Witnesses

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Draft of July 15, 2020

Abstract

What do indefinite expressions (like 'Sue has a child') and definite expressions ('The child is tall') mean? For well known reasons, classical treatments of indefinites as existential quantifiers, and definites as existential quantifiers with uniqueness presuppositions, apparently miss important generalizations about their meanings. An influential thread, starting with Kamp 1981, Heim 1982, aims to account for indefinites in a *dynamic* semantic framework, which takes a new perspective both on the meaning of (in)definites and on the nature of meaning more generally. This framework, however, has well-known problems with negation and disjunction. I develop a new theory on which indefinites have the *truth* and *falsity* conditions of existential quantifiers; but also have a *witness presupposition* which requires that, if their truth is witnessed by any individual, then that individual is assigned to the variable they bind. This approach accounts for the central desiderata of theories of (in)definites. But, locally, we avoid the particular problems negation and disjunction pose for dynamic semantics; globally, we maintain a much more conservative approach to the logic of (in)definites and the nature of meaning in general.

1 Introduction

What do indefinites and definites mean, and how do they interact? To get a feel for the questions involved, and the interest of the topic, compare (1-a) and (1-b):

(1) a. Sue has a child, but she is at boarding school.
  b. Sue is a parent, but she is at boarding school.

(1-a) is naturally interpreted as saying that Sue has a child who is at boarding school; whereas (1-b) is more naturally heard as saying that Sue has a child and *Sue* is at boarding school. This divergence is puzzling from the point of view of a classical treatment of indefinites as

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existential quantifiers: on that approach, it seems like ‘Sue has a child’ and ‘Sue is a parent’ should mean exactly the same thing.

A natural response is that ‘has a child’ and ‘is a parent’ do mean the same thing, but differ in some pragmatic way. An immediate challenge for this approach comes from minimal pairs like those in (2):

(2) a. Everyone who *has a child* loves them.
  b. Everyone who *is a parent* loves them.

The most prominent interpretation of (2-a) is that every parent loves their children. This meaning seems inaccessible for (2-b). Thus ‘is a parent’ and ‘has a child’ do not seem to contribute the same meanings to structures which embed them, which provides strong evidence that they do not have the same meaning.

There are two main responses to this puzzle, *e-type* approaches and *dynamic* approaches. E-type approaches argue that indefinites and definites have classical meanings, and that the differences in pairs like (2) come from differences in the availability of covert material that supplements their interpretation.[1] The dynamic strategy instead argues that the behavior of (in)definites shows that meanings are more fine-grained than truth-conditions; in particular, they are functions from contexts to contexts, rather than functions from points of evaluation to truth values.[2]

In this paper I develop a new approach which crosscuts these two traditions. I start by explaining a well-known problem for dynamic semantics involving disjunction and negation, which I use to motivate my theory. In my *pseudo-dynamic* theory, as in e-type theories, meanings are static (functions from indices to truth-values), and indefinites have the truth-conditions of existential quantifiers. But, as in dynamic semantics, indefinites have a secondary function of introducing discourse referents. They do so via what I call a *witness presupposition* which requires that, if their truth is witnessed by any individual, then that individual is assigned to their variable. While my theory is most immediately motivated by problems for dynamic

1 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 & Rothschild 2020, Lewerentz 2020 for more recent developments and criticism.

2 The dynamic tradition contains two threads, both growing out of Karttunen 1976: systems developed in the DRT framework following Kamp 1981, and those developed following Heim 1982. Within each of these threads there are innumerable variants. Subsequent developments in the broadly Heimian tradition include e.g. Groenendijk & Stokhof 1991, Dekker 1993, 1994, van den Berg 1993, 1996, Veltman 1996, Groenendijk et al. 1996, Aloni 2001, Beaver 2001, Nouwen 2003, Charlow 2014.

semantics, its interest is broader, for it shows that the standard desiderata motivating dynamic semantics can be captured with resources that are much more conservative, both in terms of logic and in terms of the foundations of semantics.

2 Dynamic semantics

I begin by summarizing the basic motivations and ideas behind dynamic semantics. Those familiar with dynamic semantics may want to skip to the next section.

Recall the classical Frege/Russell treatment of (in)definites and definites. On that account, $\ulcorner$an $F\urcorner$ means simply that something is F; in other words, $\ulcorner$an $F\urcorner$ is equivalent to $\exists xFx$, where $\exists$ is the classical existential quantifier. And definites have the same meaning, together with a uniqueness inference. Pronouns can be integrated in different ways into this system: either as definite descriptions with null or covert arguments, or, following Quine, 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. It is thus hard to see how we could then make sense of the contrast between sentences like (1-a) and (1-b), or between (2-a) and (2-b). It is also hard to see how this approach can account for the natural interpretation of quantified sentences like (2-a) which have an indefinite in the restrictor and a corresponding definite in the scope (*donkey sentences*), repeated here:

(2-a) Everyone who has a child loves them.

Translating this into classical logic given the classical assumptions above (in particular, assuming 'them' is a free variable) would yield (3) (with $\forall$ the classical universal quantifier and $\rightarrow$ the material conditional):

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

The problem with (3) is that the variable y in the consequent is unbound, so we don't get the intended covariation between 'a child' and 'them'. Giving the existential quantifier wide scope over the conditional doesn't help; while y ends up bound, we end up with absurdly weak truth-conditions for (2-a). So it is not at all obvious how to derive the intended meaning of (2-a)—that every parent loves their children—given the classical assumptions above. (Donkey sentences with definite descriptions rather than pronouns raise slightly different, but equally serious, issues; see Heim 1982 for discussion).

This gives a sense of the motivations for departing from classical assumptions about (in)definites. To illustrate the basic ideas of dynamic semantics, I will informally sketch a simplified version of Heim 1982's dynamic system, which in turn has formed the foundation for most subsequent developments.

Dynamic semantics treats sentence meanings as relations or functions between contexts. A context, in turn, is a set of pairs of variable assignments and worlds. In the system I sketch here, a variable assignment is any partial function from variables to individuals. The role of an indefinite is to *free* the variable that it is indexed to, and the role of definites is to pick up on a variable that has been introduced this way. Indefinites must always be indexed to novel variables (variables that haven't yet been used in the context). So the meaning of 'There is a$_i$ cat(i)' is the function that takes any context c to the context comprising pairs $\langle g, w\rangle$ such that $g(i)$ is a cat in w, and $\langle g, w\rangle$ extends some pair from c in the sense that, for some pair $\langle g', w'\rangle \in c$, $w = w'$, and g' and g agree everywhere except possibly on i. This captures the idea that indefinites serve the purpose of 'opening a new file card', in Heim's metaphor: indefinites extend a context c so that every variable assignment in any pair in the updated context is defined on i, thus making available subsequent anaphora back to i.

Definites are used to talk about variables that have already been introduced—in other words, to add information to file cards that have already been opened. So, for instance, 'The$_i$ cat(i)' presupposes that i is a 'familiar' variable in the sense of being everywhere defined; and, further, that i is assigned to a cat through the context. Where this presupposition is satisfied, 'The$_i$ cat(i)' just denotes $g(i)$. So, 'There is a$_i$ cat(i)' sets the stage for subsequent definites like 'The$_i$ cat(i) is brown', by ensuring that i is everywhere assigned to a cat; consecutive update with each of these sentences results in a context comprising pairs $\langle g, w\rangle$ such that $g(i)$ is a brown cat in w.

With this in hand, let's return to the contrast between 'Sue has a$_i$ child(i)' and 'Sue is a$_i$ parent(i)'. Consider a context c where i is novel. Updating with either of these will have the same *worldly* effect on c: when we update c with the meaning of either sentence, all and only worlds in (pairs within) c in which Sue has a child will survive the update. But they have very different effects on variable assignments. Updating with the first will result in a context which only contains pairs $\langle g, w\rangle$ such that $g(i)$ is a child of Sue's in w. By contrast, updating with the second will result in a context which only contains pairs $\langle g, w\rangle$ where where $g(i)$ is a parent and is Sue in w. So the first 'opens a file' on Sue's child, which subsequent definites can add to. The second instead 'opens a file' on Sue herself, and does not license subsequent anaphora to Sue's child. This is the key to the dynamic account of the contrasts we saw above.

Conjunction is treated in dynamic systems as successive context update, first with the meaning of the left conjunct and then the right. So, 'Sue has a$_i$ child but she$_i$ is at boarding school' first takes c to a context comprising just pairs $\langle g, w \rangle$ where $g(i)$ is a child of Sue's, then further updates this context by keeping just those pairs $\langle g, w \rangle$ where $g(i)$—that is, Sue's child—is at boarding school. By contrast, 'Sue is a$_i$ parent but she$_i$ is at boarding school' takes c to a context comprising pairs $\langle g, w \rangle$ where $g(i)$ is a parent identical to Sue; then further updates this context by keeping just those points $\langle g, w \rangle$ where $g(i)$—that is, Sue—is at boarding school. The dynamic system thus captures the stark difference in intuitive meaning between these two conjunctions. This explanation extends naturally to quantified sentences, though for reasons of space I won't spell this out.

A helpful way of characterizing this account of the contrast above is by saying that in dynamic semantics indefinites have *open scope* to their right: they can "bind" co-indexed definites to their right, whether or not the definite is in their syntactic scope. So 'Sue has a$_i$ child(i), but she$_i$ is at boarding school' will be equivalent to 'Sue has a child who is at boarding school'; while 'Sue is a$_i$ parent(i), but she$_i$ is at boarding school' will be equivalent instead to 'Sue is a parent who is at boarding school'.

3 Problems with negation and disjunction

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.

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. Where $[p]$ is the dynamic meaning of any sentence p, and $c[p]$ is the application of $[p]$ to a context c, a natural first thought is that $c[\neg p] = c \setminus c[p]$. This works for propositional fragments of dynamic semantics; but it doesn't work if we are trying to cover (in)definites. Think about the desired update of a negated sentence like (4):

(4) It's not the case that Sue has <u>a child</u>$_i$.

Negated indefinites have strong truth-conditions: (4) intuitively communicates that Sue is childless. But the current proposal gives us something very weak. In fact, if i is novel in c, updating c with (4) would just give c again. The natural, and standard, thing to say here is that, in addition to its set-complement meaning, negation also 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 $c[p]$—i.e., $\{\langle g,w\rangle \in c : \nexists g' \geq g : \langle g',w\rangle \in c[p]\}$ (where $g' \geq g$ iff g' and g agree everywhere that g is defined). So, when we update c with (4), we keep just those $\langle g,w\rangle$ in c such that no extension of g assigns a child of Sue's in w to i: i.e., just those pairs $\langle g,w\rangle$ where Sue has no children in w.

This standard approach captures the intuitive truth-conditions of (4). But it has a problematic upshot: double-negation elimination is not valid. Because of the quantification over assignments in our definition of negation, 'Not (Not (Sue has a$_i$ child))' doesn't have any effect on assignments to i 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.

So double negation elimination is not valid: double negation kills anaphoric dependencies.[3] 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 (5) (underlining here and throughout is just to draw attention to the relevant definite/indefinite pairs):

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

As in the non-negated cases, (5-a) is much easier to hear on its intended reading—as saying that Sue's child is at boarding school—than (5-b). This is brought out more naturally by question/answer pairs like those in (6):

(6) a. - Sue doesn't have <u>a child</u>. - That's not true! <u>She's</u> at boarding school.
b. - Sue isn't <u>a parent</u>. - That's not true! <u>She's</u> at boarding school.

3 This is true in nearly every dynamic semantic system, with a few important exceptions. See Karttunen 1976, Groenendijk & Stokhof 1990, 1991, Krahmer & Muskens 1995, Rothschild 2017, Gotham 2019 for discussion of the issue and some exceptions, namely those in Krahmer & Muskens 1995, Gotham 2019.

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

(7) 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.

To capture the striking contrast here, it looks like we need to make available the negations of left disjuncts to license definites in right disjuncts. But how can we do this? The natural thing to say to try to capture this pattern in a dynamic system is that $c[p \vee q] = c[p] \cup c[\neg p][q]$. Now suppose p has the form $\neg r$ and r contains a non-negated indefinite, as in (7-a). Then $c[\neg r \vee q] = c[\neg r] \cup c[\neg\neg r][q]$. What we want is for this to come out equivalent to $c[\neg r] \cup c[r][q]$—we want indefinites in r to 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 (7-a) is licensed by the negated indefinite in the left disjunct.

Schematically, again, to capture Partee disjunctions, we need the equivalence between $\neg p \vee q$ and $\neg p \vee (p \& q)$; but, while this holds in classical logic, it doesn't hold in dynamic systems, because double negation elimination is invalid.

4 Pseudo-dynamics

Perhaps these are local problems which will be amenable to local solutions. But I think they are worrying enough to motivate taking a second look at the foundations of the dynamic system. 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. The present problems suggest that dynamic semantics goes too far in its non-classicality. I will develop a new theory which, like dynamic semantics, predicts the open scope of indefinites; but which is more conservative, logically and foundationally, than dynamic semantics.

My *pseudo-dynamic* system starts with the classical treatment of indefinites as existential quantifiers. Then I propose that indefinites with the form $\ulcorner \text{An}_i(Fi) \urcorner$ have a *witness presupposition* to the effect that, if *anything* is in F_w, then $g(i)$ is. The witness presupposition guarantees that indefinites license subsequent definites; but indefinites are still, truth-conditionally speaking, just existential quantifiers, which means that the underlying logic is essentially classical. And the architecture is static: semantic values are functions from indices to semantic values, and the connectives are classical.

My system broadly builds on two existing proposals in the literature. Rothschild (2017) proposes tying the behavior of anaphora to definedness conditions in a trivalent static system. And Krahmer & Muskens (1995) propose a bilateral semantics for indefinites in a dynamic system, which is a natural precedent for the proposal I give here. My system differs from both in many obvious ways; for reasons of space I will not undertake a careful comparison with those systems here, but I want to flag them as precedents.

4.1 Truth and falsity

I work with a standard predicative language, comprising variables $x_i : i \in \mathbb{I}$ (usually written $x, y, \ldots$) and atoms $A(\tau_1, \tau_2, \ldots \tau_n)$ (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 the one-place operators $\neg$ ('not'), ιx_i ('the') and $\exists x_i$ ('a') for any variable x_i. I assume both ιx_i and $\exists x_i$ are one-place connectives; $\exists xp$ is a sentence, standing for $\ulcorner$There is a p$\urcorner$, while ιxp is term, standing for $\ulcorner$The p$\urcorner$.[4] Definites and variables are the terms of the language; everything else in the language is a sentence.

The main semantic values of our language are those of classical logic, with indefinites treated as existential quantifiers and definites as the corresponding variable. So, where $[\![\varphi]\!]^{g,w}$ is the main semantic value of φ at (possibly) partial assignment g and world w:[5]

- *Variables, definites*: $[\![x]\!]^{g,w} = [\![\iota xp]\!]^{g,w} = g(x)$ provided g is defined on x.
- *Atoms*: $[\![A(\tau_1, \tau_2, \ldots \tau_n)]\!]^{g,w} = 1$ iff $\langle [\![\tau_1]\!]^{g,w}, [\![\tau_2]\!]^{g,w}, \ldots [\![\tau_n]\!]^{g,w} \rangle \in \mathfrak{I}(A, w)$.
- *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*: $[\![\exists xp]\!]^{g,w} = 1$ iff $\exists g'[x]g : [\![p]\!]^{g',w} = 1$.

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.

4 I reserve $\exists$ for the classical existential quantifier and $\wedge$ for classical conjunction.

5 Fine print: $\mathfrak{I}$ is an interpretation function from n-ary predicates and worlds to n-tuples of individuals (assuming fixed domains across worlds); $g'[x]g$ mean that g' and g agree everywhere except possibly on x; τ_i ranges over terms, p and q over sentences. I assume bivalence for sentences: if a sentence is not true ('1') at $\langle g, w \rangle$ it is false ('0') there.

4.2 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. For brevity, I will use the abbreviation 'p is satt' for 'p has its presuppositions satisfied'.[6] I will treat presuppositions as a separable dimension of content from truth, so that any combination of values in $\{$*true, false*$\} \times \{$*satt, not satt*$\}$ is possible. In this I follow the multi-dimensional tradition of Herzberger 1973, Peters 1977; see Dorr & Hawthorne 2018 for motivation for this kind of approach (which is, I should add, separable from my broader goals here, which could also be realized in a more standard trivalent framework).

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:[7]

- *Witness presupposition*: $\mathrm{3}xp$ presupposes at $\langle g, w\rangle$ that $(\exists g'[x]g : [\![p]\!]^{g',w} = 1) \rightarrow [\![p]\!]^{g,w} = 1$

So, for instance, an indefinite with the form $\mathrm{3}x(cat\ x)$ 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. Given a classical semantics for the existential quantifier $\exists$, we can more concisely formulate the witness presupposition as follows:

- $\mathrm{3}xp$ presupposes at $\langle g, w\rangle$ that $[\![\exists xp]\!]^{g,w} = 1 \rightarrow [\![p]\!]^{g,w} = 1$.

4.3 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, 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 those in the Heimian system: sets of pairs of (possibly partial) variable 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

6 Inspired by Penelope Fitzgerald's description of the Hardenberg estate in *The Blue Flower*, pp. 32–33.
7 Many thanks to Keny Chatain for suggesting this formulation of the witness presupposition based on a much more tortuous earlier version.

picture only in checking familiarity presuppositions. Given a context κ, we can spell out the familiarity presupposition as follows:

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

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 local 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; whereas definite descriptions require that the variable be familiar in this sense and also that their restrictor be true at every point in the context.

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 κ with a sentence p results in a subsequent context which comprises exactly the points in κ where p is true and satt. Now, suppose that we have updated our context κ with the indefinite $\text{ɜ}x(\mathit{cat}\, x)$. Then the resulting context will comprise exactly the pairs $\langle g, w\rangle \in \kappa$ such that there is a cat in w—that's the contribution of the classical truth-conditions—*and* $g(x)$ is a cat in w—that's the contribution of the witness presupposition. This, in turn, means that a subsequent sentence containing a definite like $\mathit{Brown}(\iota x \mathit{cat}\, x)$ will have its familiarity presupposition satisfied throughout this new context.

4.4 Projection

Now that we have presuppositions on the scene, we need to say how they project out of complex sentences. I will follow Schlenker 2009, 2010 who develops a theory of *local contexts* to account for presupposition projection in a broadly static framework. These will provide the domains for evaluating the familiarity presuppositions of embedded definites. Then we assume that a sentence has its presupposition satisfied iff every part of that sentence has its presuppositions satisfied, relative to its local context.

In more detail: where κ is a context, I write κ^p for the set of points $\langle g, w\rangle \in \kappa$ such that p is both true and satt at $\langle \kappa, g, w\rangle$. Then we have the following conditions for presupposition satisfaction:

- *Variables:* x_i is satt at $\langle \kappa, g, w\rangle$ iff $g(x_i)$ is defined.

- *Atoms*: $A(\tau_1, \tau_2, \ldots \tau_n)$ is satt at $\langle \kappa, g, w \rangle$ iff $\forall i \in [1,n] : \tau_i$ is satt at $\langle \kappa, g, w \rangle$.
- *Conjunction*: $p\&q$ is satt at $\langle \kappa, g, w \rangle$ iff p is satt at $\langle \kappa, g, w \rangle$ and q is satt at $\langle \kappa^p, g, w \rangle$.
- *Disjunction*: $p \vee q$ is satt at $\langle \kappa, g, w \rangle$ iff p is satt at $\langle \kappa, g, w \rangle$ and q is satt at $\langle \kappa^{\neg p}, g, w \rangle$.
- *Negation*: $\neg p$ is satt at $\langle \kappa, g, w \rangle$ iff p is satt at $\langle \kappa, g, w \rangle$.
- *Indefinites*: $\mathrm{ɜ}xp$ is satt at $\langle \kappa, g, w \rangle$ iff its witness presupposition is satisfied at $\langle \kappa, g, w \rangle$ and $\exists g'[x]g : p$ is satt at $\langle \kappa, g', w \rangle$.
- *Definites*: ιxp is satt at $\langle \kappa, g, w \rangle$ iff its familiarity presupposition is satisfied at $\langle \kappa, g, w \rangle$ and $\exists g'[x]g : p$ is satt at $\langle \kappa, g', w \rangle$.

These are, again, all standard, up to the treatment of (in)definites. The main innovation here is the inclusion of the witness and familiarity presuppositions for the indefinite and definite, respectively. ((In)definites also have the standard requirement that their scopes be satt, relative to some x-variant on the starting assignment.)

This completes the exposition of our basic semantic system, which is also summarized in an appendix.

4.5 Updating: Some examples

To get more of a feel for the system, I will work through a few more concrete examples. But first, I want to emphasize an important point about updating in my theory. I've said that updating a context κ with p results in the context which comprises all and only the points $\langle g, w \rangle$ from κ such that p is both true and satt at $\langle \kappa, g, w \rangle$. This is a sharp 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 κ with p, then p has to have its presuppositions satisfied *throughout* κ; if its presuppositions fail to be satisfied at any point in κ, 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, $\mathrm{ɜ}xFx$, 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 κ with p, we simply keep all the points from κ 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. I am thinking about the presuppositions of (in)definites as being more like gender or number presuppositions on pronouns or demonstratives than like semantic presuppositions. 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.[8] I am thinking of witness and familiarity presuppositions in a similar way: as backgrounded guides to interpretation which help us trace anaphoric dependencies through conversation.

With this in hand, let's work through some examples. Suppose first that we are in a null context κ (i.e. one comprising all pairs of (possibly) partial assignments and worlds). Someone says, 'Jane has a cat'. Assume this gets parsed $\text{ɜ}x(\textit{cat-of-Jane}(x))$ (there are various ways to incorporate proper names into our system; I'll treat *cat-of-Jane* and similar expressions as atomic predicates for simplicity). Our update rule says to update κ by keeping all and only points $\langle g, w\rangle$ from κ such that $\text{ɜ}x(\textit{cat-of-Jane}(x))$ is both true and satt at $\langle \kappa, g, w\rangle$. Consider an arbitrary point $\langle g, w\rangle$. Recall that ɜ has the *truth* conditions of the existential quantifier, so $\text{ɜ}x(\textit{cat-of-Jane}(x))$ is *true* at $\langle g, w\rangle$ iff Jane owns a cat in w. Suppose first that Jane is not a cat-owner in w; then our sentence is false at $\langle g, w\rangle$ and so we eliminate this point. Suppose next that Jane owns 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 Jane owns a cat in w, then $g(x)$ is a cat owned by Jane in w. Since Jane does own a cat in w, by hypothesis, the witness presupposition is thus satisfied iff $g(x)$ is a cat of Jane's in w. So, $\langle g, w\rangle$ survives update with $\text{ɜ}x(\textit{cat-of-Jane}(x))$ iff $g(x)$ is a cat of Jane's in w.

This brings out an important fact about our system. The *update effect* of a non-negated indefinite is the same as the update effect of the corresponding open sentence: updating a context with $\text{ɜ}x(\textit{cat-of-Jane}(x))$ results in the same set of points as updating with $\textit{cat-of-Jane}(x)$ would (if we kept just the points where the open sentence is true). This, in turn, is the key to the subsequent licensing of anaphora. Let κ' be the context that results from updating κ with $\text{ɜ}x(\textit{cat-of-Jane}(x))$. Note that, in κ', not only is every world such that Jane is a cat-owner in that world, but also every variable assignment assigns x in particular to something that is a cat of Jane's in its paired world. Suppose that someone now says 'The cat is named Genji', parsed as $\textit{named-Genji}(\iota x\, \textit{cat}\, x)$. Consider an arbitrary point $\langle g, w\rangle$ in κ'. $\textit{named-Genji}(\iota x\, \textit{cat}\, x))$ has

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

its familiarity presupposition satisfied at $\langle g, w \rangle$ iff, for every point $\langle g', w' \rangle \in \kappa'$, $g'(x)$ is a cat in w'. This is guaranteed to hold because of our update with the corresponding indefinite. And *named-Genji*$(\iota x(\mathit{cat}\, x))$ is true at $\langle g, w \rangle$ iff the corresponding open sentence is true iff $g(x)$ is named Genji in w. So a point $\langle g, w \rangle$ in κ' survives update with *named-Genji*$(\iota x(\mathit{cat}\, x)))$ just in case $g(x)$ is named Genji in w.

Putting these two updates together, a point $\langle g, w \rangle$ in κ survives update with $\exists x(\textit{cat-of-Jane}(x))$ and then *named-Genji*$(\iota x(\mathit{cat}\, x)))$ just in case $g(x)$ is a cat named Genji that belongs to Jane in w.

Things work in essentially the same way for pronouns: 'It is named Genji' gets parsed *named-Genji*$(\iota x \top x)$. The familiarity presupposition requires that, for all points $\langle g, w \rangle$ in κ', $g(x)$ is defined. But this will hold thanks to the preceding indefinite. Truth and falsity conditions for the sentence are the same as for the corresponding definite description. So updating with 'Jane has a cat. It is named Genji' has exactly the same effect as updating with 'Jane has a cat. The cat is named Genji'.

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 novel definite, i.e. a definite without a corresponding indefinite.[9] 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.

This discussion brings out the similarity of the present system to Heim's file card system. Asserting an indefinite $\exists x F x$ "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, the update procedure that results from our system is very similar to Heim's. But, crucially, we mimic the Heimian opening and updating of file cards without the apparatus of dynamic semantics.

9 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.

Suppose that, instead of 'Jane has a cat', someone had asserted 'Jane doesn't have a cat', parsed as $\neg\exists x(\textit{cat-of-Jane}(x))$. Consider any point $\langle g,w\rangle \in \kappa$. $\neg\exists x(\textit{cat-of-Jane}(x))$ is true at $\langle g,w\rangle$ iff its negatum is false iff Jane is not a cat-owner in w. Suppose this holds. $\neg\exists x(\textit{cat-of-Jane}(x))$ is satt iff its witness presupposition (which projects through negation) is satisfied, which holds just in case, if Jane owns a cat in w, then $g(x)$ is a cat of Jane's in w. But, by assumption, Jane owns no cat in w; so the witness presupposition is (trivially) satisfied. So $\langle g,w\rangle$ survives update with $\neg\exists x(\textit{cat-of-Jane}(x))$ just in case Jane is not a cat-owner in w. Indeed, 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. (Since the update with negated indefinites only cares about the world parameter, updating with a negated indefinites does not license subsequent definites, as desired.)

Turning to negated definites: $\neg\textit{named-Genji}(\iota x(\textit{cat}\ x))$ projects the definite's familiarity presupposition, and is true iff x is assigned to something not named Genji. So updating a context with, say, 'Jane has a cat. It's not the case that the cat is named Genji' results in the set of all and only the points in the original context $\langle g,w\rangle$ where $g(x)$ is a cat of Jane's not named Genji.

5 Hegelian interlude: The dilemma of indefinites

Before proceeding to some important observations about our system, I want to take a minute to discuss the motivation for it in more abstract terms. In an illuminating discussion, Cumming (2015) identifies what he calls *the dilemma of indefinites*. Indefinites are two-faced. 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, say, a particular child of Sue's 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, say, 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 (i) more structured notions of context and (ii) a quantificational treatment of negation.

So much for thesis and antithesis. 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.

6 Logical facts

I return now to some of the observations that motivated our system and show how we capture them. Along the way, I'll bring out some important further generalizations about the system.

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 ⌜There is an F, and the F is G⌝. In our language, the claim that indefinites have open scope can be formulated as the claim that the three variants in (8) are in some sense 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):

(8) a. $\exists x(p\&q)$

b. $\exists x(p)\&q(\iota xp)$

c. $\exists x(p)\&q(\iota x\top x)$

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

In what sense are (8-a)–(8-c) equivalent? Well, *not* in the sense of being logically equivalent. p logically entails 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 if each logically entails the other. It is easy to find points $\langle g,w\rangle$ where sentences with the form of (8-a) are true but (8-b) and (8-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 $g(x) \notin q_w$. Then (8-a) will be true, while (8-b) and (8-c) will both be false.

But you will have noticed that, while (8-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 (8-a)–(8-c) are equivalent: these have the same truth-value *provided they are satt*. More precisely, say that p *Strawson entails* q iff, for any index i in any model satisfying the clauses above, if p and q are both satt at i and p is true at i, then q is true at i (von Fintel 1999). Say that p and q are Strawson equivalent iff each Strawson entails the other. It is in *this* sense that (8-a)–(8-c) are equivalent: they are pairwise Strawson equivalent.

The reasoning behind this is simple. For any point $i = \langle \kappa, g, w\rangle$, suppose (8-a) is satt and is true at i. As we have seen, this holds just in case $g(i) \in p_w \cap q_w$ (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). It is easy to verify that this is exactly what is required for (8-b) or (8-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). (8-b) and (8-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 $g(x) \in p_w \cap q_w$.

At a very high level, this holds because indefinites and definites have the same update effect as the corresponding open sentences. So all the sentences in (8-a)–(8-c) are also Strawson equivalent to $p\&q$.

Thus indefinites, in our system, have open scope in the sense that the sentences in (8-a)–(8-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, as we discuss presently.

You might wonder whether Strawson equivalence is enough. While there is a lot to discuss about the explanatory power of Strawson logics, I want to make a mild further point here. Given the pragmatic update system I am assuming, all of (8-a)–(8-c) result in precisely the same update: given a context κ, updating with any of of (8-a), (8-b) or (8-c) results in precisely the same subsequent context (namely, the one comprising exactly those points $\langle g, w\rangle$ from the starting context such that $g(x) \in p_w \cap q_w$).

6.2 Classicality

Recall the two closely related problems discussed in §3: 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, and it does so in a rather striking way. Under the obvious translation schema $'$ which takes $\mathrm{ɜ}xp$ to $\exists x(p')$ and takes ιxp to x and is otherwise defined in the obvious way,[10] the *logic* of our system *just is* classical predicate logic. That is, where '$\models$' stands for logical entailment, for any sentences p and q in our language, $p \models q$ in our system iff $p' \models q'$ in classical predicate logic. Thus in particular, since $\neg\neg p \mathrel{=\mid\models} p$ in classical predicate logic, $\neg\neg p \mathrel{=\mid\models} p$ in our system. Likewise, $\neg p \vee q \mathrel{=\mid\models} \neg p \vee (p \& q)$ 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 $p \models_{st} q$ (where '$\models_{st}$' stands for Strawson entailment). 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 $\neg\neg p \mathrel{=\mid\models_{st}} p$, and likewise that $\neg p \vee q \mathrel{=\mid\models_{st}} \neg p \vee (p \& q)$.

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 <u>a child</u>' will be parsed $\neg\neg(\mathrm{ɜ}x(\textit{child-of-Susie}(x)))$. This will be semantically equivalent to $\mathrm{ɜ}x(\textit{child-of-Susie}(x))$, and thus license subsequent definites like '<u>She/The child</u> is at boarding school' ($\textit{at-boarding-school}\ (\iota x \top x)$). Similarly for disjunctions like 'Either Susie doesn't have <u>a child</u>, or <u>she</u> is at boarding school'. Assume this gets the parse $(\neg \mathrm{ɜ}x(\textit{child-of-Susie}(x))) \vee (\textit{at-boarding-school}(\iota x \top x))$. 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 $\mathrm{ɜ}x(\textit{child-of-Susie}(x))$ 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 $\langle \kappa, g, w\rangle$ 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.

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

Our system thus avoids the problem that negation and disjunction poses for dynamic systems. Importantly, however, this is not because of a local fix but because of an important global property of our semantics: namely, that its logic is just the logic of classical predicate logic, under the obvious translation schema; and its Strawson logic is thus an extension of classical predicate logic. This distinguishes it from essentially every dynamic semantic system, which typically depart in a wide variety of ways from classical logic, invalidating rules like double negation elimination as well as many other classical laws.[11]

7 Quantifiers

This concludes the exposition and discussion of my basic system. Before concluding, I want to briefly discuss how quantifiers 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 (9-a), and the unavailability of a co-varying reading in (9-b):

(9) 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 (with $g_{[a\to x]}$ the assignment which takes x to a and otherwise agrees everywhere with g):

- $[\![\text{EVERY}x_\delta(p,q)]\!]^{g,w} = 1$ 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 $\langle a,g'\rangle \in \delta : [\![p]\!]^{g'_{[a\to x]},w} = 1 \to [\![p\&q]\!]^{g'_{[a\to x]},w} = 1$

We also assume that quantifiers have presuppositions, specifically about the domain parameter. A quantified sentence $Qx_\delta(p,q)$ is satt iff these three conditions hold:

11 Like the law of non-contradiction in the DPL system of Groenendijk & Stokhof (1991) and most systems that incorporate epistemic modals following Veltman 1996, as well as the law of excluded middle; see Mandelkern 2020a for discussion.

- $\langle a, g' \rangle \in \delta \to (\forall \langle a', g'' \rangle \in \delta : a' = a \to g'' = g')$. 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).

- $\langle a, g' \rangle \in \delta \to p\&q$ is satt at $\left\langle \kappa, g'_{[a \to x]}, w \right\rangle$. 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.

- $\langle a, g' \rangle \in \delta \to g' \sim_{p\&q} g$, 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. And satt quantifiers, in turn, will have the intended covarying readings.

So consider 'Every farmer is tall', $\text{EVERY}x_\delta(\mathit{farmer}(x), \mathit{tall}(x))$. Note that the variable assignments in pairs in δ are inert here, since the scope and restrictor are free only in x. So, this sentence is true just in case every individual in any pair in δ who is a farmer in w is tall in w.

Now let's work through the donkey sentence (9-a), repeated here, with the parse in (10-b):

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

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

Suppose (10-b) is satt in $\langle \kappa, g, w \rangle$. (10-b) is true in $\langle \kappa, g, w \rangle$ iff for every pair $\langle a, g' \rangle \in \delta$, if p is true at $\left\langle \kappa, g'_{[a \to x]}, w \right\rangle$, then so is $p\&q$. Consider an arbitrary pair $\langle a, g' \rangle \in \delta$. Given that p is satt at $\left\langle \kappa, g'_{[a \to x]}, w \right\rangle$, it is true at $\left\langle \kappa, g'_{[a \to x]}, w \right\rangle$ 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 (10-b). If true, then $p\&q$ must also be true at $\left\langle \kappa, g'_{[a \to x]}, w \right\rangle$ in order for (10-b) to be. Given that $p\&q$ is satt at $\left\langle \kappa, g'_{[a \to x]}, w \right\rangle$, it is true there iff a loves their child $g(i)$. So, (10-b) is true and satt at $\langle \kappa, g, w \rangle$ 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.[12]

By contrast, a co-varying reading will not be available for a sentence like (9-b):

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

This is for a simple reason: because there is no indefinite corresponding to the definite in (9-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 (9-b) to be satt, the definite in (9-b) will have to have been introduced in the global context, and (9-b) will be interpreted as saying that some particular child is loved by every parent.

8 Conclusion

There is a difference between indefinites like 'has a child' and 'is a parent', contrary to the classical analysis of indefinites as existential quantifiers. Dynamic semantics captures this difference by saying that indefinites in some sense open up new file cards while definites must add to already-open file cards. But the standard implementation of this idea has serious problems, which result, I think, from how radically that implementation rejects classical notions of meaning and corresponding classical treatments of connectives.

The *pseudo-dynamic* system I have presented here captures the file-card intuition of dynamic semantics, but in a very different way. This system avoids some specific problems for standard dynamic systems. But it also, perhaps more importantly, shows that we can pull apart many of the insights of dynamic semantics from its revisionary approach to content. In the pseudo-dynamic system, contents are functions from indices to truth-values, as in static systems. And the logic is just the logic of classical predicate logic. In these senses, my system is very conservative. All the *dynamic* action in the system comes via presuppositions, and 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.

Should the pseudo-dynamic system be considered a species of dynamic semantics? I have tried to draw out both the similarities and the departures, but the answer to this depends on what

12 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 & Pelletier 1989, Chierchia 1992, Kanazawa 1994, Chierchia 1995, Champollion et al. 2019). This is a complicated issue that I won't take up here.

we take to be the defining features of dynamic semantics. van Benthem (1996), Rothschild & Yalcin (2015, 2016) discuss two features in particular that characteristically fail in dynamic systems: eliminativity (updating a context κ with a sentence p always results in a subset of κ; i.e., where $+$ is the update operation, $\kappa + p \subseteq \kappa$); and distributivity ($\kappa + p = \bigcup_{i \in \kappa} (\{i\} + p)$). Pseudo-dynamics is eliminative, but it is not distributive, since the familiarity presuppositions of definites is a global property of contexts. Pseudo-dynamics thus cross-cuts these two standard criteria of dynamicness.

There is obvious 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, along the lines of those asked in Lewis 2012, 2014, 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.

Distinguishing presuppositional and truth-conditional dimensions in our system is not just a useful technical move, I think, but also revealing about the role of variable assignments in communication. In pseudo-dynamics, rather than playing an essential role in the truth-conditional content of a sentence, variable assignments are representational overlays on truth-conditional contents, overlays which are inert from a truth-conditional point of view, but which play a crucial role in helping speakers follow the twists and turns of conversation.

A Semantics

I summarize the semantics given in the text. I will use $\langle\!\langle\cdot\rangle\!\rangle^{\kappa,g,w}$ as a function from an expression to a pair of values. The first, underlined value is either 'satt' or 'not satt' ('$\underline{S}$' and '$\underline{N}$', 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. $\langle\!\langle p\rangle\!\rangle^{\kappa,g,w} = \langle \underline{*}, 1\rangle$ abbreviates $\langle\!\langle p\rangle\!\rangle^{\kappa,g,w} \in \{\langle \underline{S}, 1\rangle, \langle \underline{N}, 1\rangle\}$ and means that p is true at $\langle \kappa, g, w\rangle$, whether or not it has its presupposition satisfied. $\langle\!\langle\cdot\rangle\!\rangle_1^{\kappa,g,w}$ is the first (presuppositional) value, $\langle\!\langle\cdot\rangle\!\rangle_2^{\kappa,g,w}$ 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 κ and sentence p, $\kappa^p = \{\langle g, w\rangle \in \kappa : \langle\!\langle p\rangle\!\rangle^{\kappa,g,w} = \langle \underline{1}, 1\rangle\}$.

Our semantic clauses are then as follows:

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

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

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

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

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

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

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

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

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

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

- $\langle\!\langle \text{з} x p\rangle\!\rangle^{\kappa,g,w}$

  $$= \langle \underline{S}, *\rangle \text{ iff}$$
  $$\exists g'[x]g : \langle\!\langle p\rangle\!\rangle_1^{\kappa,g',w} = S \text{ and}$$
  $$(\exists g'[x]g : \langle\!\langle p\rangle\!\rangle_2^{\kappa,g',w} = 1) \rightarrow \langle\!\langle p\rangle\!\rangle_2^{\kappa,g,w} = 1$$
  $$= \langle \underline{*}, 1\rangle \text{ iff } \exists g'[x]g : \langle\!\langle p\rangle\!\rangle_2^{\kappa,g',w} = 1$$

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

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

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

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

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

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

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