Reducing pronoun accessibility to presupposition satisfaction

Keny Chatain

Abstract. Under what conditions can a pronoun refer to a given antecedent? It has long been noted that there is a connection between pronouns' accessibility conditions and patterns of presupposition satisfaction. In this paper, this connection is explicitly spelled out in the form of the existence generalization: a pronoun may refer to an (indefinite) antecedent if and only if a witness for that indefinite can be presupposed to exist in the local context of the pronoun. We show that, while dynamic approaches and E-type approaches do expect some parallels to hold between presupposition satisfaction and accessibility conditions for pronouns, they have fallen short of validating this existence generalization in full. As a result, they face various under-generation problems. Instead, we propose a system which revives the choice-functional approach of van der Does (1993); Egli and Von Heusinger (1995) and can capture the generaliaztion in full. In this system, a pronoun's accessibility conditions is an existence presupposition *simpliciter* and the existence generalization is validated as a matter of principle. With relatively minimal tooling, this approach derives an interesting range of cases (bathroom sentences, cataphoric possibilities, donkey sentences, subordination). Some limitations and possible extensions are discussed: existential/universal readings and non-indefinite antecedents.

I. Desiderata of a theory of pronouns

Pronouns can co-vary with indefinite antecedents that do not c-command them. The indefinite antecedent can find itself in a different clause, as in (1)a, in a different conjunct, as in (1)b, or in the restrictor of a quantifier whose scope includes the pronoun, as in (1)c.

(1)
- a. There is a phone-book. It is in the cabinet.
- b. There is a phone-book and it is in the cabinet.
- c. Every person who has a phone-book puts it in their cabinet.

While quite unconstrained, co-variation is impossible in certain configurations, as the examples in (2) illustrate.

(2)
- a. # There isn't a phone-book and it is in the cabinet.
- b. # Either there is a phone-book or it is in the cabinet.
- c. # If it is a phone-book, there is a phone-book.

Understanding in which configurations a pronoun may co-vary with a given antecedent and in which configurations it can't is the key question of *pronoun accessibility*. It has spurred a lot of work, since Evans (1977); Evans (1980); Heim (1982). Looking only at the examples in (1) and (2), a simple pre-theoretic intuition arises: a pronoun can be used if and only if there is an antecedent in the linguistic context and the existence of the antecedent can be presupposed at the point when the pronoun is used. In (1)a and (1)b, a phone-book is asserted to exist ; its existence can then be presupposed in subsequent discourse. In (2)a, the existence of a phone-book is explicitly denied and thus can't be presupposed afterwards. (2)b works similarly: the existence of the phone-book in the disjunction is listed as one of two possibilities and a felicitous use of the disjunction requires this possibility to be unsettled in the context ; it certainly cannot be presupposed to exist in the local context of second disjunct.

Informal though it may be, this intuition is fundamental since it connects the question of *pronoun accessibility* to the question of *presupposition satisfaction*, another fundamental topic of inquiry. As a result, many of the different proposals made about pronouns have been giving shape to this connection, in some form of other. The two main schools of thought, the dynamic approach (Heim 1982; Groenendijk and Stokhof 1991; Kamp and Reyle 2013) and the E-type approach (Evans 1980; Heim 1990; Elbourne 2005), spell out the intuition in different ways.

My argument will be that, whether in the E-type tradition or in the dynamic tradition, previous theories have not fully validated the intuitive generalization above that a pronoun to an indefinite can be used if and only if a certain existence presupposition is met (*the existence generalization*). This, I argue, leads to under-generation problems. Some of these problems are well-known, like the case of bathroom sentences, and some less well-known, involving intricate cases of cataphora. None of these limitations is fixed in full by later work.

I will propose an account with the aim of validating the existence generalization above in full. In a nutshell, the account proposed will guarantee a pronoun denotes whenever there is a suitable antecedent in the linguistic account and a certain existence presupposition is true of the local context. The account resembles an E-type account but uses choice functions rather than uniqueness definites. This move was already proposed as proposed in van der Does (1993); Egli and Von Heusinger (1995). (The difference with these early works will be explored in section VI.1).

The benefits will not only be empirical, allowing us to capture cases under-generated by other approaches, but also theoretical. Because the account does not alter much of the compositional apparatus, it will sidestep a number of explanatoriness concerns raised for theories in the dynamic traditions (Soames 1989). More precisely, I will assume given an explanatory theory of presupposition projection, such as Schlenker (2010), George (2008), Rothschild (2011) or Fox (2012). Since, in this framework, the question of pronoun accessibility is reduced to the question of presupposition satisfaction, the theory of presupposition satisfaction will naturally translate into a theory of pronoun accessibility.

The proposal here will be limited in various ways. First, I will, like other works, narrowly focus on pronouns anteceded by singular indefinites. Speculation about how to extend the proposal beyond this type of antecedent will be made in section VII, with potential empirical benefits. Second, this account will not shed any new light on the question of existential/universal readings of pronouns, a thorny issue. I will nevertheless show that the account can predict a generalization to the worst case of the facts, matching in its predictions other recent proposals (Mandelkern 2020; Elliott 2020).

The road-map is as follows. In section II, I will spell out the existence generalization formally, discuss some cases studies illustrating its explanatory power and then proceed to argue that the main two traditions for analyzing pronouns anteceded by indefinites fail to capture this generalization. In section III, I will present the account for non-quantified sentences, including conjunctions and bathroom sentences. In section IV, I will extend it to quantified statements, dealing with such cases as donkey pronouns and subordination sequences. In section V, we refine the theory to deal with some outstanding issues. In section VI, I will compare the merits of the account to specific

proposals, from other choice-functional approaches (van der Does 1993; Egli and Von Heusinger 1995) to very modern proposals like Hofmann (2019), Elliott (2020).

II. The existence generalization

1. The existence presupposition generalization

The introductory section formed a preliminary generalization regarding *pronoun accessibility*: a pronoun may co-vary with an indefinite if and only if a certain presupposition of existence is met and there is a linguistic antecedent available. Cases like (3) were used to illustrate:

(3)

a. There is a phone-book. It is in the cabinet.
b. There is a phone-book and it is in the cabinet.
c. Either there isn't a phone-book or it is in the cabinet.
d. If there is a phone-book, it is in the cabinet.
e. # It is in the cabinet and there is a phone-book.
f. # Either there is a phone-book or it is in the cabinet.
g. # If it is a phone-book, there is a phone-book.

We now spell out this generalization in an explicit manner:

(4) **Existence Generalization:**
If a discourse contains "[*a/some* RESTR] SCOPE" and a pronoun *he/she/it*, the pronoun may co-vary with the indefinite if and only if the presupposition that there exists an element in the intersection of the denotation of RESTR and the denotation of SCOPE is satisfied in the position where the pronoun is used.

The generalization is not new. We can find a very similar statement in Mandelkern and Rothschild (2019), under the heading *definiteness filtering*. Informal statements to that effect can be found in earlier literature as well (e.g. Heim (1982)). Arguably, this intuition that underlies the existence generalization underlies the emergence of such frameworks as dynamic semantics.

Before illustrating the generalization, a clarification is in order. The generalization makes reference to configurations where an indefinite antecedent is present in surrounding linguistic discourse. Merely satisfying an existence presupposition does not *ipso facto* make a co-varying reading of a pronoun possible. In particular, the generalization is silent on the felicity or infelicity of Partee's marble example in (5). There, the existence of a missing marble can be presupposed and is a very salient fact at that, but that is not sufficient to license a pronoun referring to the missing marble ; an antecedent seems lacking. Since the generalization does not talk about antecedent-less configurations, it makes no predictions about (5). Naturally, a good theory ought to predict not only the existence generalization in (4) but also the infelicity of (5). We'll come back to such cases in section III.4, after presenting the approach.

(5) # Exactly nine of the ten marbles have been found. We're looking for it.

The final caveat is that, as we'll see in section II.2, the generalization is a good first approximation but it does have some exceptions: sometimes, the existence presupposition is not met in the local context and the pronoun co-varies and vice-

versa. The exceptions will be presented below. In all cases, I'll argue that independent principles are at play (i.e. binding conditions or local accommodation).

2. Case studies

The cases presented in (3) form a standard and widely known paradigm. We now present some less well-known cases, which I argue all ultimately support a full identification between the phenomena of presupposition satisfaction and pronoun accessibility.

2.a and and *but*-conjunctions : anaphora and cataphora

In simple conjunctions, a pronoun may follow but not precede its antecedent[1]. This is captured straightforwardly by the generalization. In (6)a, the presupposition that there is a phone-book can be filtered and thus satisfied by the first conjunct. In (6)b, on the other hand, the same presupposition cannot be filtered. For the co-reference to *a phone-book* to be acceptable, the sentence must, as whole, be in a context where the existence of a phone-book can be presupposed. But in such a context, the second conjunct of (6)b redundant and the sentence, as a whole, would be infelicitous.

(6)
a. There is a phone-book and it is in the cabinet.
b. # It is in the cabinet and there is a phone-book.

Surprisingly, this pattern does not hold of *but*-coordinations. Here, the pronoun *it* is perfectly felicitous whether it precedes or follows its antecedent, as (7) attests.

(7)
a. It's not available at the library now but there is a phone-book.
b. There is a phone-book but it's not available at the library now.

As it turns out, *but* also filters presuppositions differently from *and*. As seen in (8), a factive presupposition can be filtered either from a previous or a following conjunct[2]. This contrasts with conjunction, where only one of the two orders is felicitous.

(8) *but*-coordination
a. I don't know why there is a phone-book but there is one.
b. There is a phone-book but I don't know why there is one here.
(9) *and*-coordination
a. # I don't know why there is a phone-book and there is one.
b. There is a phone-book but I don't know why there is one here.

1 The editor wonders about whether the existence generalization and the theory to be presented have anything to say about cataphoric cases like *If it is well-cooked, a hamburger can be quite tasty* (Chierchia 2009). However, such cataphora seem to be restricted to generic indefinites (# *If it is well-cooked, there is a tasty hamburger on the table,* Barker and Shan (2008)). Anaphorically speaking, generic indefinites pattern with referential expressions: they are not subject to the subordination constraint, they can be dislocated in French and Italian, when other quantifiers cannot, they can co-vary with an indefinite that repeat them (e.g. *when a baby is hungry, a baby cries*). A speculation is presented in section VII about why referential expressions may have more cataphoric possibilities.

2 There is a question of whether (8)a involves accommodation or filtering of the presupposition by the other conjunct. For the purpose of the generalization, it is not relevant how the presupposition comes to be satisfied ; all that matters is that wherever the existence presupposition can be met, a pronoun is accessible.

I won't try to explain why *but* filters presupposition differently from *and.* The argument is that the pattern of presupposition filtering correlates with the pattern of anaphora accessibility and this is precisely what the generalization predicts.

2.b Accessibility from pragmatic inferences

Sometimes, pragmatic considerations can make a presupposition felicitous or infelicitous. In (11), use of *X believes p* typically gives rise to an anti-presupposition that *p* is false (Heim 1992) when the speaker can be assumed to be knowledgeable about *p* (Chemla 2008).

(10) Jane believes that there isn't a phone-book in my house.
→ *there is a phone-book in my house*

When this inference obtains, it becomes felicitous to presuppose *not p*, as (11) shows[3]:

(11) Jane believes that there isn't a phone-book in my house.
Thankfully, her partner knows that there is one.

If an existence presupposition can be met, then the existence generalization expects a co-varying pronoun could be used. This is correct, as (12) illustrates.

(12) Jane believes that there isn't a phone-book in my house.
And yet, it's just in front of her very eyes.

The main interest of this example is to show that the existence generalization expects that, in some cases, the licensing conditions of pronouns depend on pragmatic, not just semantic factors.

In connection to this example, a reviewer points out an exception to the generalization. They note the contrast between (13)a and (13)b. In both cases, the presupposition that the speaker has a child can be met and there is an antecedent in the surrounding context. Yet, only (13)a is acceptable.

(13) Jane believes I don't have a child$_i$.
a. # Yet in fact, I'm a parent but she$_i$'s not here
b. Yet in fact, I do have a child but she$_i$'s not here.

The reviewer's example raises a significant issue but the issue is not simply for the existence generalization. Note that (14), a variant of (13) with the intervening clauses removed is felicitous. The comparison between (13)a and (14) teach us that the addition of certain intervening clauses can remove anaphoric possibilities. This is not expected by the existence generalization but it is also not expected in any theory of anaphora (where the number of available referents may only grow[4]).

(14) Jane believes I don't have a child$_i$.
She's just never seen her.

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3 Here, we can't really say that the anti-presupposition is directly responsible for the satisfaction of the upcoming presupposition. It could be that the presupposition of the following sentence is accommodated and that this is congruent with the previously derived anti-presupposition.

4 Except when indices are reused but nothing forces parse that reuses indices. Also note that, at the outset, the assumption that intervening clauses may never remove anaphoric possibilities is too strong. It is clear that in very long discourses, pronouns may not be used to refer to antecedents too "far back" in discourse. The existence generalization does not capture that effect.

The reviewer's observation can be replicated in other configurations as well with for instance bathroom sentences (*they* intended as singular gender-neutral *they*). (15)a is a standard bathroom example ; adding redundantly the clause *she's a parent* in (15)b significantly degrades the anaphoric reference.

(15)

a. Either Jane does not have a child or they don't live with her.
b. ?? Either Jane does not have a child or she's a parent and they don't live with her.
c. Either Jane does not have a child or she has a child and they don't live with her.

This suggests that *she's a parent* and such clauses may have an anti-licensing effect on subsequent pronouns refering to Jane's children. I leave it open why this is so because it is a general problem that affects even theories that don't validate the existence generalization.

2.c Condition C and cataphora from factive complements

Amir Anvari (p.c.) points out (16) as a counter-example to the existence generalization.

(16) # She$_i$ knows that there is a woman$_i$ in the room.

The existence generalization dictates that the pronoun in (16) can refer to *a woman* (cataphorically) if it can be presupposed that there is a woman in the room. As it so happens, this is already what the factive verb *know* imposes as a condition for a felicitous utterance of (16). There does not seem to be any reason why this presupposition could not be met in (16), either by accommodation or because the information is already present in the context. (16), under a co-varying reading, should have the same felicity conditions as (17) and (17) is an unobjectionable sentence. And yet, a co-varying reading of (16) is impossible.

(17) Mary knows that there is a woman in the room

(16) is indeed a *bona fide* exception to the generalization; a pronoun is inaccessible despite their being no obstacle to meeting the existence presupposition. However, this exception is a principled one: (16) is an instance of a condition C violation, as the pronoun *she* c-commands its desired antecedent.

To see that this is indeed a matter of condition C, we can look at a sentence like (18), which avoids any c-command relation between the antecedent and the pronoun. This sentence is entirely acceptable. It presupposes that there is a phone-book in the cabinet[5] and this presupposition can harmlessly be accommodated (or is already entailed by the context shared between speaker and hearer).

(18) The person that placed it$_i$ there knows that there is a phone-book$_i$ in the cabinet.

5 And that someone placed the phone-book there (presupposition of the definite).

2.d Local accommodation

There are few cases where the a pronoun may be used, even though it *prima facie* seems that the existence presupposition is not met, contrary to what the existence generalization predicts. Consider the paradigm in (19) (extracted and adapted from Hofmann (2022), cf also Kibble (1994) ao). (19)a is the familiar case of cross-conjunction anaphora. The infelicitous (19)b is not so surprising either from the perspective of the existence generalization: according to it, the pronoun may only co-vary with the indefinite if it can be presupposed that Mary has a car and the first conjunct explicitly denies that.

(19)

a. Mary has a car and it's parked outside
b. # Mary doesn't have a car and it's parked outside.
c. ? Mary doesn't have a car and it's not parked outside.

(19)c is more puzzling. Here too, the existence of a car owned by Mary is explicitly denied so the existence presupposition cannot be met in the global context. While not fully acceptable, some modifications of (19)c, like (20), are acceptable.

(20) Mary doesn't have a car so it's definitely not parked outside.

This, it seems, constitutes another exception to the existence generalization. The examples are however strongly reminiscent of cases of local accommodation (Heim 1982), illustrated in (21). Here as well, the presupposition of there being a king of France is not (and cannot be) met in the global context but, as a last resort, it is assumed that the content of the presupposition may be added in the scope of the neagation, as in (22). If a pronoun's accessibility conditions are akin to an existence presupposition, the same sort of last-resort mechanism might be available for pronouns as well, as in (23).

(21) France doesn't have a king so you definitely didn't meet the king of France.

(22) NOT [there is a unique king of France and you met the king of France]

(23) NOT [there is a car that Mary has and it is parked outside]

3. The existence generalization in previous theories

Do classical frameworks expect the existence generalization to hold and predict the case studies that it covers? We argue that neither classical dynamic approaches nor E-type approaches expect the generalization to hold as a matter of principle, despite both positing a connection between presupposition satisfaction and pronoun accessibility.

3.a The existence generalization in Dynamic Semantics

Dynamic Semantics is an influential proposal aiming to capture the patterns of pronoun accessibility and presupposition projection with one and the same mechanism. In Dynamic Semantics, sentences denote context-change potentials, i.e. instructions on how the context must be updated when a sentence is used. "Context" typically contains both a store of referents that pronouns can pick from and the worlds of the common ground, against which presuppositions are checked. It follows

that, in this system, updates to the context affect both the behavior of presuppositions and pronouns in parallel. The correlations described by the existence generalization might be *a priori* expected in a dynamic theory.

In Dynamic Semantics, both presupposition triggers and pronouns impose conditions on context to be properly assertable. A presupposition trigger would demand a certain proposition be true at every world of the context ; a pronoun would demand a particular index have a value in every assignment of the context. (24) gives a formal rendition:

in e.g. File-Change Semantics (Heim 1982), a sentence like *there is a phone-book* would denote the update described in (25): an update which (i) removes from context the world-assignment pairs such that there are no phone-books at the world coordinate of the pair, (ii) adds a phone-book there in that world at index i of the assignment coordinate.

(24)

a. $[\![$Jane knows that there is a phone-book$]\!](C) \neq \emptyset$
iff $\forall (w, g) \in C$, there is a phone-book in w

b. $[\![\text{It}_i$ is in the cabinet$]\!](C) \neq \emptyset$
iff $\forall (w, g) \in C, i \in g$

The compositional rules of Dynamic Semantics guarantee that indefinite antecedents create contexts in which both conditions are met: (i) worlds in which there are no phone-books are sieved out of the context, (ii) a phone-book discourse referent is added to the index.

(25) $[\![\text{there is a phonebook}_i]\!](C)$
$= \{(w, g[i \rightarrow x]) \mid (w, g) \in C, \text{phonebook}(w)(x) \wedge \text{there}(w)(x)\}$

In simple conjunctions like (26), the context will first be updated by (25), guaranteeing a context in which a pronoun is accessible and an existence presuppositions is satisfiable:

(26)

a. There is a phone-book$_i$ and it$_i$ is in the cabinet.
b. There is a phone-book$_i$ and Jane knows that there is a phone-book$_i$.

This *prima facie* goes toward satisfying the existence generalization, as satisfaction of the existence presupposition and subsequent pronouns reference seem to be licensed by the same mechanism – the update of the context by the indefinite.

The problem is that the correlation between existence facts and presence of an index in the assignment function is only accidental in dynamic semantics, not guaranteed as a matter of principle. Negation is well-known for creating a divergence. (27) gives a prototypical definition: an update by *not p* consists in taking only these world-assignment pairs, such that the world coordinate is not among the worlds of the context obtained by updating *p*.

(27) $[\![\text{not } p]\!](C) = \{(w, g) \in C \mid \neg \exists g', (w, g') \in [\![p]\!](C)\}$

This definition of negation has the correct effect of guaranteeing that an utterance of *not p* removes from context worlds where *p* is true, thus explaining the licensing of certain presuppositions.

(28) There isn't a phone-book and Mary knows that there isn't a phone-book.

However, it also predicts that negation can never license a subsequent pronoun. Indeed, the definition in (27) does not add any new index to the assignment g. But, as seen in the last section and as is well-known (Roberts 1987; Groenendijk and Stokhof 1991; Krahmer and Muskens 1995), negation does license subsequent co-varying pronouns, in bathroom sentences like (29) or with double negation as in (30).

(29) Either there isn't a phone-book or it is well-hidden.
(30) It's simply not true that there isn't a phone-book. It's just well-hidden.

To be complete, some dynamic theories, discussed in section VI, do solve the problem raised by bathroom sentences like (29) and double negations as in (30). But they still never guarantee the existence generalizationg in full.

More broadly, with each new case predicted by the Existence Generalization, additional assumptions seem required for Dynamic Semantics. Consider (31), repeated from (18). As sketched out earlier, we may want to explain the accessibility of the pronoun *it* by a process of accommodation: supposing the existence of a phone-book does not hold in the initial context, the hearer might be able to adjust the context they assume to one that guarantees that this presupposition holds.

(31) The person that placed it_i there knows that there is a phone-book_i in the cabinet.

What must the process of accommodation look like? In the Stalnakerian view which File-Change Semantics inspires itself from, accommodation consists in removing those worlds from the context which do not meet the presuppositions, as in (32)a. The natural extension in Dynamic Semantics would be (32)b, which performs the same operation, but on a set of world-assignment pairs. However, (32)b does not affect the assignment function and thus does not license a pronoun, as it should to account for (31). Rather, we must assume that accommodation does not simply take a subset of the context but additionally introduce a referent corresponding to the phone-book, even though that is not strictly required to meet the factive presupposition. In a theory that doesn't create a disconnect between worldly information and the availability of a discourse referent, the distinction between (32)b and (32)b would not be expressible and one would not need to stipulate that grammar behaves like (32)c, rather than (32)b.

(32)

a. Non-dynamic accommodation:
$C \rightarrow \{w \in C \mid \text{there is a phonebook in } w\}$

b. Dynamic accommodation (version I):
$C \rightarrow \{(w, g) \in C \mid \text{there is a phonebook in } w\}$

c. Dynamic accommodation (version II):
$C \rightarrow \{(w, g[i \rightarrow x]) \mid (w, g) \in C, x \text{ is a phonebook in } w\}$

In summary, while Dynamic Semantics does provide the beginning of a connection between presupposition satisfaction and pronoun accessibility, it does not guarantee the existence generalization in full. To reach closer to the generalization, additional stipulations must be made about the correct dynamic form of a connective (like negation) or the correct dynamic form of a pragmatic process (like accommodation). This point, as we'll see in section VI, extends to systems that do meet the challenge raised by negation mentioned above, such as Elliott (2020) or Hofmann (2019).

3.b The existence generalization in E-type theories

E-type theories are another major approach to the semantics of pronouns. They come with two assumptions. The first is that pronouns are underlyingly definite descriptions, as in (33).

(33) There is a phone-book.
It[= *the phone-book that there is*] is in the cabinet.

The second is an assumption that the semantic of definite descriptions involves a presupposition of existence and uniqueness[6], as in (34).

(34) $[\![\text{the}]\!](P) = [\exists!x, P(x)]\iota P$
(Notation: $[p]q$ means "*denotes q when p is satisfied, # otherwise*"; ιP is the unique element in the extension of P)

With (34), the second clause of (33) would have the following presupposition and assertion:

(35) It[= *the phone-book that there is*] is in the cabinet.
a. presupposes: *there is a phone-book, there is no more than one phone-book.*
b. asserts: *the phone-book that there is is in the cabinet.*

E-type theories, as described, stand very close to validating the existence generalization. Indeed, an existence presupposition is *one* of the licensing conditions of the pronoun, the other being a uniqueness presupposition. The connection between pronouns' accessibility conditions and presupposition satisfaction is more straightforward than in Dynamic Semantics: it is not merely that one system that underlies both constraints, it is that pronoun's accessibility conditions are truly presuppositions.

Yet, the E-type account still falls short of validating the generalization. There are two well-known challenges for the E-type account – *the formal link problem* and *strong uniqueness presuppositions* – and both imply a departure from the existence generalization as stated. First, the existence presupposition is only correct if we grant that the description that *it* stands for is truly "*the phone-book that there is*", as in (35). If we assumed that *it* stood for *the king of France*, then the licensing conditions of the pronoun would not match those expected by the existence generalization. This is sometimes called the *formal link* problem[7] (Kadmon 1987; Heim 1990). To truly validate the generalization, an answer to the formal link problem is required.

Second, the pronoun comes with a second licensing condition: the uniqueness presupposition. Under the E-type theory sketched, the pronoun *it* may not be used in (33) if there is more than one phone-book in the relevant location. This means that the accessibility conditions predicted by the E-type account are more stringent than those predicted by the existence generalization. As has been demonstrated in several

6 Following Mandelkern and Rothschild (2019), I do not call E-type theory any theory that posits that pronouns are definite descriptions *simpliciter*. There exists theories in which pronouns are indexed definite descriptions, embbeded within a Dynamic Semantics. But the properties of a system with indices and one without indices are altogether too different to warrant lumping them together.

7 The theory to be presented, which can be seen as an E-type theory without uniqueness, presents a syntactic solution to the formal link problem. There is also one other issue for the E-type approach that may carry over to the analysis here, namely the possibility of sloppy readings of discourse anaphora (Tomioka 1999). A solution to this problem within the current theory is offered in appendix A.

works since Heim (1982), uniqueness is not necessary for felicity, meaning the existence generalization is correct and the E-type account is not. Examples like (36) and (37) illustrate.

(36) If you own a cat, you also own its offspring.
(37) Jean did buy a sage-plant, as you asked.
But, since sage-plants come in packs of 6, she also bought five along with it.

The most well-known solution to the problem raised by the problematic uniqueness presupposition, consists in relativizing descriptions to situations (Heim 1990; Elbourne 2005). Without going into any details, (33) would become (38), where s is a minimal situation which contains just one phone-book. In effect, the restriction to s means that the uniqueness presupposition will be vacuously satisfied.

(38) There is a phone-book.
It[= the phone-book that there is in s] is in the cabinet.

With this solution, the pronoun's accessibility conditions are not simply tied to an existence presupposition, but also to the availability of a situation s that can trivialize the uniqueness presupposition. In Elbourne (2005), for instance, one assumes that *every* and other operators can pass on a minimal situation from restrictor to scope. When building a full compositional system around these premices, one finds that the economics of s start to resemble the economics of the context parameter C in a dynamic semantics, as argued most recently in Mandelkern and Rothschild (2019) (cf also Dekker (2004) and section 2 of Heim (1990)).

This move makes the accessibility conditions in the situational E-type approach much closer to the accessibility conditions of Dynamic Semantics: stipulations must be made about the correct form of connectives and quantifiers and these stipulations are not in principle related to patterns of presupposition projection. This therefore brings the E-type theory further away from validating the existence generalization.

The theory to be presented in the next section might be seen as a variant of the E-type theory. It embraces the idea that pronouns must meet an existence presupposition, but rejects that they come with a uniqueness presupposition. Furthermore, it does not commit to pronouns being definite descriptions[8], either syntactically or semantically.

III. The structure of pronouns

This section presents our main account of pronouns, in terms of choice functions. The idea of using choice functions comes from earlier proposals by van der Does (1993); Egli and Von Heusinger (1995). Though the initial ideas are similar, the implementation is very different and only the current proposal does justice to the existence generalization, as argued in section VI.1.

The idea behind the account, informally, is that pronouns pick their referent from a certain *witness set.* Naturally, they can only do so if the witness set in question is not empty; in other words, they carry an existence presupposition that the witness set contains an element. Whenever this existence presupposition is satisfied, whether through accommodation, through filtering, or simply by being met in the common

8 The exact syntactic and semantic relationship between definite descriptions and pronouns is an issue left outside the scope of the paper.

ground, the pronoun refers. This brings this account the closest to the Existence Generalization. Which witness set the pronoun is associated with (and thus which existence presupposition is triggered) is entirely determined by the the index born by the pronoun. Independently, some constraints impose that an antecedent can only carry an index if this index corresponds to its witness set. For instance, *there is a phonebook*$_{12}$ is only licensed if the witness set associated with 12 is the set of phone-books there.

1. Basic set-up

1.a A toy treatment of presuppositions

The account proposed can be built around any theory of presupposition projection, including so-called explanatory theories of presuppositions (Schlenker 2010; Rothschild 2011; George 2014). For concreteness of exposition though, a Middle Kleene trivalent account of presupposition projection will be assumed throughout. Concretely, I assume the domain of individuals D_e contains $\#_e$, the indeterminate individual and the domain of truth-values D_t contains #, a third truth-value besides 0 and 1. My assumptions are as follows: first, when the *et* or *eet* (etc.) denotation of a lexical predicate takes $\#_e$ as an argument, it is assumed that it returns a # truth-value, as in (39):

(39) $[\![\text{there}]\!]^w(\#_e) = \#$

Second, the meta-language expression $[p]q$ is used to represent the # truth-value when p represents the truth-value 1 and it is the truth-value represented by q otherwise. For instance, the expressions in (40) and (41) always represent the same truth-value.

(40) $[[\![\text{the phone-book}]\!]^w \neq \#_e]\ [\![\text{there}]\!]^w([\![\text{the phone-book}]\!]^w)$
(41) $[\![\text{there}]\!]^w([\![\text{the phone-book}]\!]^w)$

Second, we assume the denotations in (42) for common items like logical connectives and quantifiers. These denotations encapsulate certain standard projection behaviors: for instance, (42)a captures the fact that a presupposition from the second conjunct may be filtered by the assertion of the first, but not vice-versa; (42)c captures the fact that presupposition from the nuclear scope of *every* may be filtered by the restrictor[9].

(42) **Common items**[10]
a. $[\![\text{and}]\!]^w(q)(p) = [p \neq 0 \wedge p = 1 \rightarrow q \neq 0]\ p = 1 \wedge q = 1$
b. $[\![\text{or}]\!]^w(q)(p) = [p \neq 0 \wedge p = 0 \rightarrow q \neq 0]\ p = 1 \vee q = 1$
c. $[\![\text{every}]\!]^w(p)(q)$
$= [\forall x, p(x) = 1 \rightarrow q(x) \neq 0]\ \forall x, p(x) = 1 \rightarrow q(x) = 1$

In an "explanatory" theory, the projection behavior of these items would all follow from general principles, instead of being hard-coded in the behavior of lexical items as is done here. For the purpose of providing a working theory of presupposition

9 The denotation in (42)c also embodies the arguable assumption that the presuppositions from restrictors don't project. As far as I can tell, this has no impact on any later claims.

10 Our meta-language $\wedge$ (and other binary connectives) operates on truth-values, not formulas. Likewise, the equal sign = takes two truth-values and evaluates to 1 if they are equal. So the meta-language expression

projection, they are sufficient. The reader is referred to George (2008); Schlenker (2009); Rothschild (2011); Fox (2013) for attempts at such explanatory theories.

Finally, the pragmatics of # truth-value is regulated by the following bridge principle, as is standard:

(43) **Bridge principle**
A speaker can only utter S if $[\![S]\!]^w \neq \#$ for every world w of the common ground.

This principle is assumed violable. When faced with an utterance S, whose denotation evaluates to # in some worlds of the common ground, hearers may choose to accommodate a common ground in which this is not so. This is subject to some pragmatic conditions; for instance, accommodation cannot proceed if the assertion of S against the new accommodated common ground would be violate some other discourse conditions, such as making the assertion redundant, etc.

1.b Pronoun denotation

We assume, as is standard, that both pronouns and their indefinite antecedents[11] carry indices. Syntactic and semantic rules to be explained will then make sure that co-indexing a pronoun with an indefinite will make the pronoun co-vary with the indefinite. This theory thus assumes a formal link (Kadmon 1987) between pronouns and their antecedent, as in dynamic theories but unlike traditional E-type approaches.

To specify the interpretation of pronouns, we relativize the interpretation function to two parameters of interpretation: $G_{i,w}$ and $f_{i,w}$. $G_{i,w}$, called the *witness set*, defines, for every index i and every world w, a certain set of individuals ; it represents a certain group of entities from which one can pick a referent for the pronoun. For instance, in a sentence like (44), constraints that we will explain below will enforce that $G_{17,w}$ is the set of phone-books in w.

(44) There is a phone-book$_{17}$ and it$_{17}$ is in the cabinet.

$f_{i,w}$ defines, at every index i and every world w, a choice function. We define a choice function as any $(et)e$ function f such that (i) $f(S) \in S$ for any non-empty set S and (ii) $f(\emptyset) = \#_e$. $f_{i,w}$ will serve the purpose of picking from the pool of referents specified by $G_{i,w}$, the pronoun's referent. While choice functions are known from the literature of exceptional-scope indefinites, no connection is implied between these two phenomena; choice functions are merely used in their primitive sense of choosing from a non-empty set[12].

The rule for interpreting pronouns is given in (45). Simply put, a pronoun denotes a certain element from the witness set, picked by the choice function. According to this rule, *it* in (44) will come to denote a certain phone-book.

(45) $[\![\text{pro}_i]\!]^{G,f,w} = f_{i,w}\left(G_{i,w}\right)$

11 As discussed in section I, we focus on the case of singular indefinite antecedents ; extension to other cases are discussed in section VII.

12 One may, for instance, completely dispense from using choice functions, by assuming a form of Alternative Semantics, where the pronoun refers to a set of referents (as proposed in e.g. Chatain (2018)). This goes to show that choice functions are a mere technical expedient.

Since choice functions, in our definition, yield $\#_e$ when their input is an empty set, it follows that pronouns carry a presupposition that $G_{i,w}$ is not empty. Coming back to our theoretical desiderata, this has two consequences. First, pronouns cannot be interpreted if this existence presupposition isn't satisfied. Second, and conversely, pronouns receive an interpretation as soon as their existence presupposition is met. This is what allows us to validate the existence generalization: pronouns will indeed denote as soon as a certain existence presupposition holds (and there is an antecedent in the surrounding linguistic context).

2. Rules for *G* and *f*

Some constraints on *G* and *f* need to be added. In (44) for instance, we specifically want the index 17 on *phone-book* to require $G_{17,w}$ to be the set of phone-books in *w*.

The strategy adopted is counter-intuitive. To explain it informally first, I will assume that *G* and *f* are maximally unconstrained: any combination of set and choice function can be represented by some $G_{i,w}$ and $f_{i,w}$, for a certain value of *i*. I will then offer rules on indexation that limit what indices can be put on a given DP. Hearers are, in this view, not at a liberty to parse the sentence "there is a phone-book" as either "there is a phone-book$_{15}$" or "there is a phone-book$_{98}$", using any index. The choice of the index is meaningful. This is a departure from the traditional use of indices in e.g. Dynamic Semantics where the choice of a particular index is arbitrary and only co-indexation is meaningful. In this system, indices truly name sets and choice functions.

The reason to set up this non-traditional filtering system is to be able to assume that *G* and *f* are constant parameters of interpretation throughout discourse. For instance, the two sentences in (46) will be evaluated against the same *G* and *f,* as will be all other sentences.

(46) There is a phone-book$_i$. It$_i$ is in the cabinet.

In particular, we don't need to discuss the pragmatics or discourse update of these parameters. Because they are constants of interpretation, I will write $[\![\cdot]\!]^w$ instead of $[\![\cdot]\!]^{G,f,w}$ (following the same logic that allows one to omit the model parameter from the interpretation function).

2.a Expressivity constraint

Formally, *G* and *f* are required to satisfy the expressivity constraint[13] in (47). This constraint guarantees that indices can name any possible set and choice-functions. For instance, it guarantees that there is some index *i* for which $G_{i,w}$ is the set of phone-books in *w* and $f_{i,w}$ the function that picks from a set its longest element (in *w*). A pronoun with that particular index *i*, according to rule (45), would then always pick the longest phone-book in *w*.

(47) **Expressivity constraint on *G* and *f***
For any mapping π from worlds to sets of individuals and any mapping γ

13 For the expressivity constraint to be meet-able, we have to assume that indices include more things than the familiar numerical indices, because the set that indices must map surjectively to has a cardinality larger than $\aleph_0$.

from worlds to choice functions, there is an i such that, for all w, $G_{i,w} = \pi(w)$ and $f_{i,w} = \gamma(w)$

2.b Constraint on indexing

We then state a constraint restricting the use of indices on indefinites to only certain indices. This constraint is preliminary and will be extended when moving to embedded contexts in section IV.

(48) **Constraint on indexing** (preliminary)
A structure like "[a/some RESTR]$_i$ SCOPE" is felicitous only if, for all worlds w, $G_{i,w} = [\![\text{SCOPE}]\!]^w \cap [\![\text{RESTR}]\!]^w$

The constraint in (48) makes it so that most indices cannot be used to index indefinites like "*a phone-book*" in (44). Only those i for which $G_{i,w} = [\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w$ for all worlds w will be felicitous. Such indices exist because of the expressivity constraint stated in the previous section. In particular, it means that we can't write "*a phone-book*$_{15}$", because we don't know whether 15 meets the constraint in (48). In the sequel, I will index indefinites with *i, j* and such, assuming that i and j are indices which meet (48). The expressivity constraint will guarantee that such indices always exist.

2.c Correct felicity conditions, incorrect truth-conditions

Consider the simple example in (49). Given the indexing in (49), the indexing constraint requires that we pick an index i such that $G_{i,w}$ is as in (49)a. From then on, we can derive the rule for pronoun interpretation in (45) and standard compositional rules predict that the meaning of the second conjunct of (49) is as in (49)c.

(49) There is a phone-book$_i$ and it$_i$ is in the cabinet.
a. $G_{i,w} = [\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w$ (by the constraint on indexing)
b. $[\![\text{there is a phone-book}_i]\!]^w = \exists x, [\![\text{phone-book}]\!]^w(x) \cap [\![\text{there}]\!]^w(x)$
c. $[\![\text{it}_i \text{ is in the cabinet}]\!]^w$
$= [\![\text{in the cabinet}]\!]^w\left([\![\text{it}_i]\!]^w\right)$
$= [\![\text{in the cabinet}]\!]^w\left(f_{i,w}(G_{i,w})\right)$ (pronoun interpretation rule)
$= [\![\text{in the cabinet}]\!]^w\left(f_{i,w}\left([\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w\right)\right)$ (replacing $G_{i,w}$)
$\approx$ *a certain phone-book is in the cabinet* (pres.: *there is a phone-book*)

The denotation of second conjunct is not # in any world w where the set $[\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w$ is not empty (e.g. $[\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w \neq \emptyset$). Indeed, in this case, the choice function yields $\#_e$; the predicate denoted by *in the cabinet,* when applied to $\#_e$, returns #. In other words, the second conjunct presupposes the existence of a phone-book.

The definedness conditions and truth-conditions of the whole utterance are obtained by applying the denotation of conjunction assumed in (42)a. As is standard, this denotation derives that the whole conjunction will be undefined if either the first conjunct is undefined or it is true but the second conjunct is undefined. As seen in (50), this condition is trivially met, which means the pronoun in (49) is felicitous no matter what is common ground between participants.

(50) **Definedness conditions**
$[\![\text{there is a phone-book}_i \text{ and it}_i \text{ is in the cabinet}]\!]^w \neq \#$
iff $[\![\text{there is a phonebook}_i]\!]^w = 1 \rightarrow [\![\text{it}_i \text{ is in the cabinet}]\!]^w \neq \#$
iff $[\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w \neq \emptyset \rightarrow [\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w \neq \emptyset$

While the sentence is predicted felicitous, the truth-conditions, on the other hand, are not correct. As is standard, the whole conjunction is true if both conjuncts are true (and in particular defined), as described in (51). In plain language, these truth-conditions assert that there is a phone-book and a specific phone-book is in the cabinet. In typical contexts, such truth-conditions would be just fine: indeed, the first conjunct *there is a phone-book* would carry the implicature that there is a unique phone-book and the truth-conditions, with the implicature, would amount to the proposition that the one phone-book that there is is in the cabinet.

(51) **Truth-conditions**
$[\![\text{there is a phone-book}_i \text{ and it}_i \text{ is in the cabinet}]\!]^w = 1$
iff $[\![\text{there is a phonebook}_i]\!]^w = 1 \wedge [\![\text{it}_i \text{ is in the cabinet}]\!]^w = 1$
iff $[\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w \neq \emptyset$
$\wedge [\![\text{in the cabinet}]\!]^w \left(f_{i,w} \left([\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w \right) \right) = 1$

Different truth-conditions are revealed in contexts where uniqueness cannot be assumed (cf, in that connection, the discussion of E-type approaches in section II.3.b). One way to create such a context is through embedding as in (52).

(52) If there is a phone-book$_i$ and it$_i$ is in the cabinet, call me.
Otherwise, don't call me.

The reported intuition for sentences like (52) is that the hearer should call the speaker, if there is any phone-book in the cabinet. In other words, the truth-conditions of the clause where the pronoun appears can be rendered as in (53).

(53) $\exists x, [\![\text{phonebook}]\!]^w(x) \wedge [\![\text{there}]\!]^w(x) \wedge [\![\text{in the cabinet}]\!]^w(x)$

In particular, the truth-conditions in (51), which yield truth when a *specific* phone-book is in the cabinet and falsity if *that* phone-book isn't in the cabinet, are too strong.

The problem of obtaining the correct truth-conditions is tightly linked to the elusive problem of existential/universal readings of pronouns; to keep complexity incremental, I postpone a full discussion of this problem to section V.1. We assume, from now on, that our sentences are uttered in "typical contexts", loosely defined as sentences where there is at most one phone-book (or whatever the relevant witness might be) and we aim to guarantee correct truth-conditions in such contexts.

Second, the system does not predict impossible co-indexing relationships like (54).

(54) # There isn't a phone-book$_i$ and it$_i$ is in the cabinet

The definedness conditions for this sentence are derived in (55): for the sentence to be utterable, the fact that there is a phone-book must be common ground. Given the meaning of the first conjunct, this means that the sentence may never be true. The truth-conditions in (56) are simply unmeetable, which is grounds for infelicity.

(55) **Definedness conditions**
$[\![\text{there isn't a phone-book}_i \text{ and it}_i \text{ is in the cabinet}]\!]^w \neq \#$
iff $[\![\text{there isn't a phonebook}_i]\!]^w = 1 \rightarrow [\![\text{it}_i \text{ is in the cabinet}]\!]^w \neq \#$
iff $[\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w = \emptyset \rightarrow [\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w \neq \emptyset$

iff $[\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w \neq \emptyset$

(56) **Truth-conditions**
$[\![\text{there is a phone-book}_i \text{ and it}_i \text{ is in the cabinet}]\!]^w = 1$
iff $[\![\text{there is a phonebook}_i]\!]^w = 1 \wedge [\![\text{it}_i \text{ is in the cabinet}]\!]^w = 1$
iff $[\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w = \emptyset$
$\wedge [\![\text{in the cabinet}]\!]^w \left(f_{i,w} \left([\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w \right) \right) = 1$
iff $[\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w \neq \emptyset \wedge [\![\text{in the cabinet}]\!]^w (f_{i,w}(\emptyset)) = 1$
iff $[\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w \neq \emptyset \wedge [\![\text{in the cabinet}]\!]^w (\#_e) = 1$
iff $[\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w \neq \emptyset \wedge \# = 1$

3. Deriving the case studies

We may now derive in details all the case studies from section II.2, as well as other cases of interest such as bathroom sentences (in (57)b) and modal subordination cases (in (57)c). The logic is similar in each case: we first determine the presupposition associated with the pronoun, by examining the index carried by its antecedent. We can then examine whether the resulting presupposition can be filtered, accommodated or common ground.

(57) Case studies
a. There is a phone-book$_i$ and it$_i$ is in the cabinet.
b. Either there isn't a phone-book$_i$ or it$_i$ is in the cabinet.
c. There might be a phone-book$_i$. It$_i$ would be in the cabinet.
d. It$_i$'s not available at the library now but there is a phone-book$_i$.
e. # It$_i$ is in the cabinet and there is a phone-book$_i$.

In all of the sentences in (57), the restriction and scope of the indexed indefinite *"a phone-book$_i$"* is the same. By the constraint on indexing, we know this index is only licensed if the witness set is the set of phone-book that there is, i.e. .

(58) $G_{i,w} = [\![\text{there}]\!]^w \cap [\![\text{phone-book}]\!]^w$

The minimal clause that hosts the pronoun in each of the cases in (57)a-c is also the same. Abstracting away from tense and modality, we represent it as *it be in the cabinet*. They all receive the denotation seen in the cross-conjunction example of the previous section, namely (59). This clause has a defined truth-value whenever there is a phone-book. When defined, it is true if *a certain phone-book that there is is in the cabinet*.

(59) $[\![\text{it}_i \text{ be in the cabinet}]\!]^w$
$= [\![\text{in the cabinet}]\!]^w \left([\![\text{it}_i]\!]^w \right)$
$= [\![\text{in the cabinet}]\!]^w \left(f_{i,w}(G_{i,w}) \right)$ (pronoun interpretation rule)
$= [\![\text{in the cabinet}]\!]^w \left(f_{i,w} \left([\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w \right) \right)$ (replacing $G_{i,w}$)
$\approx$ *a certain phone-book is in the cabinet* (pres.: *there is a phone-book*)
$\neq$ # iff $[\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w \neq \emptyset$

Likewise, the clause *it's not available now at the library* will have defined truth-value if there is a phone-book and will be true if a certain phone-book is not available at the library at the time of the utterance.

(60) $[\![\text{it}_i \text{ is not available at the library now}]\!]^w$
$= [\![\text{not}]\!]^w \left([\![\text{available...}]\!]^w \left(f_{i,w} \left([\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w \right) \right) \right)$
$= [[\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w \neq \emptyset]\ [\![\text{available...}]\!](f_{iw}([\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w)) = 0$

I claim that the presupposition that there is a phone-book can be filtered in all sentences (57)a-d and therefore, that the pronoun will be felicitous in these sentences, regardless of the common ground. To see that this is so, it suffices to consider the presuppositional counterparts of (57)a-d given in (61). There, the pronoun is replaced by an element (*unaware*) triggering the presupposition that there is a phone-book, the same presupposition that is, in this theory, triggered by *it be in the cabinet* or *it's not available in the library now*.

(61) Presuppositional counterparts to (57)
a. There is a phone-book and Jane is unaware that there is one.
b. Either there isn't a phone-book or Jane is unaware that there is one.
c. There might be a phone-book. Jane would be unaware that there is one.
d. Jane is unaware that there is one but there is a phone-book.

A good theory of presuppositions ought to be able to account for the felicity of the examples in (61). Using this theory of presuppositions in conjunction with the present proposal pronouns, the felicity of all examples in (57)a-d will follow.

For concreteness though, we illustrate using the toy theory of presuppositions of section II.2.a. Starting with the "bathroom" case of (57)b, the denotation of *or* provided in section II.2.a (which embodies the standardly assumed projection behavior of *or*) guarantees that (57)b is defined when the conditions in (62) are met. As with conjunction, these conditions trivially hold and the pronoun receives an interpretation no matter what is common ground between speaker and hearer.

(62) **Definedness conditions**
$[\![\text{there isn't a phonebook}_i]\!]^w = 0 \rightarrow [\![\text{it}_i \text{ is in the cabinet}]\!]^w \neq \#$
iff $[\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w \neq \emptyset \rightarrow [\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w \neq \emptyset$

The truth-conditions also follows from the denotation for *or*. Informally, the sentence will be true if either there isn't a phone-book or a certain phone-book (whichever one is picked by f) is in the cabinet. As with conjunction, these truth-conditions are correct in situation where there is at most one phone-book but not when more may be involved; again, we defer all discussion of such issues to section V.1.

(63) **Truth-conditions**
$[\![(57)\text{b}]\!] = 1$
iff $[\![\text{there isn't a phonebook}_i]\!]^w = 1 \vee [\![\text{it}_i \text{ is in the cabinet}]\!]^w = 1$
iff $[\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w \neq \emptyset$
$\vee [\![\text{cabinet}]\!]^w(f_{i,w}([\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w)) = 1$

For the modal subordination case of (57)c, I assume *would* is a universal modal quantifier with a contextually provided accessibility relation R. Its denotation can be modeled after the denotation for *every* given in section III.1.a:

(64) $[\![\text{would}]\!]^w(R)(p)$
$= [\forall w', R(w)(w') = 1 \rightarrow p(w') \neq 0]\ \forall w', R(w)(w') = 1 \rightarrow p(w') = 1$

Given the previous sentence[14], I assume that the contextually salient accessibility relation is one relating the actual world to those epistemically accessible worlds where there is a phone-book as in (65). That such relation becomes salient is independently

14 Alternatively, we may wish to treat the restriction of *would* as provided anaphorically by the *might* in the previous clause. This would require providing a constraint on indexing for modals and require the theory of quantificational subordination, which we develop in section IV.

motivated from other *might-would* sequences that do not have presuppositions or pronouns like (66) ; there, the *would* sentence quantifies over worlds where the army stages a coup. In other words, *would* is "subordinated" to the previous *might*.

(65) $R = \lambda w.\lambda w'.\ w \sim w' \wedge [\![\text{phonebook}]\!]^{w'} \cap [\![\text{there}]\!]^{w'} \neq \emptyset$

(66) The army might stage a coup. There would be major riots in the capital.

Given (64) and the assumed R, the definedness conditions of (57)c are as given in (67) ; they are again trivially met. The truth-conditions are given in (68); they assert that in every epistemically accessible world where there is a phone-book, a certain phone-book that there is is in the cabinet.

(67) Definedness conditions

$\forall w', (w \sim w' \wedge [\![\text{phone-book}]\!]^{w'} \cap [\![\text{there}]\!]^{w'} \neq \emptyset) \rightarrow [\![\text{phone-book}]\!]^{w'} \cap [\![\text{there}]\!]^{w'} \neq \emptyset$

(68) Truth-conditions

$\forall w', (w \sim w' \wedge [\![\text{phone-book}]\!]^{w'} \cap [\![\text{there}]\!]^{w'} \neq \emptyset) \rightarrow [\![\text{cabinet}]\!]^{w'}(f_{i,w'}([\![\text{phonebook}]\!]^{w'} \cap [\![\text{there}]\!]^{w'})) = 1$

The case of *but*-conjunctions in (57)d and its presuppositional counter-part in (61)d are special. As far I can tell, they do not clearly follow from leading theories of presupposition projection. The strength of the present theory is that the stipulations needed to account for the projection behavior of *but* in the presuppositional case of (61)d are automatically adequate to the pronominal case in (57)d.

Offering an account of the projection behavior of *but* is beyond our scope and orthogonal to our point. The simplest assumptions needed to capture the behavior of *but*[15] would be to assume that *but* has the semantics in (69). Ignoring its contrastive semantics, *but* is a conjunction whether either conjunct may filter the presuppositions of the other (i.e. has the semantics of Strong Kleene conjunction).

(69) $[\![\text{but}]\!]^w(q)(p) = [q = 1 \rightarrow p \neq 0 \wedge p = 1 \rightarrow q \neq 0]\ p = 1 \wedge q = 1$

With this assumption, the definedness conditions of (57)d are as in (70) and, again, trivial.

(70) **Definedness conditions**

$[\![\text{there is a phonebook}_i]\!]^w = 1 \rightarrow [\![\text{it}_i \text{ is not available...}]\!]^w \neq \#$
$\wedge [\![\text{it}_i \text{ is not available...}]\!]^w = 1 \rightarrow [\![\text{there is a phonebook}_i]\!]^w \neq \#$
iff $[\![\text{there is a phonebook}_i]\!]^w = 1 \rightarrow [\![\text{it}_i \text{ is not available...}]\!]^w \neq \#$
iff $[\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w \neq \emptyset \rightarrow [\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w \neq \emptyset$

The truth-conditions are the same as those for conjunction. They assert that there is a phone-book and that a certain phone-book that there is is in the cabinet.

(71) **Truth-conditions**

$[\![\text{there is a phone-book}_i \text{ but it}_i \text{ is in the cabinet}]\!]^w = 1$
iff $[\![\text{there is a phonebook}_i]\!]^w = 1 \wedge [\![\text{it}_i \text{ is in the cabinet}]\!]^w = 1$
iff $[\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w \neq \emptyset$
$\wedge [\![\text{in the cabinet}]\!]^w \left(f_{i,w} \left([\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w \right) \right) = 1$

Finally, the infelicity of example (57)e follows from patterns of presupposition projection. First, it should be noted that its presuppositional counterpart, given

15 One may additionally claim that *but* does not truly filter presuppositions symmetrically. Just like *and*, it projects presuppositions from its first conjunct. Unlike *and*, these presuppositions do not lead to a redundancy violation, as happens with conjunction, because of the contrasting meaning of *but*.

in (72), is also infelicitous. So an account of the infelicity of (72) will predict (57)e's infelicity.

(72) # Jane is unaware that there is a phone-book and there is one.

The account is standard: in this case, it is assumed that the presuppositions of the first conjunct may not be filtered by the second one and must thus project into the definedness conditions of the whole utterance. Our denotation for *and* encodes this left-to-right bias and delivers (73) as the definedness conditions of the sentence. Both (72) and (57)e will require, by Stalnaker's bridge principle, that, in all worlds of the common ground, there is a phone-book. However, in such a common ground, the second conjunct *there is a phone-book* would be redundant and thus the conjunction is infelicitous.

(73) **Definedness conditions:**
$[\![\text{it}_i \text{ is in the cabinet}]\!]^w \neq \#$
iff $[\![\text{phonebook}]\!]^w \cap [\![\text{there}]\!]^w \neq \emptyset$

4. Pronouns without antecedents

(74) # It_i is in the cabinet.

In the system presented so far, the structure in (74) may be entirely felicitous in out-of-the-blue contexts, even when no linguistic antecedent is available. Indeed, whether (74) is felicitous depends on whether the presupposition that $G_{i,w}$ is not empty can be met in the context. For certain indices, that will be so: by the expressivity constraint, there is an index i_1 such that $G_{i_1,w}$ is the set of cats in w, an index i_2 such that $G_{i_2,w}$ is the set of motorcycles in w ; it is not conversationally odd to presuppose that such sets are not empty. So quite a few parses of (74) will be felicitous and yield coherent meanings. Why then is (74) deviant?

To deal with this issue, a couple of observations are required. First, there is no general ban against antecedent-less pronouns ; while (74) is infelicitous, richer contexts make antecedent-less pronouns such as those in (75) and (76) entirely natural.

(75) **Context:** *some politician appears on the TV we are both watching*.
I hope she doesn't win.

(76) **Context:** *you're struggling to fit a suitcase in the car trunk.*
It'll fit if you turn it the other way.

There does not seem to be a sharp dividing line between the acceptable (75)-(76) and the unacceptable (74). In cases like (77), I may be genuinely confused whether you're referring to Mrs. H or Mrs. M and know you intend to refer to one of the two.

(77) **Context:** *this morning, you told me* de visu *that you are supposed to meet Mrs. H so that she can introduce you to Mrs. M today. You and I both know that. A few hours later in the day, you text me:*
I'm still waiting for her so I might be home late.

So a general desideratum on all theories of anaphora is to make certain antecedent-less pronouns felicitous, while simultaneously offering soft constraints that restrict their use, for cases like (74). In other theories, e.g. dynamic theories, this may be achieved by assuming that the assignment function is not defined at any index *i,* when no antecedent indexed *i* precedes. This would predict the infelicity of (74). For cases like

(75)-(76), these theories must also posit the existence of some pragmatic mechanism that, in rich scenarios, may give *i* a value in the absence of an antecedent.

The current theory, as mentioned earlier, allows antecedent-less pronouns. However, their use are constrained by the recoverability of the intended parse. Upon hearing the phonological string in (78), lack of contextual or linguistic cues may make one unable to understand whether the speaker meant (78)a, (78)b or any of the many parses the sentence has. I make the assumption that severe under-determination of this sort is behind the type of infelicity observed in (74).

(78) It is in the cabinet.
  a. It_{45} is in the cabinet ($G_{45,w}$= set of watches there in w)
  b. It_{57} is in the cabinet ($G_{57,w}$= set of cameras there in w)
  c. ...

The proposal is unspecified in which factors are sufficient to break the under-determination but co-indexation seems to be one. From the perfect acceptability of (79), we must assume that in the absence of other clues, co-indexed parses like (79)d are preferred over all other parses.

(79) There is a phone-book and it is in the cabinet.
  a. There is a $phone\text{-}book_i$ and it_{45} is in the cabinet
  b. There is a $phone\text{-}book_i$ and it_{57} is in the cabinet
  c. ...
  d. There is a $phone\text{-}book_i$ and it_i is in the cabinet
  e. ...

There are indications that this approach to "antecedent-less pronouns" will need to be specified further. Consider Partee's marble contrast in (80). Partee notes that it seems impossible in (80)a to refer to that one marble that hasn't been found, even though its existence is asserted and made salient by the previous utterance. By contrast, the truth-conditionally equivalent example in (80)b is extremely natural.

(80)
  a. Only nine out of the ten marbles have been found.
    # We're still looking for it_j.
  b. Only one out of the ten $marbles_i$ hasn't been found.
    We're still looking for it_j.

It is a harder problem than is typically recognized. The basic dilemma is this: if a theory can explain the felicity of certain antecedent-less pronouns like (75)-(76), how can it prevent (80)a from receiving its salient referent from the context? Indeed, most theories don't discuss the mechanism that licenses such pronouns in sufficient details that may make a prediction for the case of (80)a. For instance, in the analysis of antecedent-less pronouns sketched earlier for dynamic analyses, one must explain why the pragmatic process that may introduces referents in rich context cannot apply here. The present theory suffers from the same problem: the threshold of "recoverability of a parse" is left unspecified and so it is not clear why (80)a does not clear it.

Short of explaining the infelicity of (80)a, the problem of explaining the contrast in (80) is simpler. There is a difference between (80)a and (80)b that explains differences in recoverability: (80)b, unlike (80)a, can have a parse where the pronoun is co-indexed with a previous quantifier (as indicated by the indices). Since we stipulated earlier that

co-indexed parses must be particularly recoverable, it is predicted that (80)b is more felicitous than (80)a.

IV. Pronouns under quantifiers: donkey and subordination

We now move to cases of pronouns with indefinite antecedents in quantified contexts. Two cases of interest to the theorist are cases of quantificational subordination, like (81)a, and cases of donkey pronouns, like (81)b. These cases are interesting because, in both cases, the antecedent and the pronoun have different scopes.

(81) **Quantified examples**
   a. Every tourist bought a ticket$_i$. Most have already used it$_i$.
   b. Every tourist who bought a ticket$_i$ has already used it$_i$.

To deal with the examples in (81), one minimal amendment to the hypotheses introduced in the last section will be required: we will need the set of discourse referents to be dependent on an assignment function.

1. Bound and unbound pronouns

Focusing on the quantificational subordination case in (81)a, let's investigate the effect of indexing an indefinite embedded under a quantifier. After QR, the LF is given in (82).

(82) [every tourist] λ1 [a ticket]$_i$ λ2 t_1 bought t_2

At this stage, a remark is in order. In a classical compositional treatment e.g. Heim and Kratzer (1998), the interpretation of traces is also assumed to be essentially the same as the interpretation of bound pronouns, traces being nothing but a special sort of pronouns, see (84).

(83) Lambda-abstraction:
$[\![\lambda i.\ \mathrm{XP}]\!]^{w,g} = \lambda x.\ [\![\mathrm{XP}]\!]^{w,g[i \to x]}$

(84) **Pronoun interpretation:**
$[\![t_i]\!]^{w,g} = [\![\mathrm{pro}_i]\!]^{w,g} = g(i)$

The problems is that we already committed to a certain interpretation for pronouns, when we assumed the rule in (45). Ideally, one would want a unified interpretation for pronouns, which can cover both discourse pronouns with indefinite antecedents and bound pronouns/traces. In this paper, for simplicity and to keep the scope of the project restricted, I distinguish between the interpretation of bound[16] pronouns and discourse-anaphoric pronouns. The former falls under the classical regime of assignment functions and binders, whose rules are given in (83) and (84). The latter is what this article is about.

Making the distinction between bound pronouns and discourse pronouns also implies distinguishing between the indices carried by binders, traces and bound pronouns and those carried by indefinites and unbound pronouns. As a matter of convention, I will use letters from the beginning of the alphabet for the indices carried by bound

16 Here, I use the word *bound* to mean semantic c-command co-variation. Other forms of co-variation are called *discourse-anaphoric*.

pronouns (the binding indices), keeping numerical indices and letters starting from i for the discourse-anaphoric pronouns this piece focused on. With this convention, (82) becomes (85):

(85) [every tourist] λa [a ticket]$_i$ λb t_a bought t_b

Another consequence of making this distinction is that the interpretation function (previously $[\![\cdot]\!]^w$) must now be relativized to assignment functions $[\![\cdot]\!]^{w,g}$ (as in the rules in (83) and (84)).

Given that, to my knowledge, no language has been reported to use different lexical items for bound and unbound uses[17], this is evidently unsatisfactory ; a unified treatment is called for. I however will leave this unified treatment to future research.

2. Relativizing to assignment functions

(86) [every tourist] λa [a ticket]$_i$ λb t_a bought t_b

With these remarks, we turn back to what constraints are placed on index i by choosing to index *a ticket* with this index. The indexing constraint from section III.2.b is repeated below.

(87) **Constraint on indexing** (preliminary)
A structure like "[a/some RESTR]$_i$ SCOPE" is felicitous only if, for all worlds w, $G_{i,w} = [\![\text{SCOPE}]\!]^w \cap [\![\text{RESTR}]\!]^w$

Since the interpretation function is now relative not only to w but to g, the rule in (87) needs to be adapted. The first adaptation is to assume that the witness set G is dependent on an assignment function (on top of its dependency on a world and an index): $G_{i,w,g}$. Likewise for the choice function: $f_{i,w,g}$.

Recall G and f were required to meet an expressivity constraint. This constraint ensures that for any intensional set and choice function, one could always find *an* index i for which $G_{i,w}$ and $f_{i,w}$ are that set and that choice function. This rule as also needs to be adapted, since f and G now carry more parameters:

(88) **Expressivity constraint on G and f**
For any mapping π from world-assignment pairs to sets of individuals and any mapping γ from world-assignment pairs to choice functions, there is an i such that, for all w, $G_{i,w,g} = \pi(w,g)$ and $f_{i,w,g} = \gamma(w,g)$

With these modifications, the constraint on indexing can be corrected:

(89) **Constraint on indexing** (final)
A structure like "[a/some RESTR]$_i$ SCOPE" is felicitous only if, for all worlds w and all assignments g, $G_{i,w,g} = [\![\text{SCOPE}]\!]^{w,g} \cap [\![\text{RESTR}]\!]^{w,g}$

Finally, the interpretation of (discourse-anaphoric) pronouns is modified to make them assignment-sensitive:

17 There has been claims that, in subject pro-drop languages, overt pronouns cannot be bound (*overt pronoun constraint,* Montalbetti (1984)). On the other hand, it is assumed that control PRO and reflexive anaphors can only be bound. Neither type of case is close to the desired language, since both types of pronouns are regulated by more constraints than simply being semantically bound or unbound.

(90) **Discourse-anaphoric pronoun interpretation**
$[\![\text{pro}_i]\!]^{w,g} = \left[G_{i,w,g} \neq \emptyset\right] f_{i,w,g}\left(G_{i,w,g}\right)$

As a concrete example, consider the effect of indexing *a ticket* with *i* in the LF below. The indexing constraint imposes that this indexing is only valid if the witness set $G_{i,w,g}$ is the set of tickets bought by $g(a)$.

(91) [every tourist] λa [a ticket]$_i$ λb t_a bought t_b
(92) $G_{i,w,g} = [\![\text{ticket}]\!]^{w,g} \cap \lambda x.[\![\text{bought}]\!]^{w,g}(x)(g(a))$

To simplify, we write ticket-bought$_w(x)$ for the set of tickets bought by x in w (or the predicate true of members of that set). We thus rewrite (92) as :

(93) $G_{i,w,g} = \text{ticket-bought}_w(g(a))$

We are now in a position to give an account of the subordination sequence in (94). We assume the LF in (94)a, where the restrictor of *most*, i.e. *tourists*, is elided. By the pronoun interpretation rule in (90), the pronoun in the second sentence refers to a certain ticket that $g(a)$ bought, presupposing that there is at least one such ticket:

(94) Every tourist bought a ticket$_i$. Most have already used it$_i$.
a. [most ~~tourists~~] λa t_a have already used it$_i$
b. $[\![\text{it}_i]\!]^{w,g} = \begin{array}{l}\left[\text{ticket-bought}_w(g(a)) \neq \emptyset\right] \\ f_{i,w,g}\left(\text{ticket-bought}_w(g(a))\right)\end{array}$

We then compose the VP as in (95) ; the VP is defined for y if there is some ticket that y bought. When defined, it is true if y used a certain ticket that y bought (whichever is picked by f).

(95) $\left[\!\left[\lambda a.\ t_a \text{ have already used it}_i\right]\!\right]^{w,g}$
$= \lambda y.\ \left[\!\left[t_a \text{ have already used it}_i\right]\!\right]^{w,g[a\to y]}$
$= \lambda y.\ \begin{array}{l}\left[\text{ticket-bought}_w(y) \neq \emptyset\right] \\ \text{used}(f_{i,w,g}\left(\text{ticket-bought}_w(y)\right)(y)\end{array}$

The truth-value denoted by the whole clause in w will depend on how presuppositions project out of *most*. There may be controversy in the literature regarding how presupposition should project out of various quantifiers: universally, existentially, Strong Kleene projection, etc. For our purposes, we assume the strongest of all projection rules, the universal rule; if the pronoun's presupposition can be satisfied in that case, it will also be satisfied under weaker assumptions. This projection rule is embodied by the denotation for *most* given in (96).

(96) $[\![\text{most}]\!]^{w,g}(p)(q)$
$= [\forall x, p(x) = 1 \to q(x) \neq \#] \dfrac{\text{Card}\{x \mid p(x) = q(x) = 1\}}{\text{Card}\{x \mid p(x) = 1\}} > \dfrac{1}{2}$

Given this denotation, the whole clause composes to yield the definedness conditions in (97) and the truth-conditions in (98). The sentence is defined in w iff every tourist in w bought a ticket and true if most used a certain ticket that they bought.

(97) Definedness conditions
$[\![(94)\text{a}]\!] \neq \#$
iff $\forall x, [\![\text{tourist}]\!]^{w,g}(x) = 1 \to \text{ticket-bought}_w(x) \neq \emptyset$

(98) **Truth-conditions**

$[\![(94)\text{a}]\!] = 1$

$$\text{iff } \frac{\text{Card}\left\{y \;\middle|\; \begin{array}{l}[\![\text{tourist}]\!]^{w,g}(y) = 1 \\ \wedge \text{used}(f_{i,w,g}(\text{ticket-bought}_w(y)))(y) = 1\end{array}\right\}}{\text{Card}\left\{y \mid [\![\text{tourist}]\!]^{w,g}(y) = 1\right\}} > \frac{1}{2}$$

The definedness conditions of (97) are precisely what is asserted by the previous clause. The truth-conditions assert that more than half of the tourists have already used a certain ticket that they bought. We'll come back to these truth-conditions in section V.1

3. Donkey pronouns

With this apparatus in place, donkey sentences as in (99) can also be accounted for. A standard LF would be as in (99)a. Given this LF, the indexing constraint imposes that the index i be such that $G_{i,w,g}$ is the set in (99)b: the set of tickets bought by $g(a)$. Endowed with this index, the pronoun has the denotation in (99)c and presupposes that the latter set is not empty ; in other words that $g(a)$ bought a ticket.

(99) Every tourist who bought a ticket$_i$ has already used it$_i$.

a. **LF:** [every tourist [λa. [a ticket]$_i$ λb. t_a bought t_b]] [λa. t_a has used it$_i$]

b. $G_{i,w,g} = \text{ticket-bought}_w(g(a))$

c. $[\![\text{it}_i]\!]^{w,g} = \begin{array}{l}\left[\text{ticket-bought}_w(g(a)) \neq \emptyset\right] \\ f_{i,w,g}\left(\text{ticket-bought}_w(g(a))\right)\end{array}$

The VP then receives the denotation in (100):

(100) $[\![\lambda a.\ t_a \text{ have already used it}_i]\!]^{w,g}$

$= \lambda y.\ [\![t_a \text{ have already used it}_i]\!]^{w,g[a\to y]}$

$= \lambda y.\ \begin{array}{l}\left[\text{ticket-bought}_w(y) \neq \emptyset\right] \\ \text{used}(f_{i,w,g}\left(\text{ticket-bought}_w(y)\right))(y)\end{array}$

Using standard rules of composition, the restrictor composes to yield:

(101) $[\![\lambda a.\ [\text{a ticket}]\lambda b.\ t_a \text{ bought } t_b]\!]^{w,g}$

$= \lambda y.\ [\![\text{ticket}]\!]^{w,g} \cap [\lambda x.\ [\![\text{bought}]\!]^{w,g}(x)(y)] \neq \emptyset$

$= \lambda y.\ \text{ticket-bought}_w(y) \neq \emptyset$

Finally, using the denotation for *every* from section III.1.a, we derive the definedness and truth-conditions for the whole sentence as in (102) and (103). The definedness conditions are trivial: the scope's presupposition that y bought a ticket is successfully filtered by the restrictor.

(102)Definedness conditions

$\forall x, [\![\text{tourist who bought a ticket}]\!]^{w,g}(x) = 1 \to [\![\text{has already used it}]\!]^{w,g}(x) \neq \#$

$\forall x, [\![\text{tourist}]\!]^{w,g}(x) = 1 \wedge \text{ticket-bought}_w(x) \neq \emptyset \to \text{ticket-bought}_w(x) \neq \emptyset$

(103)Truth-conditions

$\forall x, [\![\text{tourist who bought a ticket}]\!]^{w,g}(x) = 1 \to [\![\text{has already used it}]\!]^{w,g}(x) = 1$

$\forall x, [\![\text{tourist}]\!]^{w,g}(x) = 1 \wedge \text{ticket-bought}_w(x) \neq \emptyset \to \text{used}(f_{i,w,g}\left(\text{ticket-bought}_w(x)\right))(x) = 1$

The resulting truth-conditions can be paraphrased as follows: *every tourist who bought a ticket has already used a certain ticket they bought.*

V. Refinements

In the previous section, the theory was illustrated on basic cases of interest like donkey sentences and quantificational subordination. In this section, we present these various refinements needed to deal with three outstanding issues: (i) the issue of truth-conditions, (ii) preventing low pseudo-scope readings of pronouns, (iii) deriving the subordination constraint of Roberts (1987).

1. Existential and universal readings

Our system so far derives the correct accessibility conditions for pronouns but, as mentioned throughout the exposition, the truth-conditions of all sentences do not seem appropiate. For instance, (103) does not represent the truth-conditions of donkey sentences, as reported in the literature. It is typically thought that donkey sentences with *every* can receive either an *existential* reading or a *universal* reading.

(104) Every tourist who bought a ticket$_i$ has already used it$_i$.
  a. **Existential reading:** ... *has used one or more of the ticket(s) they bought*
  b. **Universal reading:** ... *has used all of the ticket(s) they bought*

Neither reading is equivalent to the derived reading in (103), meaning some changes to the system are required, as already announced in section III.2.c.

The problem of deriving correct truth-conditions for antecedent-pronoun configurations (donkey and otherwise) is a thorny one in the literature. The solution I present here will be partial: I will offer a generalization to the worst case, which accounts for all readings discovered, but fails to explain preferences for certain readings over others.

Before getting to that, it is useful to offer a recapitulation of what the facts are. The first remark is that the question of finding adequate truth-conditions is raised in all configurations: donkey sentences with various quantifiers, as in (105) and (106), cross-conjunction anaphora, as in (107), bathroom sentences, as in (108), etc. For each configuration, an existential reading or a universal reading can be written and it is an empirical question which of the two (or potentially both) is actually observed.

(105) Some of the tourists who bought a ticket$_i$ have already used it$_i$.
  a. **Existential reading:** ... *have used one or more of the ticket(s) they bought*
  b. **Universal reading:** ... *have used all of the ticket(s) they bought*

(106) None of the tourists who bought a ticket$_i$ have already used it$_i$.
  a. **Existential reading:** ... *have used one or more of the ticket(s) they bought*
  b. **Universal reading:** ... *have used all of the ticket(s) they bought*

(107) There is a phone-book$_i$ and it$_i$ is in the cabinet.
  a. **Existential reading:** ... *one or more of the phone-book(s) are in the cabinet*
  b. **Universal reading:** ... *all of the phone-book(s) are in the cabinet*

(108) Either there is a phone-book$_i$ or it$_i$ is in the cabinet.
  a. **Existential reading:** ... *one or more of the phone-book(s) are in the cabinet*
  b. **Universal reading:** ... *all of the phone-book(s) are in the cabinet*

Both informal judgments and experimental data have been used to elicit the different reading of these sentences. Foppolo (2008), in a truth-value judgment task, found that

her subjects could access both an existential reading and a universal reading in universal donkey sentences like (104)[18]. Qualitatively similar results for universal sentences were obtained in subsequent replications (Sun, Rothschild, and Breheny 2020; Denić and Sudo 2022).

In donkey sentences with *some* and *no*, like (105) and (106), Foppolo's study only finds evidence for an existential reading ; the universal reading cannot be detected. Yet, the theoretical literature (Kanazawa 1994; Brasoveanu 2007; Chierchia 2009; Champollion, Bumford, and Henderson 2017, a.o.) has argued that such readings, while marginal, do in fact exist. The main evidence comes from biased sentences like the so-called *umbrella* examples in (109) and (110) (experimental studies have so far only tested lexical material without particular biases). Be it an effect of choice of the privative verb *left* or an effect of the question under discussion likely associated with these sentences (i.e. who will get wet?), these sentences are naturally read as making universal claims (... *left all of their umbrellas at home*).

(109) No person who owns an umbrella left it at home today.
(110) Some of the persons who own an umbrella left it at home today.

Careful investigation of the truth-conditions outside of donkey environments is scarcer. For cross-conjunction cases as (107), it is typically assumed that they receive existential truth-conditions (being equivalent to *there is a phone-book in the cabinet*). However, using bets to control for uniqueness implicatures, Chatain (2018) shows that universal readings are also available for cross-conjunction cases (cf also van der Does (1993) for other evidence in support of this claim), using examples like (111).

(111) I bet you $5 that Jane has an umbrella and that she left it at home today.
Bet's winning conditions:
Jane has one or more umbrellas and left all of them at home today

In summary, it seems most configurations investigated so far licenses both existential and universal readings. However, there is some heterogeneity on the availability of each reading: in universal donkey sentences like (104), both existential and universal readings seem accessible without particular incentive; in all other cases, one reading (the existential reading) is predominant and biased items are required to evidence the universal reading. Now the facts have been laid out, I will show a way that both existential and universal readings can be derived in the system. An account of the preferences and the effect of biased items is the part left to future research.

To derive existential and universal readings, the idea is to (respectively) quantify existentially and universally over the choice function parameter f. The effect of quantifying over the choice function is illustrated for the donkey case in (112) and (113): we take the truth-conditions derived in (103), for a fixed f, and observe the truth-conditions when f is allowed to vary. As the reader can check, the resulting truth-conditions correspond to the existential and universal truth-conditions.

(112) **Universal quantification over choice functions:**
$\forall f_{i,w,g}, \forall y, \left(\text{tourist}_w(y) \wedge \text{ticket-bought}_w(y) \neq \emptyset\right) \rightarrow \text{use}_w\left(f_{i,w,g}\left(\text{ticket-bought}_w(y)\right)\right)(y)$
equivalent to:

18 In more precise language, 57% of her participants accepted the sentence in scenarios making only the existential reading true, significantly more than in a scenario making both readings false, significantly less than in a scenario making both true.

$$\forall x, \forall y, \left(\text{tourist}(y) \wedge \text{ticket-bought}(y)(x)\right) \rightarrow \text{use}(x)(y)$$

(113) **Existential quantification over choice functions:**
$\exists f_{i,w,g}, \forall y, \left(\text{tourist}_w(y) \wedge \text{ticket-bought}_w(y) \neq \emptyset\right) \rightarrow \text{use}\left(f_{i,w,g}\left(\text{ticket-bought}_w(y)\right)\right)(y)$
equivalent to:
$\forall y, \left(\text{tourist}_w(y) \wedge \exists x, \text{ticket-bought}_w(y)(x)\right) \rightarrow \exists x, \text{use}_w(x)(y) \wedge \text{ticket-bought}_w(y)(x)$

Concretely, we propose that this quantification is due to the "bridge principle" in (114), which relates truth and falsity of a piece of discourse to the parameters G and f. (Exceptionally, in stating this principle, we drop the convention adopted in section III.2 of omitting G and f from the superscript parameters of interpretation.)

(114) **Truth and falsity**
A sentence S is judged true at world w against assignment g iff, for every value of G and f, for which both the expressivity and the indexing constraint are met, $[\![S]\!]^{G,f,w,g}$ is true
It is judged false in w against g iff $[\![S]\!]^{G,f,w,g}$ is false for every value of G and f, for which both the expressivity and the indexing constraint are met.

This principle makes for truth-value gaps. A sentence can be neither true nor false, if, for instance, the sentence is true for some value of G and f but not others. This happens in cases the universal reading is false but the existential reading is true. In sentence (104) for instance, this would happen in worlds where a tourist used some but not all of the tickets they bought and the others used all the tickets they bought.

The idea to use truth-value gaps to model the multiple readings of donkey sentences is borrowed from Champollion, Bumford, and Henderson (2019). They propose that depending on the question under discussion, the worlds where the sentence is neither true or false may be judged "pragmatically true" or "pragmatically false", leading to the varied judgments observed in Foppolo (2008). This idea can then be ported to the work here.

This does not constitute a complete solution to the multiple readings of donkey sentences[19], since it fails to explain the strong biases for existential readings in certain environments. Nevertheless, it achieves the minimal desideratum stated above of allowing for existential and universal readings for all sentences.

2. Pronoun's pseudo-scope

As the editor notes, the relativization of the witness set $G_{i,w,g}$ and the choice function $f_{i,w,g}$ to assignment functions might over-generate readings in (115). With the constraint on indexing, the witness set $G_{i,w,g}$ must be the set of phone-book there in w. This witness set does not depend on the values of g.

(115) There is a phone-book$_i$. Everyone is using it$_i$.
(116) $G_{i,w,g}$ = phone-book$_w$ ∩ there$_w$

19 A reviewer notes the following problem: in *It might be the case that every farmer who owns a donkey pats it*, the account predicts too high a scope for the universal reading, namely a reading like *for every way of mapping donkey-owning farmers to donkey that they own, it might be that every donkey-owning farmer pats the corresponding donkey*. This suggests we need a more local scope on the quantification over choice functions. I leave it to future research to see how it may be done.

With this constraint and standard rules of composition, we derive the truth-conditions of *Everyone is using it* in (117).

(117) Everyone $\lambda a\ t_a$ is using it_i.
$\forall x, \text{human}_w(x) \rightarrow \text{using}_w\left(f_{i,w,g[a\rightarrow x]}(G_{i,w,g[a\rightarrow x]})\right)(x)$
$\forall x, \text{human}_w(x) \rightarrow \text{using}_w\left(f_{i,w,g[a\rightarrow x]}(\text{phone-book}_w \cap \text{there}_w)\right)(x)$

The problem is that the choice function may depend on the value of the assignment function and may therefore pick different phone-books for different individuals. But that seems incorrect: in scenarios there are in fact multiple phone-books, it does seem that *a minima*, the sentence suggests that there is a phone-book that everyone is using[20].

Removing the dependency of choice functions on assignments would fix the problem in (117). But we can see in other cases that we do need choice functions to vary with assignment functions. Consider (118) for instance. The witness set is given in (118)a. The pronoun's denotation would be (118)b, under the assumption that f does not depend on g. The prediction would be that two people who have access to the same set of computer need to use the same computer to play games, contrary to fact.

(118) Every person who $\lambda a.\ t_a$ has access to a computer_i $\lambda a.\ t_a$ uses it_i to play games.
a. $G_{i,w,g} = \text{computer}_w \cap \lambda x.\ \text{access}_w(x)(g(a))$
b. $[\![\text{it}_i]\!]^{w,g} = f_{i,w}\left(\text{computer}_w \cap \lambda x.\ \text{access}_w(x)(g(a))\right)$

We therefore need some amount of variation. The generalization seems to be the following: the choice function may not vary along binding indices that the witness set itself does not. To formalize this notion, we define what it means for the choice function and witness set to *not* vary on a given binding index a.

(119) The witness set is constant in a at index i iff
$\forall w, \forall g, g', (\exists y, g' = g[a \rightarrow y]) \rightarrow G_{i,w,g} = G_{i,w,g'}$
(120) The choice function is constant in a at index i iff
$\forall w, \forall g, g', (\exists y, g' = g[a \rightarrow y]) \rightarrow f_{i,w,g} = f_{i,w,g'}$

With these definition in hand, we can state the following constraint on the parameters f and G. The constraint

(121) **Constraint on choice function variation**
If the witness set G is constant in a at index i, the choice function f must also be.

There is a side-effect to that constraint: since it is no longer possible to name all witness sets/choice function pairs, we must weaken the expressivity constraint to only make reference to those choice function/witness set pairs that meet (121):

(122) **Expressivity constraint on G and f**
For any mapping π from world-assignment pairs to sets of individuals and any mapping γ from world-assignment pairs to choice functions such that

20 It should be said at the outset that the existence of such readings is explicitly argued for in Chatain (2018) (cf also Solomon (2012)), on the basis of examples like *every traveler with a valid ID presents it whenever they go through security*. There, it is argued that a traveler with multiple valid forms of ID need not to present the same ID every time they go through security for the sentence to be judged true.

they meet the constraint in (121), there is an i such that, for all w, $G_{i,w,g} = \pi(w,g)$ and $f_{i,w,g} = \gamma(w,g)$

With these constraints in place, the problematic case in (115) can be resolved. In this sentence, the witness set G is constant on all binding indices at index i. The constraints in (121) impose that the choice function at index i also is. This means that the truth-conditions in (117) are equivalent to (123).

(123) $\forall x, \text{human}_w(x) \rightarrow \text{using}_w\left(f_{i,w,g}(\text{phone-book}_w \cap \text{there}_w)\right)(x)$

3. Subordination constraint

There's a last missing piece in the analysis. Typically, pronouns under quantification are subject to a *subordination constraint* (Roberts 1987). Namely, when an antecedent is in the scope of a quantifier Q_1 and the pronoun is in the scope of a quantifier Q_2, co-variation is only possible when the domain of Q_2 is a subset of the domain of Q_1.

(124) Every tourist bought a ticket$_i$ ...
a. ... Most have already used it$_i$.
b. ... Most French tourists have already used it$_i$.
c. ... # Most locals have already used it$_i$.

As it stands, the theory does not capture that fact: given the indexing on *a ticket,* the witness set will be the set of tickets bought by $g(a)$ (assuming *every tourist* introduces a binder over a).

(125) $G_{i,w,g} = \text{ticket-bought}_w(g(a))$

The problem is that there are no restrictions on what $g(a)$ can be. Repeating the derivation conducted in section IV.2 (cf (127)) yields definedness conditions that are too weak: they simply require that every local has bought a ticket. It is not clear why this presupposition couldn't be accommodated (or already common ground).

(126) Most locals λa. t_a have already used it$_i$

(127) Repeated from (100)
$[\![\lambda a.\ t_a \text{ have already used it}_i]\!]^{w,g}$
$= \lambda y.\ [\![t_a \text{ have already used it}_i]\!]^{w,g[a \rightarrow y]}$
$= \lambda y.\ \begin{array}{l}[\text{ticket-bought}(y) \neq \emptyset] \\ \text{used}(f_{i,w,g}(\text{ticket-bought}(y)))\end{array}(y)$

(128) **Definedness conditions**
$[\![(128)]\!] \neq \#$
iff $\forall x, [\![\text{local}]\!](x) = 1 \rightarrow [\![\text{ticket}]\!]^{w,g} \cap \lambda y.[\![\text{bought}]\!]^{w,g}(y)(x) \neq \emptyset$
(i.e. *every local bought a ticket*)

To derive the subordination constraint, it would suffice if the witness set required $g(a)$ to belong to the set of farmers.

(129) $G_{i,w,g} = \begin{cases} \text{ticket-bought}_w(g(a)) & \text{if } \text{farmer}_w(g(a)) = 1 \\ \emptyset & \text{otherwise} \end{cases}$

With this modification, the definedness conditions come out stronger (cf (130)). They now require, in addition to what we had earlier, that every local is a tourist, i.e. the subordination constraint.

(130) **Definedness conditions**

$[\![(128)]\!] \neq \#$

iff $\forall x, \text{local}_w(x) = 1 \rightarrow \exists y, \text{tourist}_w(x) = 1 \wedge \text{ticket-bought}_w(x)(y) = 1$

(i.e. *every local is a tourist that bought a ticket*)

The question then is how to guarantee the witness set is as in (129). Here, I suggest two solutions[21]. The first solution is conservative and keeps the theory developed so far intact. It requires adopting the Trace Conversion theory of Fox (2002). This view is embedded within the copy theory of movement, according to which elements in a movement chain are copies of the moved expression. Left as is, lower copies are uninterpretable at LF and so it is assumed that they undergo a process called Trace Conversion at LF. In this operation, the determiner of the moved expression is converted to an element THE and an equality predicate is added to the NP.

(131) every tourist λa. [every tourist]$_a$ bought a ticket
→ every tourist λa. [THE tourist $=a$] bought a ticket

(132) Every tourist λa. [a ticket$_i$] λb. [the tourist $=t_a$] bought [the ticket $=t_b$]

(133) $G_{i,w,g} = \lambda x.[\text{tourist}_w(g(a))]$ ticket-bought$_w(x)(g(a))$

While conservative, this approach imposes a certain commitment to syntactic assumptions[22]. For instance, one may need the process of Trace Converstion

The second solution is purely semantic and requires redefining the constraint on indexing in such a way that it takes into account the "semantic context" in which the antecedent occurs. Here, I suggest the relevant notion of semantic context is local contexts.

(134) **Constraint on indexing** (subordination)

In an utterance of the form "S[[a/some RESTR]$_i$ SCOPE]" is felicitous only if for all worlds w and all assignments g,

$G_{i,w,g} = R_{w,g} \cap [\![\text{SCOPE}]\!]^{w,g} \cap [\![\text{RESTR}]\!]^{w,g}$

where $R_{w,g}$ is the local context of "[a/some RESTR]$_i$ SCOPE" in S.

Theory-neutrally, the local context of an expression E can be defined as the strongest assignment-dependent proposition which can be presupposed in the position where E is used. To make more concrete predictions, we may adopt Schlenker (2009)'s proposal about what local contexts are[23]: the local context of an expression is the strongest transparent assignment-dependent proposition. $R_{w,g}$ is transparent if it can be added to an expression *salva veritatis*. such that $[\![R]\!]^{w,g} = R_{w,g}$.

(135) For all E,

"every tourist λa. R t_a E"

"every tourist λa. t_a E"

---

21 It may be argued that the need for a stipulation at this point is a shortcoming of the theory compared to others, like Dynamic Semantics. For this argument to hold, it needs to be shown that the competing theory does not need to make these stipulations. In the case of Dynamic Semantics, it is definitely possible to write dynamic systems where the subordination constraint isn't validated

22 It would in addition require that other quantifiers

23 I make two departures from Schlenker (2009). First, I don't assume incrementality. This is simply for ease of exposition, as it is not needed in the case we consider. Second, I use assignment functions, consistent with the semantics used so far.

In the case *every tourist bought a ticket*, the strongest such restriction (cf also Schlenker (2009)) is given in (136).

(136) $R_{w,g} = 1$ iff $\text{tourist}_w(g(a)) = 1$

Combined with the principle in (134), this determines exactly the needed witness set in (129).

VI. Previous literature

In section II, preliminary comparisons between the account presented here and others were made. There, it was shown that neither the E-type tradition nor the dynamic tradition, in their classical implementations, predict the existence generalization to hold. This section does a more thorough review, looking at both antecedents of the choice-functional approach, and more modern proposals. I argue that the initial conclusion remain that the existence generalization is not predicted as a matter of fact by these approaches, but it is by the current ones.

1. Pioneers of the choice-functional approach

1.a Egli and Von Heusinger (1995)

In Egli and Von Heusinger (1995), an E-type theory account of pronouns that uses choice functions is presented. The focus of this work is on definite descriptions; they propose to analyze the definite article as denoting a choice function (glossing over the ε-calculus[24] used to couch their claim) which applies to the description, as in (137).

(137) $[\![\text{the phone-book}]\!]^w = f(\text{phone-book}_w)$

Pronouns, in their view, are simply definite descriptions whose descriptive content is recovered from context, in unspecified ways.

(138) it → it<the phone-book>

The idea bears much resemblance to the proposal here but there are two minor differences and one major difference with the current account. First, Egli and Von Heusinger (1995) don't take a stance on how a pronoun's descriptive content is obtained. Through the constraint on indexing, our analysis makes that step formally explicit. Second, the scope of their proposal on pronouns is much more limited, as most of the work is devoted to definite descriptions. They only give an explicit account of cross-conjunction anaphora and conditional bishop sentences. There is no account of quantificational cases such as those analyzed in section IV and so one contribution of the present work is to explain how the machinery may be ported to their cases.

The third difference is substantive. Egli and Von Heusinger (1995) consider that choice functions can apply to empty sets ; $f(\emptyset)$, for them, simply denotes an arbitrary individual (e.g. Julius Caesar, the Sun, etc). Thus, pronouns in their view don't carry the existence presuppositions we argued are key to derive the existence generalization.

24 They adopt an indirect semantics in which the intermediate language is Hilbert's ε-calculus and the model-theoretic interpretation of ε-terms is provided by choice functions. This paper prefers a direct semantics whereby denotations are immediately model-theoretic object (e.g. a choice function).

The motivation for this assumption does not come from pronouns *per se*, but from definite descriptions. Using examples like (139), they argue that definite descriptions don't carry existence presuppositions, as is typically thought.

(139) The ghost making noise in the attic isn't a ghost.

They would represent (139) as (140). Given their assumptions about choice functions, (140) implies that there isn't a ghost making noise in the attic ; if there were, f would pick one such ghost out and the sentence would contradictorily assert that it isn't a ghost.

(140) $\neg\text{ghost}\left(f\left(\text{ghost}(x) \wedge \text{makes.attic.noise}(x)\right)\right)$

However, the analysis in (140) seems inadequate for (139). First, it does not predict a salient intuition of (139), namely the inference that there is *something* making noise in the attic. Second, it asserts that the arbitrary individual $f(\emptyset)$ is not a ghost. Since no assumption is made regarding the identity of the arbitrary individual is, it is not clear how the speaker is so confident that $f(\emptyset)$ is not a ghost. Perhaps, we could argue that such sentences ought to be interpreted as existentially quantifying over choice functions (as defined by Egli and Von Heusinger (1995)), as in (141). $f(\emptyset)$ would then truly be arbitrary. An proposition like (141) is equivalent to asserting that (i) there is no ghost making noise in the attic and that (ii) something is not a ghost. (i) is one of the desired inferences and (ii) seems trivially true and an innocuous addition to the truth-conditions of the sentence.

(141) $\exists f \in \text{CH}, \neg\text{ghost}\left(f\left(\text{ghost}(x) \wedge \text{makes.attic.noise}(x)\right)\right)$
where $\text{CH} := \left\{f \in D_{(et)e} \;\middle|\; \forall S, S \neq \emptyset \rightarrow f(S) \in S\right\}$

However, what is innocuous in (139) becomes problematic in (142)a: in a discourse where it is established that there are no ghosts in the attic, *the ghost in the attic* should then behave likes an ordinary existential quantifier. (142)a would come out equivalent to (142)b. In particular, the infelicity of (142)a is not predicted.

(142) There is no ghost in the attic...
a. # ... the ghost in the attic moved the chair.
b. ... the chair was moved.

All in all, (139) does not seem to motivate giving up existence presuppositions in definite descriptions. Setting aside the analysis of definite descriptions (which are outside the purview of this work), Egli and Von Heusinger (1995)'s lack of any existence presupposition prevents them from predicting any of the accessibility conditions we seek to derive. For instance, it is not clear why (143) is not felicitous and (144) is, if pronouns lack any presuppositions. Assuming we reconstruct the description of the pronoun as in (143) and (144), both sentences should mean (145).

(143) # It<the phone-book there> is in the cabinet and there is a phone-book.
(144) There is a phone-book and it<the phone-book there> is in the cabinet.
(145) $\text{cabinet}_w(f(\text{phone-book}_w \cap \text{there}_w)) \wedge \exists x, \text{phone-book}_w(x) \wedge \text{there}_w(x)$

The infelicity of (143) cannot follow from a ban on redundancy: without existence presuppositions, $\text{cabinet}_w(f(\text{phone-book}_w \cap \text{there}_w))$ comes out logically independent from $\exists x, \text{phone-book}_w(x) \wedge \text{there}_w(x)$ and thus, the first conjunct does not make the second one redundant to assert. On the other hand, as we showed in

section III.2.c, assuming an existence presupposition predicts (143) will be redundant but not (144).

Overall, I describe the account in this work as pursuing the choice-functional approach of Egli and Von Heusinger (1995), making formally explicit some points left unspecified. However, I believe that the existence presupposition is critical to explaining pronoun accessibility and that the motivation to give it up coming from definite descriptions isn't quite sufficient.

1.b van der Does (1993)

van der Does (1993) offers a more formally explicit choice-functional account of pronouns, which he calls *Dynamic Quantifier Logic* (DQL). Like Egli and Von Heusinger (1995) and the present account, he proposes that a pronoun is interpreted as a choice function applied to a restriction provided by context. Unlike Egli and Von Heusinger (1995), van der Does is fully explicit as to where the contextually provided restriction of the choice function comes from. He proposes in essence that restrictions are provided dynamically ; each piece of discourse may in principle provide a restriction for subsequent pronouns. A fragment of this dynamic semantics is given in (146). Contexts are thought of as partial functions mapping variables to formulas. His dynamics differs from standard dynamic semantics in that negation and quantifiers are not externally static, as (146)a shows. Second, indefinites do not add a witness to the context, as in classical dynamic approaches, but rather a restriction, as (146)d illustrates.

(146) Fragment of DQL's dynamic component[25]

a. $c + \neg\varphi = c + \varphi$

b. $c + \varphi \wedge \psi = c + \varphi + \psi$

c. $c + \varphi \vee \psi = c + \neg(\neg\varphi \wedge \neg\psi)$

d. $c + [\exists x : \varphi]\psi = c[x \rightarrow \varphi \wedge \psi] + \varphi + \psi$

A truth component is then defined on the basis of the dynamic component. A fragment of this truth component is reproduced below in (147). Truth is defined relative to context c, an assignment function g and a choice function f. I use the numbers 0 and 1 to represent truth and falsity.

The rule of interpretation for pronouns is defined in (147)d. In plain language, a pronoun has scope over a formula. A constituent headed by a pronoun yields truth if the pronoun's prejacent is true when x is mapped to whichever individual is picked by the choice function f from the restriction $c(x)$ that c associates to the pronoun's variable.

(147) Fragment of DQL's static component

a. $[\![\neg\varphi]\!]^{c,g,f} = 1 - [\![\varphi]\!]^{c,g,f}$

b. $[\![\varphi \wedge \psi]\!]^{c,g,f} = \max([\![\varphi]\!]^{c,g,f}, [\![\psi]\!]^{c+\varphi,g,f})$

c. $[\![[\exists x : \varphi]\psi]\!]^{c,g,f} = \min\left\{d \in D_e \mid [\![\varphi]\!]^{c,g[x\rightarrow d],f} = 1, [\![\psi]\!]^{c+\varphi,g[x\rightarrow d],f} = 1\right\}$

d. $[\![[\text{pro } x]\varphi]\!]^{c,g,f} = [\![\varphi]\!]^{c,g[x\rightarrow f([\![c(x)]\!]^{c,g,f})],f}$ (if x is defined in c)

25 For sake of simplicity, some adjustments were made to DQL, specifically: I don't distinguish between the classical, anaphoric and cataphoric connectives, I take conjunction to be the primitive binary connective, I don't mention plurals and other quantifiers than existential. The full details are available in van der Does (1993).

Choice functions are defined so that $f(\emptyset) = ◉$ where ◉ is a dummy individual ; by definition, this dummy individual is not part of the extension of any predicate and thus yields falsity when any predicate applies to it.

There are two points of comparison with the current approach. First, van der Does obtains the restrictions of the choice function through a dynamic process. Thus, for every connective, stipulations have to be made about the connective's context-change potential. Thus, whether a conjunction is anaphoric or cataphoric is independent of its presupposition filtering behavior ; the correlations we observed between the two in section II can only be a coincidence under this approach.

Second, pronouns do not give rise to presuppositions in DQL. As seen above, they simply yield falsity when the restriction provided by the context is empty (through the device of the dummy individual). Consequently, pronouns do not carry existence presuppositions but existence assertions. This is at odds with the accessibility generalizations described by the existence generalization of section II.

To give just one example that existence assertions are undesirable, consider (148). If pronouns truly assert the existence of their referent, then (148) would be felicitous as is and have the truth-conditions in (148)a, where the existence of the phone-book is asserted in the consequent of the conditional.

(148) There might be a phone-book.
If this house were well organized, it would$_C$ be in the cabinet.
a. **DQL's truth-conditions:**
if this house were well-organized, then there would be a phone-book and it would be in the cabinet.
b. **Truth-conditions:**
if this house were well-organized and there is a phone-book, it would be in cabinet

By contrast, treating the existence condition as a presupposition predicts that the conditional is felicitous if one can implicitly restrict the conditional to worlds where there is a phone-book, which would satisfy the presupposition (a.k.a. *accommodation in the restriction*). This is precisely the attested reading of (148).

2. Dynamic Alternative Semantics (Elliott 2020)

Elliott (2020) proposes Dynamic Alternative Semantics to deal with some of the recalcitrant cases of bathroom sentences and double negation. The originality of the approach lies in its ability to state general principles to convert static connectives into their dynamic counterparts, using rules inspired by Strong Kleene logic. The approach uses a dynamic semantics in which updates may be tagged true, false or #. For instance, the denotation of the sentence *There is a phone-book* has true updates that introduce a phone-book for future reference. Likewise, the denotation of the sentence *there isn't a phone-book* has false updates that introduce a phone-book discourse referent.

The recipe can be stated in simple terms. Suppose P and Q are the left and right arguments of a binary connective **Bin**. We wish to construct **DBin**, the dynamic counterpart of **Bin**. For any update in P mapping g to g_1 tagged with truth-value t_1 and any update in Q from g_1 to g_2 tagged with t_2, there is an update in P **DBin** Q from g to g_2 tagged with t_1 **Bin** t_2. Elliott shows that these denotations are fit for the

task of accounting for the small paradigm of pronouns in a "propositional" fragment of English:

(149)
a. There is a phone-book and it is in the cabinet.
b. Either there isn't a phone-book or it is in the cabinet.
c. # There isn't a phone-book and it is in the cabinet.

The existence of a general recipe for lifting static connectives is a step towards an explanatory dynamic semantics (hence the title of this article). As the paper acknowledges, it remains for now a partial effort limited to the particular connectives *or* and *and*[26]. When expanding to other connectives, some cracks in the picture start to show. Take the case of cataphoric *but*. As seen in section II.2.a, *but* allows cataphora as in (151) and this seems tied to the possibility of right-to-left presupposition filtering, as in (150).

(150) She isn't there now but one of my students went to Norway.
(151) Mary's no longer in Norway but she used to be there at some point.

In Elliott's system, it would be most natural to treat presuppositions through trivalence, as '#' is already part of the system. The fact that *and* filters presuppositions from left to right might be a consequence of a so-called middle Kleene semantics for the static connective $\wedge$ from which *and* is derived. *But*'s lack of directionality could also stem from it being lifted from a Strong Kleene static conjunction (I'm ignoring *but*'s rhetorical contributions to discourse).

The point is that, regardless of the exact underlying semantics for *and* and *but* assumed, cataphora are predicted to be impossible. Indeed, the lifting recipe given above gives precedence to the "left" argument of the connective for updates of the context, regardless of its static semantics. A pronoun must follow the object that introduced its discourse referent.

More generally, the recipe creates a complete disconnect between patterns of presupposition projection and patterns of pronoun's accessibility conditions. The two dimensions are specified independently; any correlation observed between the two phenomena must be coincidental.

3. Hofmann's intensional CDRT

Very similar ideas to the ones proposed in this work are found in recent work by Hofmann (Hofmann 2019; Hofmann 2022). In essence, she proposes a dynamic semantics in which indefinites introduce individual concepts, defined only in worlds where a witness to the indefinite exists. For instance, (152) would denote the DRS in (152)a, which introduces ι, which is defined in all φ-worlds, and is a phone-book in all of these worlds. The reader is referred to Hofmann (2019) for the exact technical details and notation.

(152) There is a phone-book$_{23}$. It$_{23}$ is in the cabinet.
a. $\left[\varphi : \iota \;\middle|\; \text{phone-book}_{\varphi}(\iota)\right]$

26 There is also a recipe for unary connectives (which explains the semantics of *not*) but it is not needed for the discussion.

$$\text{b. } \lambda i.\lambda j.\ i[\varphi, \iota]j \quad \begin{array}{l} \wedge[\forall w \in \varphi(j),\ \iota(j)(w) \neq \#] \\ \wedge[\forall w \notin \varphi(j),\ \iota(j)(w) \neq \#] \\ \wedge[\forall w \in \varphi(j),\ \text{bathroom}\left(\iota(j)(w)\right)(w)] \end{array}$$

φ represents the worlds in which the discourse-referent (i.e. the phone-book) exists. The accessibility conditions for pronouns simply states that the local context of the pronoun must be a subset of φ.

This condition appears, up to notation and terminological choices, equivalent to the existence presupposition argued for in this piece. It is unsurprising then that some of the puzzling cases covered here (bathroom sentences, double negation) are already satisfactorily handled in Hofmann's system.

While empirical reasons may not decide between Hofmann's approach and the approach here, there are theoretical considerations militating in favor of the approach here. One important point is that Hofmann's system retains the dynamic assumption that discourse referents are introduced by way of updates. For a pronoun to be tied to a certain discourse referent, it must be in a context previously updated to make this discourse referent available. This means that there are effectively two accessibility conditions for pronouns: the existence presupposition and the requirement that the antecedent updated the context "before" the pronoun, in a given chain of updates.

This leads to stipulations. Consider the examples (153) and (154) below (repeated from section II.2). To account for (153) in a dynamic setting, it is required to design a lexical entry for *but* which chains updates from right to left. In (154), a lexical entry for *know* would be needed, which updates the context with its complement prior to updating the context with whatever updates the subject brings.

(153) She isn't here now but one of my students went to Norway.
(154) The person that placed it there surely knows that there is a phone-book in the cabinet.

Unlike the system presented in this work, merely being able to meet the presupposition that a phone-book exists in (153) and (154) is insufficient to license the pronoun, because the pronoun also needs access to the discourse referent ι introduced by the antecedent. These stipulations may be made. However, they do raise the question of whether, having admitted that the condition that pronouns presuppose existence, the cost of the different compositional stipulations needed for ICDRT remains justified.

VII. Extending to a wider class of antecedents

Our effort has so far focused on singular indefinite antecedents. The rule on indexing repeated below is specifically geared towards such antecedents.

(155) **Constraint on indexing** (from section IV.2)
A structure like "[a/some RESTR]$_i$ SCOPE" is felicitous only if for all worlds w and all assignments g, $G_{i,w,g} = [\![\text{SCOPE}]\!]^{w,g} \cap [\![\text{RESTR}]\!]^{w,g}$

(155) suffers from making reference to English-specific constructs, like *a* and *some*. It cannot, as it stands, be a rule of Universal Grammar, applicable to all languages, making the status of this rule dubious (is it learned? if not, where does it come form?).

The rule in (156) is a minimal improvement: it replaces *a/some* by a putative universal feature [+indef], which *some* and *a* would carry. It is however barely more satisfactory: while it makes no reference to English-specific constructs, it isn't clear how to enforce any principled connection between D having the semantics of an indefinite and D carrying the [+indef] feature.

(156) **Constraint on indexing** (unsatisfactory extension)
A structure like "$[\text{D}_{[+\text{indef}]}\ \text{RESTR}]_i$ SCOPE" is felicitous only if, for all worlds w and all assignments g, $G_{i,w,g} = [\![\text{SCOPE}]\!]^{w,g} \cap [\![\text{RESTR}]\!]^{w,g}$

All of this points to a different direction: one ought to find a general way to obtain the witness set from the semantics of the quantifier/item itself.

This step is not trivial but providing a systematic derivation of the witness set from the quantifier would not only make the indexing constraint more principled but it might also help derive from new phenomena. For instance, *every* seems to license a plural referent corresponding to its restrictor. To account for sentences like (157), one might desire the indexing constraint to $G_{i,w,g}$to be the set in (157)b: the set of maximal sums of phone-books.

(157)
a. Every phone-book$_i$ was collected and they$_i$ were placed in the cabinet.
b. $G_{i,w,g} = \max^* [\![\text{phone-book}]\!]^{w,g}$
where $\max S = \{x \in S \mid \forall y, x \prec y \rightarrow x = y\}$
(*the set containing maximal pluralities of sums of phone-books*)

The set (157)b is empty if and only if there are no phone-books and it is a singleton set containing the plurality of all phone-books otherwise. When non-empty, it refers to the set of phone-books

If an analysis of (157)a requires something like (157)b, a fine-grained prediction is made about differences in accessibility conditions when the pronoun is an indefinite or a quantifier like *every*, namely that pronouns with *every* as an antecedent should be much looser accessibility conditions than pronouns with indefinites as antecedent. Let's see why with the contrast in (158):

(158)
a. # Either there is a phone-book$_i$ or it$_i$ is in the cabinet.
b. ✓ Either every phone-book$_i$ is in the cabinet or they$_i$'ve been misplaced.

Consider (158)a first. In the analysis presented, it_i carries the presupposition that there is a phone-book. This presupposition cannot felicitously be met: it cannot be filtered by the first disjunct; nor can it be accommodated. Indeed accommodating the existence of a phone-book would make the first disjunct entailed by context, resulting in an infelicitous disjunction.

In the case of (158)b, where the antecedent is *every*, assuming the witness set is as in (157)b, the presupposition of the pronoun is much weaker: it simply requires the existence of phone-books. This weak presupposition can be felicitously accommodated ; doing so does not make the first disjunct trivial.

In conclusion, the weakness of the presupposition for non-indefinite DPs might be used to explain why the discourse anaphora they antecede are freer in their distribution. Certainly, we're still lacking an explanation on how to derive witness sets

in the general case. Yet, it seems the mechanism of witness sets/existence presupposition could be beneficial to predict distinctions to be drawn between the accessibility conditions of indefinite-anteceded pronouns and other types of pronouns.

VIII. Conclusion

This work has argued for the existence generalization, which states that a pronoun can co-vary with an indefinite antecedent if and only if one can presuppose the existence of a witness to the indefinite in the local context of the pronoun. While previous accounts have been trying to give shape to the intuitive connection between presuppositions and pronouns, I argued that no account fully validates this generalization, resulting in various under-generation issues.

To remedy this situation, I propose an account in which pronouns receive an interpretation as soon as a certain existence presupposition is met. This is achieved by (i) proposing postulates regulating the use of indices, so that antecedents can only carry indices which name their witness set, (ii) assuming that pronouns pick their referent from the witness set by means of a choice function. Because choice functions must apply to non-empty sets, pronouns naturally come with existence presuppositions, which project and are filtered just like any other presupposition.

The advantage of this system is that it can piggy-back on explanatory accounts of presupposition projection. It does not require specifying how discourse referents are passed through connectives; this follows from an account of presupposition projection and filtering. The account can claim to propose relatively modest changes to standard compositional apparatus, most of the stipulations relating to the use of indices, parameters of interpretation and the interpretation of pronouns.

There are still challenges for this approach. First, it remains to be seen whether it can successfully be extended to a broader class of antecedents. Second, it does not move the *statu quo* in the literature on the question of existential/universal readings of discourse pronouns, predicting all readings to be available, but missing an account of the relative ease of accessing each reading.

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Appendix A: Sloppy readings of discourse anaphora

The analysis presented in this work has some similarities with E-type analyses and may inherit some of its difficulties[27]. In E-type analyses, one assumes that a pronoun carries descriptive content; for instance, *it* in (159) must be read as *the gray donkey they own*.

(159) The farmer who owns a gray donkey treats it<the gray donkey they own> well.

In our analysis, pronouns also carry some sort of descriptive content in the form of the witness set G_{iwg}.

(160) The farmer who $\lambda a.\, t_a$ owns [a gray donkey]$_i$ $\lambda a.\, t_a$ treats $f_{iwg}(G_{iwg})$ well.

$$G_{iwg} = \left\{ x \;\middle|\; \begin{array}{l} \text{gray-donkey}(w)(x) \\ \wedge \text{owns}(w)(x)(g(a)) \end{array} \right\}$$

$\approx$ *the set of donkeys owned by* $g(a)$

As has been discussed (Wescoat 1989; Dalrymple, Shieber, and Pereira 1991; Hardt 1993; Tomioka 1999; Charlow 2020), the idea that pronouns carry descriptive content creates issues for certain cases of sloppy readings of pronouns in ellipsis, as in (161)a, or focus constructions, as in (161)b.

(161) **Sloppy reading of discourse anaphora**[28]

27 I thank the editor for pressing me on this point.

28 The examples usually presented in the literature use definite or referential antecedents, e.g. *The officer who arrested* BILL *read him his rights. The officer who*

a. The farmer who owns a GRAY donkey treats it well.
   The farmer who owns a GREEN donkey doesn't treat it well.
b. Only the farmer who owns a GRAY donkey treats it well.

(161)a and (161)b raise different but related problems. The question for (161)a is how one can meet the parallelism conditions on ellipsis. According to both the traditional E-type analysis or the current proposal, the first *it* in (161)a should stand for *a certain/the gray donkey they own* and the second one for *a certain/the green donkey they own*. But then, it appears as though the two clauses in (161)a are not semantically parallel and that ellipsis should thus not be licensed. More precisely, a standard (semantic) licensing condition on ellipsis (Rooth 1985) requires that the antecedent clause belongs to the focus value of the clause containing the ellipsis site ; this condition is thought to be enforced by a covert squiggle operator ~. Here, it is clear that the set of propositions in the focus value of the second clause, schematically given in (162), doesn't contain the proposition expressed by the first clause.

(162) The farmer who owns a *P* donkey treats the gray donkey they own well

As for (161)b, both the E-type theory and the current approach look like they would derive truth-conditions paraphrasable as in (163). To the extent that we can make sense of these truth-conditions, they don't appear to yield the correct reading.

(163) Only the farmer who owns a GRAY donkey treats a certain/the gray donkey they own well.

In the present framework (cf Elbourne (2008) for solution within E-type approaches), a solution to this challenge comes from recognizing that both constructions involve a focus-sensitive operator: the overt *only* in (161)b and a covert squiggle operator (Rooth 1985) in (161)b. To deal with these examples, we must thus discuss how the theory of this work may be integrated with a focus semantics.

Let us start with some assumptions about focus semantics. I will adopt the assignment function-based theory of focus semantics proposed by Kratzer (1991)(cf also suggestions in Rooth (1985)) This theory has the advantage of playing well with binding, by effectively treating focus constructions, as involving a form of binding. In (my presentation[29] of) this theory, the semantic value of an expression is relativized to a new parameter: the focus parameter h. h may either be an assignment function h or a special value $\times$, used to represent ordinary meaning. The use of this parameter is only relevant in the presence of F-marked material. F-marked expressions have *focus indices*, and the h assignment function maps such indices to semantic values. Specifically, the semantic value of *gray* is its ordinary predicate meaning when the parameter is $\times$. Otherwise, it is whichever predicate h maps F_a to.

(164) $[\![\text{GRAY}_{F_a}]\!]^{g,\times,w}$ = gray
$[\![\text{GRAY}_{F_a}]\!]^{g,h,w}$ = $h(F_a)$ if h is an assignment function

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arrested SUE didn't (Wescoat 1989). Because this paper focuses on pronouns with indefinite antecedents (cf section VII for an extension to other types of antecedent), I chose to carry over the examples to indefinite antecedents.

29 Kratzer distinguishes between a normal and a focus semantic value, which compose in much of the same way and are only distinguished by the lexical rules. Here, for ease of presentation, I try to remove some duplication by presenting one unified value.

The focus semantic value composes using the standard rules that the normal semantic value uses (Functional Application, Predicate Modification, etc).

(165) $[\![\text{GRAY}_{F_a}\ \text{donkey}]\!]^{g,\times,w} = \lambda x.\ \text{donkey}(x)(x) \wedge \text{gray}(w)(x)$
$[\![\text{GRAY}_{F_a}\ \text{donkey}]\!]^{g,h} = \lambda x.\ \text{donkey}(w)(x) \wedge h(F_a)(w)(x)$

I assume *only* is not inherently focus-sensitive and comes with a domain of quantification C. It simply asserts the truth of its prejacent and the falsity of any non-weaker proposition in C.

(166) $[\![\text{only}_C\ S]\!]^{g,h,w} = 1$
iff
$[\![S]\!]^{g,h,w} = 1$
$\wedge \forall p \in C, p(w) = 1 \rightarrow \left(\forall w', [\![S]\!]^{g,h,w'} = 1 \rightarrow p(w') = 1\right)$

Focus sensitivity is introduced in the form of a squiggle operator which constrains what values C can take, as in (168): namely, it requires that every proposition in C be equivalent to the meaning of the prejacent for some value of the focus parameter h. This squiggle operator, it is assumed, must occur immediately below *only*, as in the LF in (167).

(167) only_C [~ C] the farmer who owns a GRAY donkey is happy

(168) $[\![[\sim C]\ S]\!]^{g,h,w} \neq \#$ iff $\forall p \in C, \exists h, \forall w', p(w') \leftrightarrow [\![S]\!]^{g,h,w'}$
When defined, $[\![[\sim C]\ S]\!]^{g,h,w} = [\![S]\!]^{g,h,w}$

Assembling these ingredients, we can compose a LF like (167) with the domain C in (169). We write $\iota x : P$ for the unique individual x such that $P(x)$ or $\#_e$ if there is no such individual and "own-donkey" for the relation that holds between farmers and donkeys that they own.

(169) $C = \{\lambda w.\ \text{happy}(\iota x : \exists y, c(w)(y) \wedge \text{own-donkey}(w)(y)(x)) \mid c \text{ is a color}\}$

The squiggle's presupposition is met for C because every proposition in C is indeed the value of the prejacent for some value of the focus parameter h, i.e. by setting h to be any assignment function that maps F_a to the desired color predicate.

(170) $\left[\!\left[\text{the farmer who owns a GRAY}_{F_a}\ \text{donkey is happy}\right]\!\right]^{w,g,h} = 1$
iff $\text{happy}(\iota x : \exists y, h(F_a)(w)(y) \wedge \text{own-donkey}(w)(y)(x)) = 1$

(171) $\text{happy}(\iota x : \exists y, \text{gray}(y) \wedge \text{own-donkey}(y)(x))$
$\forall h, \text{happy}(w)(\iota x : \exists y, h(F_a)(w)(y) \wedge \text{own-donkey}(w)(y)(x)) = 1 \rightarrow$

With these ground assumptions in place, the challenge of (161) is the challenge of integrating focus semantics to the theory of anaphor built here: since interpretation is relativized interpretation to yet another parameter, the constraint on indexing and the interpretation rule for pronouns stated in section IV.2 are no longer sensical. We adapt the new constraint on indexing and pronoun interpretation rule are as in (172) and (173).

(172) **Constraint on indexing** (focus version)
A structure like "[a/some RESTR]$_i$ SCOPE" is felicitous only if, for all worlds w and all assignments g and all values of the focus parameter h:
$G_{i,w,g,h} = [\![\text{SCOPE}]\!]^{w,g,h} \cap [\![\text{RESTR}]\!]^{w,g,h}$

(173) **Discourse-anaphoric pronoun interpretation**
$[\![\text{pro}_i]\!]^{w,g,h} = \left[G_{i,w,g,h} \neq \emptyset\right] f_{i,w,g,h}\left(G_{i,w,g,h}\right)$

While this may seem like yet another complication to the basic principles of the theory, it is important to recognize that this complication fits a general pattern: whenever the denotations of the restrictor and the scope of an indefinite vary based on the value of some parameter, its witness set must be able to vary in the same way too. The rules stated so far and (172) and (173) can be given in the general form in (174), where $\vec{c}$ stands for whichever parameters of evaluation the scope and the restrictor of the indefinite may depend on.

(174)
a. $G_{i,\vec{c}} = [\![\text{SCOPE}]\!]^{\vec{c}} \cap [\![\text{RESTR}]\!]^{\vec{c}}$
b. $[\![\text{pro}_i]\!]^{\vec{c}} = \left[G_{i,\vec{c}} \neq \emptyset\right] f_{i,\vec{c}}\left(G_{i,\vec{c}}\right)$

We may now turn to (161)b, whose LF is given in (175). By the constraint on indexing, the witness set is as described in (175)a-b.

(175) only_C [~C]the farmer who $\lambda a.\ t_a$ owns [a GRAY donkey]$_i$ $\lambda a.\ t_a$ treats it_i well
a. $G_{i,w,g,x} = \{x \mid \text{gray}(w)(x) \wedge \text{own-donkey}(w)(x)(g(a))\}$
b. For h an assignement function:
$G_{i,w,g,h} = \{x \mid h(F_a)(w)(x) \wedge \text{own-donkey}(w)(x)(g(a))\}$

Given this, the squiggle operator will license domains C for the operator *only* only if they belong to the set in (176), the set of propositions roughly paraphrasable as "*the farmer who owns the $h(F_a)$ donkey treats a certain $h(F_a)$ donkey they own well*".

(176) $\left\{\lambda w.\ \text{treats-well}\left(f_{i,w,g,h}\left(\lambda y.\ \begin{array}{l} h(F_a)(w)(y) \\ \wedge\text{own-donkey}(w)(y)(d_{wh}) \end{array}\right)\right)(d_{wh}) \;\middle|\; h\right\}$
where $d_{wh} = \iota x : \exists y, h(F_a)(w)(y) \wedge \text{own-donkey}(w)(y)(x)$

Among these propositions, one can find the proposition "*the farmer who owns the blue donkey treats a certain blue donkey they own well*" and similar ones for other colors, cf (177). This effectively means that we can achieve the sloppy reading of the pronoun under *only* as desired[30].

(177)
$\left\{\lambda w.\ \text{treats-well}\left(f_{i,w,g,h}\left(\lambda y.\ \begin{array}{l} c(w)(y) \\ \wedge\text{own-donkey}(w)(y)(d_{wc}) \end{array}\right)\right)(d_{wc}) \;\middle|\; c \text{ is a color}\right\}$
where $d_{wc} = \iota x : \exists y, c(w)(y) \wedge \text{own-donkey}(w)(y)(x)$

30 The truth-conditions are involved, because of choice functions. Prior to quantification over choice functions (as discussed in section V.1), they assert the farmer who owns a gray donkey treats a certain gray donkey they own well and for any other color *c*, the farmer who owns a donkey of that color does not treat a certain donkey of that color well. With the assumptions made in section V.1, the sentence will be true just in case, for every way of pairing farmers to donkeys they own, the proposition will be true. This is the same as demanding that the farmer who owns a gray donkey treat all of the gray donkeys they own well and for any color, the farmer who owns any donkeys of that color doesn't treat any of them well. These are the right truth-conditions whenever all of the farmers involved own at most one donkey of the relevant color so the truth-conditions are better than those derived by the standard E-type analysis. It is not clear whether this is right or wrong outside of this case and I leave the full elucidation of the truth-conditions to future research.

Turning to the case of ellipsis in (161)a, we assume the ellipsis semantic parallelism licensing condition is enforced by a different[31] squiggle operator, as defined in (178):

(178) $[\![[\sim p]\ S]\!]^{g,h,w} \neq \#$ iff $\exists h, \forall w', p(w') \leftrightarrow [\![S]\!]^{g,h,w'}$
When defined, $[\![[\sim p]\ S]\!]^{g,h,w} = [\![S]\!]^{g,h,w}$

Likewise, the squiggle's felicity conditions in (161)a can be met. I assume the LF in (179) ; I take it that the value of p in (179)b is the proposition expressed by (179)a.

(179)
a. The farmer who $\lambda a.\ t_a$ owns [a GRAY donkey]$_i$ $\lambda a.\ t_a$ treats it$_i$ well
b. [~ p]The farmer who $\lambda a.\ t_a$ owns [a GREEN donkey]$_j$
$\lambda a.\ t_a$ doesn't treat it$_j$ well.

The constraint on indexing impose that $G_{i,w,g,h}$ is defined as in (180) and that $G_{j,w,g,h}$ be as in (181).

(180)
a. $G_{i,w,g,\times} = \{x \mid \text{gray}(w)(x) \wedge \text{own-donkey}(w)(x)(g(a))\}$
b. For h an assignment function:
$G_{i,w,g,h} = \{x \mid h(F_a)(w)(x) \wedge \text{own-donkey}(w)(x)(g(a))\}$

(181)
a. $G_{j,w,g,\times} = \{x \mid \text{green}(w)(x) \wedge \text{own-donkey}(w)(x)(g(a))\}$
b. For h an assignment function:
$G_{j,w,g,h} = \{x \mid h(F_a)(w)(x) \wedge \text{own-donkey}(w)(x)(g(a))\}$

Given this, the ordinary meaning of (179)a (when the focus parameter is ×) is as in (182)a. The meaning of (179)b, when the focus parameter is an assignment function h, is (182)b.

(182)
a. $\text{treats-well}\left(f_{i,w,g,h}\left(\lambda y.\ \begin{array}{l}\text{gray}(w)(y)\\ \wedge\text{own-donkey}(w)(y)(d_{w,\text{gray}})\end{array}\right)\right)(d_{w,\text{gray}})$
b. $\text{treats-well}\left(f_{j,w,g,h}\left(\lambda y.\ \begin{array}{l}h(F_a)(w)(y)\\ \wedge\text{own-donkey}(w)(y)(d_{wh})\end{array}\right)\right)(d_{wh})$

As one can see, the meanings are almost the same, if we choose h to map F_a to the predicate "gray"; the only difference is in the choice function. In (182)a, the donkey referred by *it* is picked by $f_{i,w,g,h}$, while in (182)b, it is picked by $f_{j,w,g,h}$ (using index j). There is no *a priori* guarantee that these choice functions are the same, if i and j are picked arbitrarily among the indices that meet the constraint on indexing. Therefore, there is no guarantee that the squiggle's presupposition will be met for an arbitrary choice of indices meeting the indexing constraint.

However, the expressivity constraint guarantees the following: there is at least *some* choice of index j such that $G_{j,w,g,h}$ is what is required by the indexing constraint, namely (181), and $f_{j,w,g,h} = f_{i,w,g,h}$.

In summary, the sloppy readings are achievable. Admittedly, they do not come for free in this analysis ; a particular analysis of focus (Kratzer 1991) which treats focus as a form of regular assignment function-based binding is required. It is not clear to me whether the same result could be achieved in more standard theories of focus

31 It is a well-known and orthogonal problem that there has to be two squiggle operators which are close but different in meaning (Rooth 1992).

semantics. Yet, I believe the binding view of focus confers the advantage of revealing the sloppy readings as analogues in the focus semantics realm of subordination cases (for (161)a) and donkey cases (for (161)b).