have the same *worldly* effect on c: all and only worlds in (pairs within) c in which Sue has a child will survive the update. But these updates have very different effects on variable assignments. Updating with 'Sue has a_x child(x)' will result in a context which only contains pairs $\langle g, w\rangle$ such that $g(x)$ is a child of Sue's in w. By contrast, updating with 'Sue is a_x parent(x)' will instead result in a context which only contains pairs $\langle g, w\rangle$ where $g(x)$ is instead *Sue*. So the first 'opens a file' on Sue's child (indexed to x), which subsequent definites can add to.The second instead 'opens a file' on Sue, and thus does not license subsequent anaphora to Sue's child.

This is the key to the dynamic account of the contrasts we saw in (2) and (5). Conjunction and sequential assertion are both treated in dynamic systems as successive context update, first with the meaning of the left conjunct (first sentence) and then the right (second sentence). That is: where $[p]$ is the dynamic meaning of any sentence p—the function from contexts to contexts denoted by p—let $c[p]$ be the application of the function $[p]$ to context c. The dynamic treatment of conjunction says $c[p\&q] = (c[p])[q]$. So, 'Sue has a_x child(x) [./and] she_x is at boarding school' first takes c to a context comprising just pairs $\langle g, w\rangle$ where $g(x)$ is a child of Sue's, then further updates this context by keeping just those pairs $\langle g, w\rangle$ where $g(x)$—that is, Sue's child—is at boarding school. By contrast, 'Sue is a_x parent(x) [./and] she_x is at boarding school' takes c to a context comprising pairs $\langle g, w\rangle$ where $g(x)$ is a parent identical to Sue; then further updates this context by keeping just those points $\langle g, w\rangle$ where $g(x)$—that is, Sue—is at boarding school. The dynamic system thus captures the stark contrast in (2).

A general way of characterizing this account of that contrast is by saying that in dynamic semantics indefinites have *open scope* to their right (Egli 1979): they can "bind" co-indexed definites to their right, whether or not the definite is in their syntactic scope. Schematically:

> *Open scope of indefinites*: ⌜Something is (F and G)⌝ and ⌜Something is F, and [it/the F] is G⌝ and ⌜Something is F. [It/The F] is G⌝ are all equivalent.

So in particular, 'Sue has a child, and she is at boarding school' will be equivalent to 'Sue has a child who is at boarding school'; while 'Sue is a parent, and she is at boarding school' will be equivalent instead to 'Sue is a parent who is at boarding school'—accounting for their divergence.

This explanation of the contrast in (2) and (5) extends naturally to quantified sentences like those in (1). For reasons of space I won't spell this out, but the intuition behind it is the same: 'has a child' and 'is a parent' update contexts in different ways, making available different possibilities for subsequent anaphora.

4 Problems with non-classicality

While I think that much about this kind of dynamic approach is promising, it has well-known problems involving negation and disjunction, which I will explain in this section, and which I will use to motivate my own approach.

The problem, abstractly, is that the logic of this dynamic approach is highly non-classical. This leads to serious problems. In short: in classical logic, $\neg\neg p$ and p are equivalent. Likewise, $\neg p \vee q$ is equivalent to $\neg p \vee (p \& q)$. Standard dynamic treatments of the connectives have neither of these features, and this is a problem.

To work up to the problem, let's start by thinking about how to extend our dynamic system to negation. A natural first thought is that $c[\neg p] = c \setminus c[p]$. This doesn't work. Think about the desired update of a negated sentence like (6):

(6) It's not the case that Sue has a_x child(x).

Negated indefinites have strong truth-conditions: (6) intuitively communicates that Sue is childless. Thus what we want, when we update c with (6), is to keep just those pairs $\langle g, w \rangle$ in c such that Sue has no children in w. But the current proposal gives us something much weaker. In fact, assuming x is novel in c, updating c with (6) would just give c again, since $c[(6)]$ will comprise only *extensions* of pairs from c, and so $c \setminus c[(6)]$ will be c.

The natural, and standard, thing to say here is that negation quantifies over assignments: $c[\neg p]$ is the set of pairs from c which *can't be extended* in any way to be a part of $c[p]$—that is, $c[\neg p] = \{\langle g, w\rangle \in c : \neg\exists g' \geq g : \langle g', w\rangle \in c[p]\}$ (where $g' \geq g$ iff g' and g agree everywhere that g is defined). Given this treatment of negation, when we update c with (6), we keep just those pairs $\langle g, w\rangle$ in c such that no extension of g assigns a child of Sue's in w to x—in other words, just those pairs $\langle g, w\rangle$ in c such that Sue has no children in w, as desired.

This standard approach captures the intuitive truth-conditions of (6). But it has a problematic upshot: double-negation elimination is not valid. Because of the quantification over assignments in this definition of negation, 'Not (Not (Sue has a_x child(x)))' doesn't have any effect on assignments in the resulting context. Instead, given this definition of negation, updating c with this doubly negated sentence will yield a context containing exactly the pairs $\langle g, w\rangle$ from c where Sue has a child in w. Since this update puts no constraints on variable assignments, it does not set up subsequent anaphora dependencies.[7]

So double negation elimination is not valid. Non-negated indefinites set up subsequent anaphoric dependencies (in addition to communicating 'worldly' information)—i.e., they ensure that subsequent definites have their familiarity presuppositions satisfied. By contrast, doubly-negated indefinites do not set up subsequent anaphoric dependencies: in fact, they have no effect at all on contextual variable assignments.[8]

How big of a problem is this? While stacked negations are strange in natural language, there still seems to be a striking contrast in pairs like (7):

(7) a. It's not the case that Sue doesn't have <u>a child</u>. <u>She's</u> at boarding school.

7 In more detail: assuming x is novel in c, updating c with 'Not (Not (Sue has a_x child(x)))' results in the context c' which comprises the pairs $\langle g, w\rangle \in c$ which can't be extended to be in c[Not (Sue has a_x child(x))]. The latter, in turn, is the set of pairs $\langle g, w\rangle \in c$ where Sue is childless in w, as we have just seen; so c' is just the pairs $\langle g, w\rangle \in c$ such that Sue is not childless in w.

8 This is true in nearly every dynamic semantic system, with a few important exceptions. See Karttunen 1976, Groenendijk and Stokhof 1990, 1991, Dekker 1993, van den Berg 1996, Krahmer and Muskens 1995, Rothschild 2017, Gotham 2019, Hofmann 2019, Elliott 2020 for discussion of the issue and some exceptions.

b. It's not the case that Sue isn't a parent. She's at boarding school.

The doubly-negated indefinite in (7-a), like the non-negated indefinite 'Sue has a child', seems to license subsequent anaphora to Sue's child—in striking contrast to the doubly-negated indefinite in (7-b), which only seems to naturally license subsequent anaphora to Sue. This is brought out more naturally by question/answer pairs like those in (8):

(8) a. - Sue doesn't have a child. - That's not true! She's at boarding school.
b. - Sue isn't a parent. - That's not true! She's at boarding school.

Furthermore, this problem with negation infects other environments, in particular disjunction.[9] As Heim, citing Partee, observes, negated indefinites in left disjuncts license definites in right disjuncts. Compare:

(9) a. Either Sue doesn't have a child, or she's at boarding school.
b. Either Sue isn't a parent, or she's at boarding school.

Only in (9-a) can 'she' be naturally interpreted as referring to Sue's child. But this is not captured by dynamic semantics. The natural, and standard, thing to say about disjunction in a dynamic system is that $c[p \vee q] = c[p] \cup c[\neg p][q]$. Thus $c[\neg r \vee q] = c[\neg r] \cup c[\neg\neg r][q]$. What we want is for this to come out equivalent to $c[\neg r] \cup c[r][q]$—then indefinites in r would be accessible to definites in q. But, because double negation elimination is not valid, this is not what we get, and so we won't be able to predict that the pronoun in the right disjunct of (9-a) is licensed by the negated indefinite in the left disjunct.

Schematically, to account for the contrast in (9), we need the equivalence between $\neg p \vee q$ and $\neg p \vee (p \& q)$; that is, we need to predict that (9-a) is equivalent to 'Either Sue doesn't have a child, or she has a child and she is at boarding school'. But, while this equivalence holds in classical logic, it doesn't hold in dynamic systems, because double negation elimination is invalid.

9 For a different set of problems with negation in dynamic semantics, which are important but which I won't try to address here, see Lewis 2020.

5 Pseudo-dynamics

These problems with negation and disjunction are worrying enough to motivate taking a second look at the foundations of dynamic semantics. If we want to follow dynamic semantics in holding that indefinites have open scope to their right—as I think we should—then we need *something* non-classical in our system, since, of course, classical predicate logic cannot predict the equivalence between ⌜Something is (F and G)⌝ and ⌜Something is F, and it is G⌝. But the present problems suggest that dynamic semantics goes too far in its non-classicality.

In this section I will lay out a new theory which, like dynamic semantics, predicts the open scope of indefinites—and thus accounts for the key contrasts that motivate dynamic semantics—but which is more conservative, logically and foundationally, than dynamic semantics. In particular, my theory has a classical logic, meaning that it validates double negation elimination and thus avoids the two problems just surveyed.

My *pseudo-dynamic* system starts with the classical treatment of indefinites as existential quantifiers. Then I propose that indefinites with the form ⌜Something$_x$ is Fx⌝ have a *witness presupposition* which requires, at $\langle g, w\rangle$, that, if *anything* is F in w, then $g(x)$ is. This witness presupposition guarantees that indefinites license subsequent definites, which are interpreted as variables which presuppose that they are indexed to a familiar variable. But indefinites are still, truth-conditionally speaking, just existential quantifiers. The connectives, too, are classical, which means that the underlying logic is classical; and the notion of content is static.

My system builds on an existing tradition in the literature. Krahmer and Muskens (1995), van den Berg (1996), Rothschild (2017), Elliott (2020) all propose solutions to the double negation problem which exploit semantic partiality or multidimensionality; Krahmer and Muskens (1995)'s bilateral account of indefinites in particular is an important precedent for my witness presupposition (cf. also Onea 2013). And unpublished work in Schlenker 2011, Chatain 2017 develops systems which exploit static local contexts, like mine. My system differs from these in many obvious ways, but I want to flag them as precedents.

5.1 Truth and falsity

I will start, in this subsection, by introducing the language I will work with and the main semantic entries for that language. This is all fairly standard; all of the interesting action will come in the next sections, when I introduce the presuppositions of indefinite and definites.

I work with a standard predicative language[10] closed under the definite article ιx ('the') and indefinite article $\text{ɜ}x$ for any variable x. (I use ɜ for the indefinite because I reserve $\exists$ for the classical existential quantifier.) For any (possibly open) sentence p, $\text{ɜ}xp$ stands for ⌜Something is a p⌝ or ⌜There is a p⌝. ιxp is term, standing for ⌜The p⌝.

The main semantic values of our language are those of classical logic, with indefinites getting the truth-conditions of existential quantifiers, and definites receiving the semantic value of the corresponding variable:[11]

- *Variables, definites*: $[\![x]\!]^{g,w} = [\![\iota xp]\!]^{g,w} = g(x)$ provided g is defined on x.
- *Atoms*: $[\![A(\tau_1, \tau_2, \dots \tau_n)]\!]^{g,w} = 1$ iff $\langle [\![\tau_1]\!]^{g,w}, [\![\tau_2]\!]^{g,w}, \dots [\![\tau_n]\!]^{g,w} \rangle \in \mathfrak{I}(A,w)$.
- *Conjunction*: $[\![p \& q]\!]^{g,w} = 1$ iff $[\![p]\!]^{g,w} = [\![q]\!]^{g,w} = 1$.
- *Disjunction*: $[\![p \vee q]\!]^{g,w} = 1$ iff $[\![p]\!]^{g,w} = 1$ or $[\![q]\!]^{g,w} = 1$.
- *Negation*: $[\![\neg p]\!]^{g,w} = 1$ iff $[\![p]\!]^{g,w} = 0$.
- *Indefinites*: $[\![\text{ɜ}xp]\!]^{g,w} = 1$ iff $\exists a \in D : [\![p]\!]^{g[x \to a],w} = 1$.

These are, again, just the standard interpretation rules for classical predicate logic under the translation which takes indefinites to existential quantifiers, and definites to variables.[12]

10 Comprising variables $x_i : i \in \mathbb{I}$ (usually written $x, y, z \dots$) and atoms $A(\tau_1, \tau_2, \dots \tau_n)$ (for any n-ary relation symbol A and terms $\tau_i : i \in [1,n]$), and closed under the two-place connectives & ('and') and $\vee$ ('or') and one-place operator $\neg$ ('not'). I reserve '$\wedge$' for classical conjunction.

11 $[\![\varphi]\!]^{g,w}$ is the main semantic value of φ at a partial assignment g and world w; $\mathfrak{I}$ is an interpretation function from n-ary predicates and worlds to n-tuples of individuals (I assume fixed domains across worlds); $g_{x \to a}$ is the variable assignment just like g but which takes x to a; D is the domain of the model. τ_i ranges over terms, which comprise definites and variables, p and q over (possibly open) sentences. I assume bivalence: if a sentence is not true ('1') at $\langle g, w \rangle$ it is false ('0') there.

12 It is perhaps implausible to give definites and indefinites different semantic types (though not a new suggestion). However, it is fairly straightforward to eliminate this feature of the present system by making

5.2 Witness presuppositions of indefinites

In addition to truth and falsity conditions, our system will have *presuppositions*, and it is in the presuppositional dimension that we capture the interactions of indefinites and definites.[13]

The centerpiece of my proposal is that indefinites have a *witness presupposition* which says that if their scope is true relative to *any* assignment, then their scope is true relative to the starting assignment. In other words:[14]

- *Witness presupposition*: $\mathtt{3}xp$ presupposes at $\langle g,w\rangle$ that $(\exists a \in D : [\![p]\!]^{g[x\to a],w} = 1) \to [\![p]\!]^{g,w} = 1$

So, for instance, an indefinite with the form $\mathtt{3}x(cat\ x)$ presupposes that, if *anything* is a cat in w, then $g(x)$ is. This will be our way of ensuring that indefinites 'open up a file' on x: they do so by ensuring that, throughout the context, x is assigned to a witness of the corresponding existential quantifier.

We can equivalently formulate the witness presupposition in terms of the classical existential quantifier by saying that $\mathtt{3}xp$ presupposes at $\langle g,w\rangle$ that $[\![\exists xp]\!]^{g,w} = 1 \to [\![p]\!]^{g,w} = 1$.

5.3 Familiarity presuppositions of definites

Definites have a corresponding presupposition that they are indexed to a 'familiar' variable, as in Heim's system. In other words, in Heim's metaphor, while indefinites *open* files, definites presuppose that a file has *already* been opened on their variable, and that whatever information is in their scope is already contained in that file.

To implement this idea, we add a context parameter to our points of evaluation. Contexts will be just like Heimian contexts, i.e. sets of pairs of (possibly partial) variable

indefinites terms, too (as in Heim's system); if we go that way, we have to let indefinites move and bind traces.

13 I treat presuppositions as a separable dimension of content from truth/falsity. In this I follow the multi-dimensional tradition of Herzberger 1973 (who credits Buridan) and Peters 1977; see Mandelkern 2016, Dorr and Hawthorne 2018 for recent motivation for this kind of approach.

14 Many thanks to Keny Chatain for suggesting this formulation of the witness presupposition based on a much more tortuous earlier version.

assignments and worlds. Contexts in our system will never affect truth or falsity; this will be crucial in preserving a classical logic for the system. Instead, contexts come into the picture only in checking the presupposition of definites, which requires that the definite's scope be true throughout the context:

- *Familiarity presupposition*: ιxp presupposes at $\langle c, g, w\rangle$ that $\forall \langle g', w'\rangle \in c : [\![p]\!]^{c,g',w'} = 1$

Pronouns can be treated as definites with tautological restrictors, so a sentence like $\ulcorner F(\text{she})\urcorner$ gets parsed as $F(\iota x \top x)$, where $\top x$ is an arbitrary tautological predicate free in x. The familiarity presupposition for pronouns thus simply requires that $\top x$ is true at each $\langle g, w\rangle$ in its context, which in turn is simply the requirement that $g(x) \neq \#$. So pronouns require that their variable be familiar, in the sense of being defined throughout their context; definite descriptions require that the variable be familiar in this sense and also that their restrictor be true at every point in the context.

5.4 Updating

Although there is more to do in laying out the system, we are now in a position to see roughly how things will fit together. We assume that updating a context c with a sentence p results in a subsequent context which comprises exactly the points in c where p is true and has its presuppositions satisfied (for brevity, I will use 'satt' for 'has its presuppositions satisfied').[15] Now, suppose that we have updated our context c with the indefinite $\epsilon x(cat\, x)$. Then the resulting context will comprise exactly the pairs $\langle g, w\rangle \in c$ such that there is a cat in w (the contribution of the classical truth-conditions) *and* $g(x)$ is a cat in w (the contribution of the witness presupposition). This, in turn, means that a subsequent sentence containing a definite like $Brown(\iota x cat\, x)$ will have its familiarity presupposition satisfied throughout this new context; and thus updating

15 This is a departure from the standard account of the role of presuppositions in update given in Stalnaker 1974 and incorporated into dynamic semantics (Heim 1983). On that account, if we are trying to update c with p, then p has to have its presuppositions satisfied *throughout* c; if its presuppositions fail to be satisfied at any point in c, then the update will fail. If we took on this Stalnakerian assumption, then updating with indefinites would lead to constant crashes: when we update a context with, say, ϵxFx, we don't want to have a crash just because there are some points $\langle g, w\rangle$ in the context where $g(x)$ is not in F_w (the extension of F at w). This is why I assume that when we update c with p, we simply keep all the points from c where p is true and satt. This raises the important question of how to integrate theories of semantic presupposition into my theory: an important question, but not one I will address here.

the context with $Brown(\iota x cat\ x)$ will just have the effect of preserving the points $\langle g, w\rangle$ where the cat $g(x)$ is brown in w.

In more detail, suppose we are in a null context c (i.e. one comprising all pairs of (possibly) partial assignments and worlds). Someone says, 'There is a cat'. This gets parsed $\mathrm{з}x(cat\ x)$. We update by keeping all and only points $\langle g, w\rangle$ from c such that $\mathrm{з}x(cat\ x)$ is both true and satt at $\langle c, g, w\rangle$. Consider an arbitrary point $\langle g, w\rangle \in c$. Recall that $\mathrm{з}$ has the *truth* conditions of the existential quantifier, so $\mathrm{з}x(cat\ x)$ is *true* at $\langle g, w\rangle$ iff there is a cat in w. Suppose first that w has no cats; then our sentence is false at $\langle g, w\rangle$ and so we eliminate this point. Suppose next that there is a cat in w. Then our sentence is true at $\langle g, w\rangle$. But this isn't enough for this point to survive; we must also check whether our sentence's witness presupposition is satisfied. That presupposition says that, if w has a cat, then $g(x)$ is a cat in w. Since w does have a cat, by hypothesis, the witness presupposition is thus satisfied iff $g(x)$ is a cat in w. So, $\langle g, w\rangle$ survives update with $\mathrm{з}x(cat\ x)$ iff $g(x)$ is a cat in w.

This brings out an important fact about our system. The *update effect* of an indefinite is the same as the update effect of the corresponding open sentence: updating a context with $\mathrm{з}x(cat\ x)$ results in the same set of points as updating with *cat x* would.

This, in turn, is the key to the subsequent licensing of anaphora. Let c' be the context that results from updating c with $\mathrm{з}x(cat\ x)$. Note that, in c', not only does every world contain cats, but also every variable assignment assigns x in particular to something that is a cat in its paired world. Suppose that someone now says 'The cat is named Superman', parsed as $named\text{-}Superman(\iota x\ cat\ x)$. Consider an arbitrary point $\langle g, w\rangle$ in c'. $named\text{-}Superman(\iota x\ cat\ x))$ has its familiarity presupposition satisfied at $\langle g, w\rangle$ iff, for every point $\langle g', w'\rangle \in c'$, $g'(x)$ is a cat in w'. This is guaranteed to hold because of our update with the corresponding indefinite. And $named\text{-}Superman(\iota x(cat\ x))$ is true at $\langle g, w\rangle$ iff the corresponding open sentence *named-Superman(x)* is true iff $g(x)$ is named Superman in w.

Putting these two updates together, a point $\langle g, w\rangle$ in c survives update with $\mathrm{з}x(cat\ x)$ and then $named\text{-}Superman(\iota x(cat\ x)))$ just in case $g(x)$ is a cat named Superman in w. Things work in essentially the same way for pronouns;[16] updating with 'There is a cat.

16 'It is named Superman' gets parsed $named\text{-}Superman(\iota x \top x)$. The familiarity presupposition requires that, for all points $\langle g, w\rangle$ in c', $g(x)$ is defined. But this will hold thanks to the preceding indefinite.

It is named Superman' has exactly the same effect as updating with 'There is a cat. The cat is named Superman'. Both take us to a context which comprises exactly those points $\langle g, w\rangle$ from the initial context where $g(x)$ is a cat named Superman in w.

Note something important in the calculation of familiarity presuppositions: since the familiarity presupposition quantifies universally over points in the context, it will hold at either all or none of them. This is what accounts for the infelicity that results from asserting a definite without a corresponding indefinite.[17] This is very different from the witness presuppositions of indefinites, which, crucially, can be satisfied at some points in a context and not at others. I am thinking about witness presuppositions as being much like gender or number presuppositions on pronouns or demonstratives—as guides to interpretation which help us trace anaphoric dependencies through conversation. Think about the way, say, the gender presupposition of 'She is purring' helps us understand who the speaker is talking about, when both a male and female cat are present, without intuitively adding to the main content of the sentence.[18] In the same way, indefinites' witness presupposition help us keep track of individuals, so that we can update with further information as the conversation proceeds. There is a deep similarity here to Heim's file card system: in our system, asserting $\exists x F x$ 'opens a file' on x by making x defined at every point in the updated context, and adds to this file the information that x is F by ensuring that this holds at every point in the context. Asserting a definite $G(\iota x F x)$ is then licensed, in the sense that its familiarity presupposition is satisfied throughout the context, because a file has been opened on x that contains the information that F. The definite adds to the file the further information that x is G. So, abstractly, our system is very similar to Heim's. But, crucially, we mimic Heimian opening and updating of file cards without the apparatus of dynamic semantics.

Let's look, finally, at the update effect of a negated indefinite, like 'There is not a cat', parsed as $\neg\exists x(cat\ x)$. Consider any point $\langle g, w\rangle \in c$. $\neg\exists x(cat\ x)$ is true at $\langle g, w\rangle$ iff its negatum is false iff there is no cat in w. Suppose this holds. $\neg\exists x(cat\ x)$ is satt iff

17 Of course, definites can also be accommodated, as Heim 1982 and many since discuss at length. As Heim discusses, there is a spectrum of difficulty in accommodation from pronouns (hardest) to definite descriptions to possessives (easiest). Heim speculates that this is because of the increasing amount of descriptive material across this spectrum, which serves as an aide to accommodation.

18 See Sudo 2012 for extensive recent discussion; compare a similar use of presuppositions in the theory of modality in Mandelkern 2019.

its witness presupposition (which projects through negation—more in a moment) is satisfied, which holds just in case, if there is a cat in w, then $g(x)$ is a cat in w. But, by assumption, there's no cat in w; so the witness presupposition is (trivially) satisfied. So $\langle g, w \rangle$ survives update with $\neg \exists x(cat\ x)$ just in case w has no cats.

In general, whenever an indefinite sentence is false, its witness presupposition is trivially satisfied, and thus inert. So *negated indefinites* are always satt (modulo any presuppositions of their scope), meaning that negated indefinites have exactly the same update effect as the corresponding negated existential quantifiers. This means that we capture the strong, intuitively universal, meaning of negated indefinites. (Since the update with negated indefinites only cares about the world parameter, updating with a negated indefinites does not license subsequent definites, as desired.)

6 Logic

So far, we have shown that updating works in much the same way in our system as in dynamic semantics. Now I will show that my system also captures the intra-sentential dynamics of anaphora—and that it does a better job at this than dynamic semantics, avoiding the problems with negation and disjunction that we observed above.

In order to spell this out, we need to add a final piece to our theory. Since our system contains presuppositions, we need to say how they project out of complex sentences: i.e., what the presuppositions are of a complex sentence in terms of the presuppositions of its components. Here we can simply follow one standard approach: that of Schlenker 2009, 2010, who develops a theory of *local contexts* to account for presupposition projection in a broadly static framework. So, for instance, the local context for a right conjunct will be the set of points from the global context where the left conjunct is both true and satt; the local context for a negated sentence is the global context; and the local context for a right disjunct is the set of points from the global context where the left conjunct is both false and satt. Then we simply say that a sentence has its presupposition satisfied iff every part of that sentence has its presuppositions satisfied relative to its local context.

In the appendix, I unpack this generalization, spelling out recursive projection conditions for our language. For the present, this informal characterization suffices.

6.1 Open scope of indefinites

Recall that one standard way to formulate the key generalization about indefinites which motivates dynamic semantics is to say that indefinites have open scope to their right: ⌜Something is (F and G)⌝ is in some sense equivalent to ⌜Something is F, and [it/the F] is G⌝. Thus, for instance, we saw above that ‘Sue has a child, and she is at boarding school’ is intuitively equivalent to ‘Sue has a child at boarding school’; while ‘Sue is a parent, and she is at boarding school’ is intuitively equivalent to ‘Sue is a parent at boarding school’.

In our language, the claim that indefinites have open scope to their right can be formulated as the claim that the three variants in (10) are equivalent (where p and q are any sentences in our language and $q(\iota xp)$ is the sentence obtained from q by replacing every instance of x in q with ιxp):[19]

(10) a. $\exists x(p \& q)$ — *Something is (p and q)*
b. $\exists x(p) \& q(\iota xp)$ — *Something is p, and the p is q*
c. $\exists x(p) \& q(\iota x \top x)$ — *Something is p, and it is q*

In what sense are (10-a)–(10-c) equivalent in our system? *Not* in the sense of being logically equivalent. p logically entails q (written $p \models q$) just in case for any index i in any model satisfying the semantic clauses given above, if p is true at i then q is true at i; p and q are logically equivalent ($p \dashv\models q$) iff each logically entails the other. It is easy to find points $\langle g, w\rangle$ where sentences with the form of (10-a) are true but (10-b) and (10-c) are false. For instance, assume that p and q are one-place predicates; then find a point $\langle g, w\rangle$ where $p_w \cap q_w$ is non-empty, and $g(x) \notin q_w$ (p_w is the extension of p at w). Then (10-a) will be true at $\langle g, w\rangle$, while (10-b) and (10-c) will both be false there.

But you will have noticed that, while (10-a) is is true at $\langle g, w\rangle$, its witness presupposition is not satisfied—there is something in $p_w \cap q_w$, but $g(x)$ is not in $p_w \cap q_w$. This points the way towards the sense in which (10-a)–(10-c) are equivalent: they have the same truth-value *provided their presuppositions are satisfied*. More precisely, following (von Fintel 1999), say that p *Strawson entails* q ($p \models_{st} q$) iff, for any index i in any model satisfying the semantic clauses above, if p and q are both satt at i and p is true

19 I focus on conjunction here, but the same points go for sequences of indefinites and definites.

at i, then q is true at i. Say that p and q are Strawson equivalent ($p \dashv\models_{st} q$) iff each Strawson entails the other. It is in *this* sense that (10-a)–(10-c) are (pairwise) equivalent.

The reasoning behind this is simple. For any point $i = \langle c, g, w\rangle$, suppose (10-a) is satt and is true at i. As we have seen, this holds just in case $g(i) \in p_w \cap q_w$.[20] It is easy to verify that this is exactly what is required for (10-b) or (10-c) to be true and satt. Both have a familiarity presupposition arising from the definite in the right conjunct. In both cases, this presupposition is guaranteed to be satisfied, because it will be assessed relative to a local context which has been updated with the corresponding indefinite in the left conjunct (since the local context for a right conjunct entails the left conjunct). (10-b) and (10-c) are true at $\langle g, w\rangle$ provided something is in p_w and $g(x) \in q_w$; they are satt provided that their indefinites' witness presupposition is satisfied, iff $g(x) \in p_w$. So both are satt and true iff $g(x) \in p_w \cap q_w$.

Another way to see that this holds is to note, again, that indefinites and definites are Strawson equivalent to the corresponding open sentences. So all the sentences in (10-a)–(10-c) are also Strawson equivalent to $p\&q$.

Thus indefinites, in our system, have open scope in the sense that the sentences in (10-a)–(10-c) are pairwise Strawson equivalent. It is crucial, however, that we do *not* predict these to be logically equivalent, because this lets us retain a logic which is overall much more conservative than the standard logic of dynamic semantics: by locating the open scope of indefinites in a separate presuppositional dimension, we are able to account for the open scope of indefinites without adopting a non-classical logic.

6.2 Classicality

Recall the two closely related problems discussed in §4: in dynamic semantics, $\neg\neg p$ and p are not always equivalent; nor are $\neg p \vee q$ and $\neg p \vee (p\&q)$.

Our system avoids these problems, in a striking and simple way. Since our connectives are classical, the logic of our system just is the logic of classical predicate logic, under the obvious translation schema (i.e. the schema $'$ which takes $\varepsilon x p$ to $\exists x(p')$ and takes $\iota x p$ to x and is otherwise defined in the obvious way).[21] That is, for any sentences

20 I continue to assume for simplicity that p and q are one-place predicates, so p_w and q_w are their extensions at w; but the reasoning goes through in general.

21 I.e. $(p\&q)' = p' \wedge q'$, $(p \vee q)' = p' \vee q'$, $(\neg p)' = \neg p'$, and $x_i' = x_i$.

p and q in our language, $p \models q$ in the pseudo-dynamic system iff $p' \models q'$ in classical predicate logic.

Thus in particular, since $\neg\neg p \dashv\models p$ in classical predicate logic, $\neg\neg p \dashv\models p$ in our system. Likewise, $\neg p \vee q \dashv\models \neg p \vee (p \& q)$ in our system.

Importantly, the Strawson logic of any system is always a superset of the system's logic: that is, if $p \models q$, then $p \models_{st} q$. This is for the obvious reason that, if $p \models q$, then q is true at any point in any model where p is, and thus a fortiori q is true at any point where p and q are satt and p is true. So we also have $\neg\neg p \dashv\models_{st} p$, and likewise that $\neg p \vee q \dashv\models_{st} \neg p \vee (p \& q)$.

The basic reasoning behind all this, again, is very simple: our connectives are, at the level of truth and falsity, just the classical connectives, and so all classical equivalences also hold in our system.

More concretely, doubly negated indefinites will thus license subsequent definites, as desired. 'It's not the case that Susie doesn't have a child' will be parsed $\neg\neg(\exists x(\textit{child-of-Susie}(x)))$. This will be semantically equivalent to $\exists x(\textit{child-of-Susie}(x))$, and thus license subsequent definites like 'She/The child is at boarding school' ($\textit{at-boarding-school}\ (\iota x \top x)$). Similarly for disjunctions like 'Either Susie doesn't have a child, or she is at boarding school' $(\neg \exists x(\textit{child-of-Susie}(x))) \vee (\textit{at-boarding-school}(\iota x \top x))$. The local context for $\iota x \top x$ will only include points where the negation of the left disjunct is true and satt, which holds at a point iff the indefinite $\exists x(\textit{child-of-Susie}(x))$ is true and satt there; thus the local context will only contain pairs $\langle g, w \rangle$ where $g(x)$ is a child of Susie's in w. That means that the familiarity presupposition of the definite will be satisfied. The whole sentence will thus be true and satt at $\langle c, g, w \rangle$ iff either Susie is childless in w; or (i) $g(x)$ is Susie's child in w (this follows from the indefinite's witness presupposition, which projects to the whole sentence) and (ii) $g(x)$ is at boarding school in w.

Our system thus avoids the problem that negation and disjunction pose for dynamic systems. This is not because of a local fix but because of its classical logical architecture. This distinguishes it from essentially every dynamic semantic system, which depart in a wide variety of ways from classical logic.[22]

22 Thus in addition to invalidating double negation elimination, many systems invalidate the laws of non-contradiction and excluded middle; see Mandelkern 2020 for discussion.

7 Quantifiers

This concludes the exposition and discussion of my basic system. Before concluding, I want to briefly discuss how generalized quantifiers like 'every' and 'most' can be added. This is important given how central a role donkey sentences have played in the literature on anaphora, though my discussion of this complicated area will necessarily be very brief.

Recall the core data we are trying to capture in the interaction between quantification and anaphora, namely the co-variation between 'a child' and 'it/the child' in a sentence like (11-a), and the unavailability of a co-varying reading in (11-b):

(11) a. Everyone who has <u>a child</u> loves <u>it/the child</u>.
b. Every parent loves [it/the child].

In standard fashion, we assume quantifiers like 'every' take three arguments: an unpronounced domain δ, restrictor, and scope. Instead of treating the domain as a set of individuals, we treat it as a non-empty set of pairs of individuals and variable assignments. Given this set, we proceed in the natural way: for instance, 'every' and 'most' will get the following truth-conditions:

- $[\![\text{EVERY}x_\delta(p,q)]\!]^{g,w}{=}\,1$ iff $\forall\langle a,g'\rangle \in \delta : [\![p]\!]^{g'_{[a\to x]},w} = 1 \to [\![p\&q]\!]^{g'_{[a\to x]},w} = 1$
- $[\![\text{MOST}x_\delta(p,q)]\!]^{g,w}{=}\,1$ iff for most $\langle a,g'\rangle \in \delta$ s.t. $[\![p]\!]^{g'_{[a\to x]},w} = 1, [\![p\&q]\!]^{g'_{[a\to x]},w} = 1$

We also assume that quantifiers have presuppositions, specifically about the domain parameter. The basic idea is that the domain parameter should not contain duplicates (each individual should be in a pair in the domain only once); it should contain only pairs that make the restrictor and scope satt; and, finally, it should only contain assignments which agree with the starting assignment, except possibly on variables which are bound by indefinites in the restrictor or scope. In more detail, a quantified sentence $Qx_\delta(p,q)$ is satt iff these three conditions hold:

- $\langle a,g'\rangle \in \delta \to (\forall\langle a',g''\rangle \in \delta : a' = a \to g'' = g')$. In other words, each individual a is included in at most one pair in δ (this is crucial for avoiding the 'proportion problem' which arises for some versions of dynamic semantics).

- $\langle a, g' \rangle \in \delta \rightarrow p\&q$ is satt at $\left\langle c, g'_{[a \rightarrow x]}, w \right\rangle$. This is crucial for ensuring that (i) definites in p and q are satt (if they weren't, then δ would be empty, contrary to assumption); and (ii) indefinites have their witness presuppositions satisfied relative to the variable assignments in δ.

- $\langle a, g' \rangle \in \delta \rightarrow g' \sim_{p\&q} g$, where, for any sentence p, $g' \sim_p g$ iff g' and g agree on all variables except for those which "introduced" by p. In essence, a variable is introduced by p iff it is bound by an indefinite or free in p. More precisely, let ω be the null context, comprising the set of all (possibly) partial variable assignment-world pairs. x is *introduced by p* just in case ω^p is non-empty and x is familiar in ω^p.

The basic idea is that principles of charity will lead interlocutors to interpret the intended domain as being one which satisfies these constraints, so that the whole sentence is satt.

For sentences without (in)definites, the variable assignments in δ don't do any interesting work. So, e.g., $\text{EVERY}x_\delta(\textit{farmer}(x), \textit{tall}(x))$ is true just in case every individual in any pair in δ who is a farmer in w is tall in w.

The more interesting case is that of a donkey sentence like (11-a), repeated here, with the parse in (12-b):

(12) a. Everyone who has <u>a child</u> loves <u>it</u>.

b. $\text{EVERY}x_\delta(\underbrace{\exists i(\textit{child-of-x}(i))}_{p}, \underbrace{\textit{x-loves}(\iota i \top i)}_{q})$

Suppose (12-b) is satt in $\langle c, g, w \rangle$. (12-b) is true in $\langle c, g, w \rangle$ iff for every pair $\langle a, g' \rangle \in \delta$, if p is true at $\left\langle c, g'_{[a \rightarrow x]}, w \right\rangle$, then so is $p\&q$. Consider an arbitrary pair $\langle a, g' \rangle \in \delta$. Given that p is satt at $\left\langle c, g'_{[a \rightarrow x]}, w \right\rangle$, it is true at $\left\langle c, g'_{[a \rightarrow x]}, w \right\rangle$ iff $g'(i)$ is a child of a, false iff a is childless. If false, then $\langle a, g' \rangle$ doesn't count against the truth of (12-b). If true, then $p\&q$ must also be true at $\left\langle c, g'_{[a \rightarrow x]}, w \right\rangle$ in order for (12-b) to be. Given that $p\&q$ is satt at $\left\langle c, g'_{[a \rightarrow x]}, w \right\rangle$, it is true there iff a loves their child $g(i)$. So, (12-b) is true and satt at $\langle c, g, w \rangle$ iff, for every a in (some pair in) the domain, if a has a child in w, then a loves a child of theirs in w. We thus derive the standard dynamic update effect for quantified donkey sentences.[23]

By contrast, a co-varying reading will not be available for a sentence like (11-b):

(11-b) Every parent loves [it/the child].

This is for a simple reason: because there is no indefinite corresponding to the definite in (11-b), the variable the definite is indexed to won't count as being introduced by the restrictor or scope; and thus we don't get to vary children with parents in assessing the sentence. Instead, for (11-b) to be satt, the definite in (11-b) will have to have been introduced in the global context, and (11-b) will be interpreted as saying that some particular child is loved by every parent.

There is, again, a huge amount more to explore here, but this brief discussion shows the basic contours of how the pseudo-dynamic approach can make sense of donkey sentences.

8 Conclusion

There is a difference between indefinites like 'has a child' and 'is a parent'. This poses a challenge to the classical analysis of indefinites as existential quantifiers. Both dynamic semantics (which I have focused on here) and e-type theories captures this difference by rejecting (in different ways) classical notions of meaning and corresponding classical treatments of connectives. The pseudo-dynamic system I have presented here captures the contrast between pairs like this, but in a very different way from existing theories. Pseudo-dynamics separates the two characteristic contributions of indefinites: their existential import, which we locate in their truth-conditions; and their ability to license subsequent anaphora, which we locate in their presuppositions. This system avoids the specific problems for dynamic systems involving negation and disjunction explored above. But it also, more importantly, shows that we can pull apart many of the insights

23 Or at least, one of two standard readings. The other reading would say that everyone who has a child loves *every child they have*. It is famously difficult to distinguish these two readings, and there is controversy about whether these are really two readings or two pragmatic interpretations see e.g. Heim 1982, Root 1986, Rooth 1987, Schubert and Pelletier 1989, Chierchia 1992, Kanazawa 1994, Chierchia 1995, Champollion et al. 2019). This is a complicated issue that I won't take up here.

of dynamic semantics from its revisionary approach to content and connectives. In the pseudo-dynamic system, contents are set of indices, as in static systems. And the logic is just the logic of classical predicate logic. In these senses, the system is very conservative. All the *dynamic* action in the system comes via presuppositions; it is in the presuppositional domain that the logic extends classical logic—in particular predicting that indefinites have open scope to their right as a matter of Strawson (but not logical) validity.

There is obviously much more work to do in exploring the pseudo-dynamic system. We should look at extensions of the system to other key empirical domains, like modals, conditionals, attitude reports, and plural anaphora. We should explore questions of order: I have followed most of the literature in assuming there are order asymmetries in anaphora, which is represented in our system with the asymmetric calculation of local contexts. But the empirical situation is complicated; and, as Schlenker discusses with respect to presupposition, local contexts can just as easily be generated in a symmetric fashion, which means that we have more flexibility than standard dynamic systems in accounting for order symmetries. We should compare the pseudo-dynamic systems in more detail to other theories of anaphora. We should explore alternate systems broadly in the spirit of pseudo-dynamics: it is relatively straightforward to formulate nearby variations which have similar profiles of logical properties (though none that I have found seems as intuitive to me as the system I have presented here). Finally, we should explore further foundational questions about the system. This includes internal questions about the system along the lines of those asked in Lewis 2012, 2014, Chatain 2017, as well as work in progress by Keny Chatain which explores whether something like the witness presupposition could be seen to originate from the presuppositions of predicates; as well as questions about the relationship between anaphora, presupposition, and modality, where pseudo-dynamics contributes to a developing research program (Schlenker 2008, 2009, Dorr and Hawthorne 2013, Mandelkern 2019) which aims to capture the insights of dynamic semantics in systems that are more conservative, foundationally and logically.

Let me close with a high-level comment on the structure of pseudo-dynamics. In an illuminating discussion, Cumming (2015) identifies what he calls *the dilemma of indefinites*. On the one hand, they seem to have existential import: whether an indefinite sentence is true or false apparently depends just on the truth or falsity of the corresponding existential quantifier. Intuitively ‘Sue has a child’ is true just in case Sue is a parent, false otherwise, whether or not the speaker has a particular child in mind. If Sue is a parent, but John thinks she is the parent of Latif when in fact she is the parent of Arden, then ‘Sue has a child’ is as true when John says it with Latif in mind, as when I say it with Arden in mind. On the other hand, indefinites license subsequent anaphora in ways not predicted by a purely existential account: ‘Sue is a parent’ and ‘Sue has a child’ seem inequivalent when we look at how they contribute to environments like sequences of sentences, conjunctions, or quantifiers. Crudely speaking, the two main approaches to indefinites in the literature aim to generalize to one of these two faces. On e-type approaches, indefinites are, after all, just existential quantifiers; their ability to license subsequent anaphora is explained by appeal to pragmatic and/or syntactic reconstruction that they make available. On dynamic approaches, by contrast, indefinites are fundamentally variables; their existential import is explained by appeal to more complicated notions of context and truth, and a quantificational treatment of negation.

Pseudo-dynamics suggests a synthesis: both faces of indefinites are present, but in different dimensions of content. At the level of truth-conditions, indefinites are existential quantifiers. At the level of presupposition, they do more: they require the presence of a witness to their truth, a witness that enables subsequent coreference with definites. These presuppositions help us keep track of anaphoric relations, and thus follow the twists and turns of conversation. But they do so on top of a classical system, explaining the validity of classical inference patterns, and accounting for the existential import of indefinites.

A Semantics

I summarize the semantics given in the text. I will use $\langle\!\langle \cdot \rangle\!\rangle^{c,g,w}$ as a function from an expression to a pair of values. The first value is either ‘satt’ or ‘not satt’ (‘S’ and ‘N’, respectively); the second value is the expression’s main semantic value (in the sentential case, ‘1’ abbreviates ‘true’ and ‘0’ ‘false’). I use $*$ to range over possible semantic values, so e.g. $\langle\!\langle p \rangle\!\rangle^{c,g,w} = \langle *, 1 \rangle$ abbreviates $\langle\!\langle p \rangle\!\rangle^{c,g,w} \in \{\langle S, 1 \rangle, \langle N, 1 \rangle\}$ and means that p is true at $\langle c, g, w \rangle$, whether or not it has its presupposition satisfied. $\langle\!\langle \cdot \rangle\!\rangle_1^{c,g,w}$ is the first (presuppositional) value, $\langle\!\langle \cdot \rangle\!\rangle_2^{c,g,w}$ is the second (main) value. As a notational convenience, where g is a partial assignment, I will treat g as a total assignment which takes any variable where g is undefined to an individual # of which no predicate is true (i.e. which is such that, for any sequence of individuals $\vec{v} = \langle a_1, a_2, \dots a_n \rangle$, if $\exists i \in [1,n] : a_i = \#$, then $\forall A, w : \vec{v} \notin \mathfrak{I}(A,w)$).

For any context c and sentence p, $c^p = \{\langle g,w \rangle \in c : \langle\!\langle\, p \,\rangle\!\rangle^{c,g,w} = \langle 1,1 \rangle\}$. The presupposition projection rules in general say that a complex sentence is satt iff every part is satt, relative to its local context. In the case of (in)definites indexed to x_i, we require that their scope be satt relative to some x_i-variant. The reason for this is that we do not want, say, a negated indefinite with the form $\neg \mathrm{з} x F x$ to require at $\langle g,w \rangle$ that g be defined on x. For quantifiers, again, the projection rules concern the elements in the associated domain.

Our semantic clauses are then as follows:

- $\langle\!\langle\, x \,\rangle\!\rangle^{c,g,w}$

$$= \langle S, * \rangle \text{ iff } g(x) \neq \#$$
$$= \langle *, g(x) \rangle$$

- $\langle\!\langle\, A(\tau_1, \tau_2, \dots \tau_n) \,\rangle\!\rangle^{c,g,w}$

$$= \langle S, * \rangle \text{ iff } \forall i \in [1,n] : \langle\!\langle\, \tau_i \,\rangle\!\rangle_1^{c,g,w} = S$$
$$= \langle *, 1 \rangle \text{ iff } \left\langle \langle\!\langle\, \tau_1 \,\rangle\!\rangle_2^{c,g,w}, \langle\!\langle\, \tau_2 \,\rangle\!\rangle_2^{c,g,w}, \dots \langle\!\langle\, \tau_n \,\rangle\!\rangle_2^{c,g,w} \right\rangle \in \mathfrak{I}(A,w)$$

- $\langle\!\langle\, p \& q \,\rangle\!\rangle^{c,g,w}$

$$= \langle S, * \rangle \text{ iff } \langle\!\langle\, p \,\rangle\!\rangle_1^{c,g,w} = \langle\!\langle\, q \,\rangle\!\rangle_1^{c^p,g,w} = S$$
$$= \langle *, 1 \rangle \text{ iff } \langle\!\langle\, p \,\rangle\!\rangle_2^{c,g,w} = \langle\!\langle\, q \,\rangle\!\rangle_2^{c^p,g,w} = 1$$

- $\langle\!\langle\, p \vee q \,\rangle\!\rangle^{c,g,w}$

$$= \langle S, * \rangle \text{ iff } \langle\!\langle\, p \,\rangle\!\rangle_1^{c,g,w} = \langle\!\langle\, q \,\rangle\!\rangle_1^{c^{\neg p},g,w} = S$$
$$= \langle *, 1 \rangle \text{ iff } \langle\!\langle\, p \,\rangle\!\rangle_2^{c,g,w} = 1 \text{ or } \langle\!\langle\, q \,\rangle\!\rangle_2^{c^{\neg p},g,w} = 1$$

- $\langle\!\langle\, \neg p \,\rangle\!\rangle^{c,g,w}$

$$= \langle S, * \rangle \text{ iff } \langle\!\langle\, p \,\rangle\!\rangle_1^{c,g,w} = S$$
$$= \langle *, 1 \rangle \text{ iff } \langle\!\langle\, p \,\rangle\!\rangle_2^{c,g,w} = 0$$

- $\langle\!\langle\, \mathrm{з} x p \,\rangle\!\rangle^{c,g,w}$

$$= \langle S, * \rangle \text{ iff}$$
$$\exists a \in D : \langle\!\langle\, p \,\rangle\!\rangle_1^{c,g_{[x \to a]},w} = S \text{ and}$$
$$(\exists a \in D : \langle\!\langle\, p \,\rangle\!\rangle_2^{c,g_{[x \to a]},w} = 1) \to \langle\!\langle\, p \,\rangle\!\rangle_2^{c,g,w} = 1$$
$$= \langle *, 1 \rangle \text{ iff } \exists a \in D : \langle\!\langle\, p \,\rangle\!\rangle_2^{c,g_{[x \to a]},w} = 1$$

- $\langle\!\langle\, \iota x p \,\rangle\!\rangle^{c,g,w}$

$$= \langle S, * \rangle \text{ iff}$$

Witnesses

$$\begin{aligned}
&\qquad \exists a \in D : \langle\!\langle\, p \,\rangle\!\rangle_1^{c,g_{[x\to a]},w} = S \text{ and} \\
&\qquad \forall \langle g', w' \rangle \in c : \langle\!\langle\, p \,\rangle\!\rangle_2^{c,g',w'} = 1 \\
&= \langle *, g(x) \rangle
\end{aligned}$$

- $\langle\!\langle\, \text{EVERY} x_\delta(p,q) \,\rangle\!\rangle^{c,g,w}$

$$\begin{aligned}
&= \langle S, * \rangle \text{ iff} \\
&\qquad \langle a, g' \rangle \in \delta \to (\forall \langle a', g'' \rangle \in \delta : a' = a \to g'' = g'); \\
&\qquad \langle a, g' \rangle \in \delta \to \langle\!\langle\, p\&q \,\rangle\!\rangle_1^{c,g'_{[a\to x]},w} = S; \text{ and} \\
&\qquad \langle a, g' \rangle \in \delta \to g' \sim_{p\&q} g. \\
&= \langle *, 1 \rangle \text{ iff } \forall \langle a, g' \rangle \in \delta : \langle\!\langle\, p \,\rangle\!\rangle_2^{c,g'_{[a\to x]},w} = 1 \to \langle\!\langle\, p\&q \,\rangle\!\rangle_2^{c,g'_{[a\to x]},w} = 1
\end{aligned}$$

- $\langle\!\langle\, \text{MOST} x_\delta(p,q) \,\rangle\!\rangle^{c,g,w}$

$$\begin{aligned}
&= \langle S, * \rangle \text{ iff} \\
&\qquad \langle a, g' \rangle \in \delta \to (\forall \langle a', g'' \rangle \in \delta : a' = a \to g'' = g'); \\
&\qquad \langle a, g' \rangle \in \delta \to \langle\!\langle\, p\&q \,\rangle\!\rangle_1^{c,g'_{[a\to x]},w} = S; \text{ and} \\
&\qquad \langle a, g' \rangle \in \delta \to g' \sim_{p\&q} g. \\
&= \langle *, 1 \rangle \text{ iff for most } \langle a, g' \rangle \in \delta \text{ s.t. } \langle\!\langle\, p \,\rangle\!\rangle_2^{c,g'_{[a\to x]},w} = 1, \langle\!\langle\, p\&q \,\rangle\!\rangle_2^{c,g'_{[a\to x]},w} = 1
\end{aligned}$$

References

Aloni, M. D. (2001). *Quantification Under Conceptual Covers*. PhD thesis, University of Amsterdam, Amsterdam.

Beaver, D. (2001). *Presupposition and Assertion in Dynamic Semantics*. CSLI Publications: Stanford, CA.

van Benthem, J. (1996). *Exploring Logical Dynamics*. Center for the Study of Language and Information, Stanford, CA.

van den Berg, M. (1996). *Some Aspects of the Internal Structure of Discourse: The Dynamics of Nominal Anaphora*. PhD thesis, ILLC, Universiteit van Amsterdam.

Brasoveanu, A. (2007). *Structured nominal and modal reference*. PhD thesis, Rutgers.

Büring, D. (2004). Crossover situations. *Natural Language Semantics*, 12:23–62.

Champollion, L., Bumford, D., and Henderson, R. (2019). Donkeys under discussion. *Semantics & Pragmatics*, 12(1):1–50.

Charlow, S. (2014). *On the Semantics of Exceptional Scope*. PhD thesis, NYU.

Chatain, K. (2017). Local contexts and anaphora. Handout, MIT.

Chierchia, G. (1992). Anaphora and dynamic binding. *Linguistics and Philosophy*, 15(2):111–183.

Chierchia, G. (1995). *Dynamics of Meaning: Anaphora, Presupposition, and the Theory of Grammar*. University of Chicago Press, Chicago, IL.

Cooper, R. (1979). The interpretation of pronouns. In Heny, F. and Schnelle, H. S., editors, *Syntax and Semantics*, volume 10, pages 61–92. Academic Press.

Cumming, S. (2015). The dilemma of indefinites. In Bianchi, A., editor, *On Reference*. Oxford University Press.

Dekker, P. (1993). *Transsentential Meditations: Ups and Downs in Dynamic Semantics*. PhD thesis, University of Amsterdam.

Dekker, P. (1994). Predicate logic with anaphora. In Harvey, M. and Santelmann, L., editors, *Semantics and Linguistic Theory (SALT)*, volume IV, pages 79–95.

Dorr, C. and Hawthorne, J. (2013). Embedding epistemic modals. *Mind*, 122(488):867–913.

Dorr, C. and Hawthorne, J. (2018). If...: A theory of conditionals. Manuscript, NYU and USC.

Egli, U. (1979). The Stoic concept of anaphora. In Bäuerle, R., Egli, U., and von Stechow, A., editors, *Semantics from Different Points of View*, pages 266–283. Springer, New York.

Elbourne, P. (2005). *Situations and Individuals*. MIT Press.

Elliott, P. D. (2020). Crossover and accessibility in dynamic semantics. Manuscript, MIT.

Evans, G. (1977). Pronouns, quantifiers and relative clauses. *Canadian Journal of Philosophy*, 7:467–536.

von Fintel, K. (1999). NPI licensing, Strawson entailment, and context dependency. *Journal of Semantics*, 16(2):97–148.

Geach, P. (1962). *Reference and Generality*. Cornell University Press.

Gotham, M. (2019). Double negation, excluded middle and accessibility in dynamic semantics. In Schlöder, J. J., McHugh, D., and Roelofsen, F., editors, *Proceedings of the 22nd Amsterdam Colloquium*, volume 22, pages 142–151.

Groenendijk, J. and Stokhof, M. (1990). Dynamic Montague grammar. In *University of Amsterdam Technical Report*. University of Amsterdam.

Groenendijk, J. and Stokhof, M. (1991). Dynamic predicate logic. *Linguistics and Philosophy*, 14(1):39–100.

Heim, I. (1982). *The Semantics of Definite and Indefinite Noun Phrases*. 2011 edition, University of Massachusetts, Amherst.

Heim, I. (1983). On the projection problem for presuppositions. In Barlow, M., Flickinger, D. P., and Wiegand, N., editors, *The West Coast Conference on Formal Linguistics (WCCFL)*, volume 2, pages 114–125. Stanford, Stanford University Press.

Heim, I. (1990). E-type pronouns and donkey anaphora. *Linguistics and Philosophy*, 13:137–177.

Herzberger, H. G. (1973). Dimensions of truth. *Journal of Philosophical Logic*, 2(4):535–556.

Hofmann, L. (2019). The anaphoric potential of indefinites under negation and disjunction. In Schlöder, J. J., McHugh, D., and Roelofsen, F., editors, *Proceedings of the 22nd Amsterdam Colloquium*, pages 181–190.

Kamp, H. (1981). A theory of truth and semantic representation. In et al., J. G., editor, *Formal Methods in the Study of Language*. Mathematisch Centrum.

Kanazawa, M. (1994). Weak vs. strong readings of donkey sentences and monotonicity inference in a dynamic setting. *Linguistics and Philosophy*, 17(2):109–158.

Karttunen, L. (1976). Discourse referents. In *Syntax and semantics: Notes from the linguistic underground*, volume 7. Academic Press.

Krahmer, E. and Muskens, R. (1995). Negation and disjunction in discourse representation theory. *Journal of Semantics*, 12:357–376.

Lewerentz, L. (2020). Situation pragmatics. Manuscript, Oxford.

Lewis, K. (2012). Discourse dynamics, pragmatics, and indefinites. *Philosophical Studies*, 158:313–342.

Lewis, K. (2014). Do we need dynamic semantics? In Burgess, A. and Sherman, B., editors, *Metasemantics: New Essays on the Foundations of Meaning*, chapter 9, pages 231–258. Oxford University Press, Oxford.

Lewis, K. (2020). Negation and anaphora. *Philosophical Studies*.

Lewis, K. S. (2019). Descriptions, pronouns, and uniqueness. MS, Columbia University.

Ludlow, P. (1994). Conditionals, events, and unbound pronouns. *Lingua e Stile*, 29:3–20.

Mandelkern, M. (2016). Dissatisfaction theory. In Moroney, M., Little, C.-R., Collard, J., and Burgdorf, D., editors, *Semantics and Linguistic Theory (SALT)*, volume 26, pages 391–416.

Mandelkern, M. (2019). Bounded modality. *The Philosophical Review*, 128(1):1–61.
Mandelkern, M. (2020). Dynamic non-classicality. *Australasian Journal of Philosophy*, 98(2):382–392.
Mandelkern, M. and Rothschild, D. (2020). Definiteness projection. *Natural Language Semantics*, 28:77–109.
Muskens, R. (1996). Combining Montague semantics and discourse representation. *Linguistics and Philosophy*, 19(2):143–186.
Neale, S. (1990). *Descriptions*. MIT Press, Cambridge, MA.
Nouwen, R. (2003). *Plural Pronominal Anaphora in Context*. PhD Thesis, Utrecht University, Netherlands Graduate School of Linguistics Dissertations 84. LOT.
Onea, E. (2013). Indefinite donkeys on islands. In *Proceedings of SALT 23*, pages 493–513.
Parsons, T. (1978). Pronouns as paraphrases. MS University of Massachusetts, Amherst.
Peters, S. (1977). A truth-conditional formulation of Karttunen's account of presupposition. In *Texas Linguistic Forum 6*. University of Texas at Austin.
Root, R. (1986). *The Semantics of Anaphora in Discourse*. PhD thesis, University of Texas at Austin.
Rooth, M. (1987). Noun phrase interpretation in Montague Grammar, File Change Semantics, and Situation Semantics. In Gärdenfors, P., editor, *Generalized quantifiers: Linguistic and Logical Approaches*, pages 237–268. Dordrecht Reidel, Netherlands.
Rothschild, D. (2017). A trivalent approach to anaphora and presupposition. In Cremers, A., van Gessel, T., and Roelofsen, F., editors, *Amsterdam Colloquium*, volume 21, pages 1–13.
Rothschild, D. and Yalcin, S. (2015). On the dynamics of conversation. *Noûs*, 51(1):24–48.
Rothschild, D. and Yalcin, S. (2016). Three notions of dynamicness in language. *Linguistics and Philosophy*, 39(4):333–355.
Schlenker, P. (2008). Be articulate: a pragmatic theory of presupposition projection. *Theoretical Linguistics*, 34(3):157–212.
Schlenker, P. (2009). Local contexts. *Semantics and Pragmatics*, 2(3):1–78.
Schlenker, P. (2010). Presuppositions and local contexts. *Mind*, 119(474):377–391.
Schlenker, P. (2011). On donkey anaphora. Handout of talk given at the Oxford-Paris Workshop (organized by D. Rothschild and M. Abrusán), All Souls College, Oxford.
Schubert, L. K. and Pelletier, F. J. (1989). Generically speaking, or, using discourse representation theory to interpret generics. In Chierchia, G., Partee, B., and Turner, R., editors, *Properties, Types, and Meaning, Volume II: Semantic Issues 39*, Studies in Linguistics and Philosophy, pages 193–268. Kluwer, Dordrecht, Netherlands.
Stalnaker, R. (1974). Pragmatic presuppositions. In Munitz, M. K. and Unger, P., editors, *Semantics and Philosophy*, pages 197–213. New York University Press, New York.
Sudo, Y. (2012). *On the Semantics of Phi Features on Pronouns*. PhD thesis, Massachusetts Institute of Technology.