

On the Semantics of Phi Features on Pronouns

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by

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in partial fulfillment of the requirements for the degree of

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Abstract

This thesis investigates three topics relating to the semantics of phi features on pronouns.

Part I focuses on gender features on pronouns. Following previous studies (Cooper 1983, Heim & Kratzer 1998), I claim that they are presupposition triggers. Based on this assumption, I show that predicates containing bound gendered pronouns have an assertive meaning that does not entail the gender presupposition, and further point out that such predicates pose a serious challenge for existing theories of presupposition projection, especially with respect to quantified sentences. A conclusion drawn from this discussion is that the presupposition needs to be dissociated from the assertive meaning, as in Karttunen & Peters's (1979) two dimensional theory. However, such a theory is known to run into the so-called *binding problem* in quantified sentences. I propose a solution to the binding problem using the mechanism of cross-sentential anaphora, and show that the resulting theory nicely accounts for the projection properties of various quantificational determiners.

Part II discusses the interpretation of person and number features on bound pronouns. It is known that some occurrences of phi features on bound pronoun behave as if they are semantically inert (Heim 2008b, Jacobson to appear, Kratzer 1998a, 2009, Partee 1989). One popular account of this phenomenon, the minimal pronoun account, claims that such phi features are purely morphological, and postulates a PF operation that transmits phi features of a binder onto each pronoun that it binds (Heim 2008b, Kratzer 1998a, 2009). I put forward an alternative account that dispenses with the PF operation, and instead puts most of the burden on syntax, by encoding more information in the indices than standardly assumed. As a result, all occurrences of phi features are semantically relevant. I offer both empirical and conceptual arguments for the proposed account over the minimal pronoun account.

Part III deals with the phenomenon of indexical shifting where person features are systematically affected (Anand 2006, Anand & Nevins 2004, Schlenker 1999, 2003b). I discuss novel data from Uyghur and Japanese as well as data drawn from previous studies, particularly focusing on the universals and variation within and across languages.

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1 Introduction

Pronouns are those expressions whose meanings are not completely fixed, and can be used to mean different things in different conversational contexts. In this dissertation, I almost exclusively discuss pronouns that refer to individuals, such as *she*, *you*, *it* and *we*, disregarding other kinds of pronouns such as *so*, *one*, and *here*. Pronouns typically refer to some entity or entities already known, mentioned, familiar and/or salient in the discourse. To the best of my knowledge, every natural language known so far has pronouns. Pronouns have attracted much attention of formal linguists, and are one of the most actively studied topics in morphology, syntax and semantics. This dissertation is primarily concerned with the semantic aspect of pronouns, especially the semantic inferences triggered by the so-called phi features that are attached to them. Still, semantics cannot be studied without recourse to syntax and morphology, and some of the topics I will discuss in the body of this dissertation are concerned with how these subcomponents of language interact with each other. In this introduction section, I spell out the basic theoretical assumptions that are necessary to understand the discussions to follow.

The organization of this introductory section is as follows. I first introduce in Section 1.1 the general theoretical framework that I assume throughout this dissertation, and in Section 1.2 theoretical assumptions about the interpretation of pronouns. The central topic of the present dissertation, phi features on pronouns, is briefly discussed in Section 1.3. Section 1.4 gives an overview of the dissertation.

1.1 Basic Assumptions

I largely adopt Heim & Kratzer's (1998) framework, and presuppose a certain degree of familiarity with the framework and notational conventions, and I will only give a very brief overview of it in what follows. Some of the core proposals I will make are largely independent from this particular framework, and perhaps can be implemented in alternative theories more or less straightforwardly, while some others might be more dependent on the general framework assumed here, but detailed comparisons of different frameworks are left for future research.¹ In any event, my ultimate hope is to deepen our theoretical understanding of the linguistic phenomena discussed in the body of the present dissertation, and I consider the formal aspects of the framework only meaningful inasmuch as they clearly convey the core ideas put forward in this dissertation.

Following Heim & Kratzer (1998) and much of the recent literature in transformational syntax, I assume that the syntactic and semantic components of grammar operate independently. More specifically, it is assumed that syntax generates a hierarchically organized structural description of a sentence called a Logical Form (LF), which might not directly correspond to how the sentence is pronounced, and semantics takes it as its input and assigns a model-theoretic interpretation to it. An LF representation is assumed to be unambiguous with respect to quantifier scope, and pronominal reference.

The semantic component consists of two major mechanisms, the lexicon and the compositional rules. The meaning of each atomic expression is listed in the lexicon, and the

¹One alternative approach of pronouns analyzes all pronouns as disguised definite descriptions (Elbourne 2005, Schlenker 2005). My analysis of person features might not be amenable to such a radical reductionism. Another major approach is variable free semantics advocated by Jacobson (1999, 2000, 2002, 2008, to appear).

meanings of syntactically complex expressions are compositionally derived from the meanings of their parts via compositional rules, including Functional Application and Predicate Abstraction, which will be defined shortly. The interpretation function, conventionally represented by $\llbracket \]$, assigns each constituent of an LF representation a unique denotation/semantic value (provided that $\llbracket \]$ is defined; see Part 1 for discussion). As we will discuss some intensional phenomena later, I assume that the interpretation function is relativized to a possible world w . The denotation of an expression α with respect to a possible world w is represented as $\llbracket \alpha \rrbracket^w$. The parameters to which $\llbracket \]$ is relativized will be enriched as we go along. Our metalanguage is essentially English augmented with lambda calculus and set theory. Each denotation is uniquely typed, and I generally annotate a lambda term with the type of the variable as a subscript.² For instance, the proper name *John* and the verb *left* are given the following denotations in the lexicon.

- (1) a. $\llbracket \text{John} \rrbracket^w = \text{the individual John}$
 b. $\llbracket \text{left} \rrbracket^w = \lambda x_e. x \text{ left in } w$

(1a) is an expression of type e , which is the type of individuals, and (1b) is a function of type $\langle e, t \rangle$ which is the type of functions from individuals to truth values.

In order to analyze a simple sentence like *John left*, we need its LF representation. In this case, the following rather simple LF will do. I will not annotate the syntactic categories of the nodes unless for expository purposes, because in the framework adopted here, syntactic labels do not play any semantic roles. I will also omit certain details, e.g. the tense information is often disregarded and correspondingly the tense node in syntax is omitted.

- (2) $\begin{array}{c} \wedge \\ \text{John} \quad \text{left} \end{array}$

The meaning of the complex phrase *John left* is determined by the structure in (2) and the meanings of its component expressions in (1). The compositional rule of Functional Application, defined in (3), specifies how the meanings of *John* and *left* combine to give rise to the meaning of *John left*.

- (3) *Functional Application*
 If α has β and γ as its daughter constituents and $\llbracket \beta \rrbracket^w \in D_\sigma$ and $\llbracket \gamma \rrbracket^w \in D_{\langle \sigma, \tau \rangle}$, then $\llbracket \alpha \rrbracket^w = \llbracket \gamma \rrbracket^w(\llbracket \beta \rrbracket^w)$.

Here, α, β and γ here are metavariables ranging over LF constituents, and σ and τ are metavariables ranging over semantic types (also w is implicitly universally quantified). Given the rule, the meaning of (2) with respect to a possible world w is as follows.

- (4) $\llbracket (2) \rrbracket^w = 1$ if and only if John left in w

It should be stressed at this moment that the theory sketched in this introductory section including the compositional rules and lexical entries are only provisional, and I will make both major and minor modifications to the system introduced here and below.

²I generally stick to the standard convention that x, y, z, \dots , etc. are variables of type e, P, Q, R, \dots and f, g, h, \dots , are variables ranging over functional types (f and g are often used to designate assignment functions), w, u, v, \dots for variables of type s, c, c', \dots for variables ranging over contexts (type k ; see Part 3), and p, q, r, \dots for variables ranging over propositional objects.

1.2 The Semantics of Pronouns

The central topic of this dissertation is the semantics of pronouns, and I will start with Heim & Kratzer's (1998) analysis, which captures the major semantic characteristics of pronouns (see also Büring 2005).

One hallmark of the semantics of pronouns is the versatility with respect to their referents. Pronouns that we are interested in here refer to individuals, and hence their semantic values are always of type *e*. However, the referent of the same pronoun, say *her*, is not predetermined in the lexicon, and changes depending on various factors, linguistic or non-linguistic, of the context in which it is used. Thus, without such information, it is not possible to know the meaning of a sentence containing a pronoun. I do not have much to say in this dissertation about pragmatic aspects of pronominal reference, e.g. how exactly the referent is determined, or how the hearer grasps what or who the intended referent is (see, for example, Grosz, Joshi & Weinstein 1995, Walker, Joshi & Prince 1998, Ariel 2001 for discussion). However, a semantic analysis of pronouns should at least be able to capture the fact that their referents are not fixed.

Another important aspect of the semantics of pronouns is that the meaning of a pronoun can be dependent on another phrase occurring in the same sentence. It is traditionally recognized that pronouns have two uses, *free* and *bound*. The technical definitions of these terms require certain theoretical assumptions, which will be introduced shortly, but the rough idea is the following. The referent of a free occurrence of a pronoun is one particular individual, while that of a bound occurrence is dependent on the meaning of some other phrase, and its referent is not fixed to one individual. For instance, consider the following example.

(5) Every boy brought lunch with him today.

The pronoun *him* here does not designate any particular person, but is dependent on the subject quantifier *every boy*. The semantic dependency of this sort can be intuitively understood as 'co-variation'. More concretely, assuming that the relevant boys are John, Bill and Adam, the sentence is paraphrased as: Today, John brought lunch with John, Bill brought lunch with Bill, and Adam brought lunch with Adam. Thus, the meaning of *him* in (5) co-varies with the values that the quantifier ranges over.

Under a free use, on the other hand, the pronoun has a fixed referent. For example, *him* in (6) is a particular person the speaker has in mind, and its meaning is not dependent on any other phrase in the same sentence.

(6) I received an email from him yesterday.

It should be mentioned that the notions of free and bound should be understood with respect to a syntactic domain. In the above examples, I implicitly assumed the relevant domain to be the entire sentence. The formal definitions of free and bound pronouns given below will clarify this point.

A semantic analysis of pronouns needs to capture the above two properties, i.e. (i) the versatility of referents, and (ii) the free and bound uses. The widely held idea in the tradition of formal linguistics, which I adopt here, is that pronouns are interpreted as variables, and their referents are determined by an assignment function, an idea that originates in formal logic (the literature is exceptionally copious; e.g. Büring 2005, Higginbotham 1980, Montague 1973, Scott 1970). I assume that the interpretation function is now relativized to

an assignment function $g : \mathbb{N} \rightarrow D_e$ (or equivalently an infinite sequence of individuals), in addition to a possible world w .³ It is assumed that pronouns always come with a numerical index, which does not have a phonological reflex, and is represented as a subscript throughout this dissertation. One important function of indices is to differentiate the denotations of different occurrences of pronouns. The idea is that pronouns with different indices may have different semantic values. This degree of flexibility is necessary as different occurrences of one and the same pronoun can denote different individuals even in the same sentence. For instance, one can read two occurrences of *him* in the following sentence to designate two different individuals, e.g. the first *him* as Bill and the second *him* as John.

(7) John told him that Mary called him this morning.

With these mechanisms at hand, a pronoun *him* can be given the following semantics. Throughout the present dissertation, I use i as a metavariable that ranges over natural numbers.

(8) $\llbracket \text{him}_i \rrbracket^{w,g} = g(i)$

This semantics captures the versatility of pronominal reference. According to it, the referent of a pronoun is determined by the index it carries and the assignment function used to evaluate it. For instance, if the two occurrences of *him* in (7) carry different indices, e.g. 5 and 9, then their referents can be different, since $g(5)$ need not be the same as $g(9)$. As I remarked above, I am not concerned in this dissertation with how indices and assignment functions are actually chosen (see Stokke 2010 for discussion), but rather only with capturing the range of interpretations pronouns allow in a given sentence in a given context.

Furthermore, the analysis (8) allows for a uniform treatment of free and bound pronouns with some ancillary assumptions. The technique that Heim & Kratzer (1998) makes use of to this end is phonologically implicit binder indices and the compositional rule of Predicate Abstraction (see also Büring 2005). Binder indices are assumed to be introduced in syntax by movement of a phrase, which also creates a trace with the same index that the binder index has.⁴ It is assumed that traces are simply phonologically null versions of pronouns and interpreted via an assignment function in the same way as pronouns.⁵

(9) $\llbracket t_i \rrbracket^{w,g} = g(i)$

For the sake of clarity, I write λi as the binder index in our LF representations (instead of just i as in Heim & Kratzer 1998; but λ here should not be conflated with the metalanguage λ ; cf. Büring's 2005 μ -operator). A binder index triggers the following compositional rule which manipulates the assignment function g .

(10) *Predicate Abstraction*
 If α has a binder index λi and β as its daughter constituents, then $\llbracket \alpha \rrbracket^{w,g} = \lambda x_e. \llbracket \beta \rrbracket^{w,g[i \mapsto x]}$.

The modified assignment $g[i \mapsto x]$ is the assignment function different from g at most in

³Accordingly, the definition of Functional Application should mention g . Since Functional Application does not affect g , we can just add it as a superscript as $\llbracket \rrbracket^{w,g}$ in (3).

⁴Büring (2005) allows a binder index to appear without movement, but the present dissertation is neutral with respect to whether such a mechanism is necessary.

⁵I will not be concerned much with the interpretation of traces in this dissertation. See Fox (2000), Sauerland (1998, 2004) for analyses of traces as definite descriptions.

that $g[i \mapsto x](i) = x$.

For an illustration, consider the following sentence.

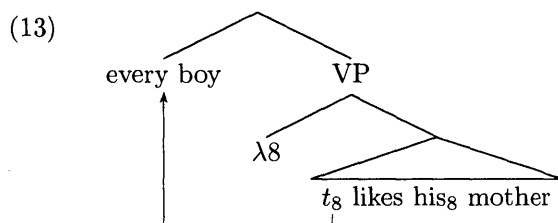
(11) Every boy likes his mother.

This sentence has two readings paraphrased by (12).

(12) a. John likes John's mother, Bill likes Bill's mother, Phil likes Phil's mother, ...
 b. All the boys likes the same person, e.g. Sam's mother.

The reading (12a) is captured by the bound interpretation of *his*, while the reading (12b) involves a free reading of the same pronoun. I call them the bound pronoun interpretation and the free pronoun interpretation of the sentence in (11).

Let us analyze first the bound pronoun reading (12a). Assuming movement of *every boy*, indicated by the arrow in (13), we can assign the following LF.⁶



As mentioned above, an movement creates a binder index $\lambda 8$, and leaves a trace with the same numerical index 8.

Now we are ready to analyze the LF in (12). According to Predicate Abstraction in (13), the constituent labeled VP denotes the following function:

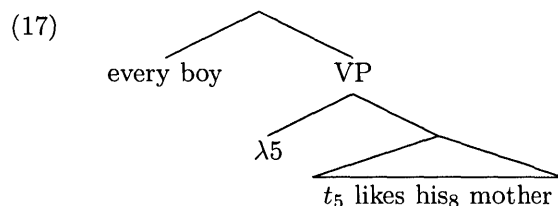
$$(14) \quad \lambda x_e. \llbracket t_8 \text{ likes his}_8 \text{ mother} \rrbracket^{w,g[8 \mapsto x]} \\ = \lambda x_e. x \text{ likes } x\text{'s mother in } w$$

Assuming that the meaning of *every boy* is simply a universal generalized quantifier as defined in (15), the predicted truth conditions of the sentence are as in (16).

$$(15) \quad \llbracket \text{every boy} \rrbracket^{w,g} = \lambda P_{\langle e,t \rangle}. \text{ for every } x \text{ who is a boy in } w, P(x) = 1$$

$$(16) \quad \llbracket (13) \rrbracket^{w,g} \Leftrightarrow \text{for every } x \text{ who is a boy in } w, x \text{ likes } x\text{'s mother in } w$$

Furthermore, the free pronoun interpretation in (12b) can be captured by contra-indexing the binder and *his*, as depicted in the following tree diagram.



In this case, the VP node here denotes the following function.

⁶One can think of this movement as movement to [Spec, TP] from [Spec, VP].

$$(18) \quad \lambda x_e. \llbracket t_5 \text{ likes his}_8 \text{ mother} \rrbracket^{w,g[5 \rightarrow x]} \\ = \lambda x_e. x \text{ likes } g(8)\text{'s mother in } w$$

Importantly, *his* here denotes $g(8)$, rather than x in (18). Thus, the sentence is predicted to be true just in case every boy likes $g(8)$'s mother, where $g(8)$ is a particular person, say Sam.

As demonstrated by the example above, the bound use of a pronoun requires a binder index with the same index in a c-commanding position. The pronoun his_8 in (13), for instance, is c-commanded by the binder index $\lambda 8$. If it were not for such a binder index, e.g. (18), it would not receive a bound interpretation, as in the case of (17). We can now define the notions of bound and free as in (19).

$$(19) \quad \text{A pronoun } \pi \text{ with an index } i, \pi_i, \text{ is } \textit{bound} \text{ in a constituent } \gamma, \text{ if there is a binder index } \lambda i \text{ in } \gamma \text{ that c-commands } \pi. \text{ Otherwise it is } \textit{free} \text{ in } \gamma.$$

The notions of bound and free here are defined relative to a syntactic domain γ . This is as it should be, because the bound interpretation of a pronoun is not inherent in the semantics of the pronoun itself, but is relative to the presence/absence of a binder index λi higher up in the tree. For instance, under both LF representations above, the noun phrase *his₈ mother* denotes $g(8)$'s mother, for some g , and hence the meaning of the noun phrase is the same. What is crucially different is the assignment function, which has been manipulated by the binder index $\lambda 8$ in the case of (13), but not in the case of (17). That is, $\lambda 8$ in the former introduces a λ term with a variable x in the metalanguage, and forces pronouns and traces with the same index 8 under its scope to denote x . In this case, I will speak of $\lambda 8$ binding the pronoun his_8 , or more generally:

$$(20) \quad \text{A binder index } \lambda i \text{ binds a pronoun } \pi_i, \text{ just in case the former c-commands the latter, and there is no other } \lambda i \text{ that is c-commanded by the former and c-commands the latter.}$$

I will also say derivatively that a noun phrase binds a pronoun, when the binder index it introduces binds it.

Another way to look at the bound vs. free interpretations of pronouns is in terms of the sensitivity to the assignment function. The denotation of a free pronoun changes according to the assignment function used to interpret it. For instance, we saw above that the LF in (17) is true relative to w and g if and only if every boy likes $g(8)$'s mother in w , and in order to know whether this is true or not we need to know what g is. On the other hand, under the bound pronoun interpretation, all assignment function will give the same truth values. This is evident in (16) above, as these truth conditions do not contain g , and hence does not matter which g to use in interpreting the sentence.⁷

This much is all we need to know about pronouns before proceeding to the main topics of this dissertation, which will be modified and elaborated, as we go along. That said, it should be acknowledged that the semantics of pronouns is a highly complex topic, and there are many intriguing phenomena that cannot be subsumed by the theory introduced here or by my later modifications, in particular those that fostered the developments of the theory of D/E-type pronouns (Geach 1962, Evans 1977a,b, 1980, Cooper 1979, Heim & Kratzer

⁷As pointed out to me by Irene Heim (p.c.), the two notions are not completely equivalent. That is, when the relevant domain denotes a tautology or contradiction for all assignment functions, the interpretation will be assignment independent, but the pronouns occurring in the domain might not be bound.

1998, Heim 1991, Elbourne 2005, Buring 2005) and dynamic semantics (Kamp 1981, Heim 1982, Kamp & Reyle 1993, Chierchia 1995, Brasoveanu 2007, 2010). Although I will briefly touch on related phenomena later, it is beyond the scope of this dissertation to discuss them in depth, and the interested reader is referred to the works mentioned here.

1.3 Phi Features on Pronouns

The main focus of this dissertation is the semantic properties of phi features on pronouns. Across languages pronouns morphologically mark some information regarding their referents, typically person, gender and/or number information.⁸ Honorific information is also commonly encoded in pronouns, although not in English.

English pronouns typically carry three types of features, person, gender and number features, although not all pronouns are specified for all three categories.⁹

(21)	I, me, my, myself	[1st, singular]
	we, us, our, ourselves	[1st, plural]
	you, your	[2nd]
	yourself	[2nd, singular]
	yourselves	[2nd, plural]
	he, him, his, himself	[3rd, masculine, singular]
	she, her, herself	[3rd, feminine, singular]
	it, its, itself	[3rd, neuter, singular]
	they, them, their, themselves	[3rd, plural]

The features in (21) are motivated on semantic grounds. For example, *I* can only denote the current speaker and cannot be used to denote anybody else. This requirement is encoded as the person feature [1st]. Also it can only denote a single person, and cannot be used to denote a group of people, which is specified by the number feature [singular]. On the other hand, English *I* can be used for both male and female individuals, as far as they are speakers of the contexts in which this pronoun is used. The lack of requirement for gender is analyzed as underspecification for the gender feature. This is a locus of crosslinguistic variation, and languages like Japanese have multiple first person singular pronouns with different gender restrictions. For example, *boku* is specified as [1sg, masculine, singular], and cannot be used to denote a female speaker.

Similarly different languages have different inventories of second person singular pronouns. As shown in (21), English *you* is only specified for [2nd], and underspecified for gender and number. Therefore, it can be used for any individual regardless of their gender as far as they are the addressee. Also as it does not have a number restriction it can pick out one addressee, or some group of people including the addressee.¹⁰ Just as in the case of first person pronouns, languages vary here. For example Hebrew has two forms for second person singular pronouns, *atah* and *at*, which are specified as masculine and feminine,

⁸One exception is a phonologically null pronoun *pro* that can be found in *pro*-drop languages. At least in certain languages, e.g. Japanese, *pro* can be analyzed as underspecified for all phi features.

⁹Some authors such as Percus (2006) and Sauerland (2008b) argue that some of these features are not interpreted as indicated here (e.g. [masculine] does not always require the referent to be male), but I assume here the full specification. Also see Cysouw (2009), Harley & Ritter (2002), van Koppen (2012), Kratzer (2009) and references therein for more elaborate feature systems, which are primarily motivated by morphological considerations. Here I assume a very simple system that works for English.

¹⁰English second person pronouns have a generic use, which I believe is not commonly observed crosslinguistically. I will not discuss this use of second person pronouns here. See Malamud (2006).

respectively, and are morphologically distinguished from plural second person pronouns.

Therefore we want to assign a semantic interpretation to each of these phi features. Notice that in our earlier entry for *him* in (8), we left out this information. How can we encode the inferences phi features beget? Should gender, person and number features be treated in the same manner? What theoretical consequences do analyses of phi features on pronouns have? These are the main questions we will be concerned with in this dissertation.¹¹

1.4 Overview

The present dissertation is organized into three parts, each covering one major topic pertaining to the semantics of phi features. The three topics are more or less independent from each other, and each part can be read independently.

Part I deals with the meanings of gender features, and the problem of presupposition projection. Following many previous studies, most notably Cooper (1983), I claim that gender features are presupposition triggers. Based on this assumption, I show that predicates containing bound gendered pronouns have a particular property, namely that they have an assertive meaning that does not entail the gender presupposition. This property poses a serious challenge to existing theories of presupposition projection, especially with respect to presuppositions of quantified sentences. A conclusion drawn from this discussion is that the presupposition needs to be dissociated from the assertive meaning, as in Karttunen & Peters's (1979) two dimensional theory. However, such a theory is known to run into the so-called *binding problem* in quantified sentences. I propose a solution to the binding problem, using the mechanism of cross-sentential anaphora, and show that the resulting theory nicely accounts for the interaction of quantificational determiners and presuppositions.

Part II looks at phi features on bound pronouns, especially focusing on person and number features. I argue that person features cannot be analyzed in the same way as gender features. This conclusion leads to a question of how to account for the bound uses of first and second person pronouns. After critically reviewing three previous approaches, I offer a novel analysis that makes use of structurally complex indices. I further extend this proposal to cover number features on bound pronouns which interact with person features in an interesting way, and give both empirical and conceptual arguments for my analysis.

Part III investigates the phenomenon of indexical shifting. Recent studies in formal semantics revealed that languages differ with respect to the interpretation of first and second person pronouns in various attitude contexts. That is, in certain languages, they can be interpreted relative to the reported context of utterance, rather than the current context of utterance. I examine data taken from previous studies such as Schlenker (1999, 2003b), Anand & Nevins (2004), and Anand (2006), and also novel data in Uyghur and Japanese, and propose a theoretical account of indexical shifting, focusing especially on the universals and variation observed within and across languages.

¹¹I do not have much to say about the syntax and morphology of phi features on pronouns, which are highly intriguing research areas. See Cardinaletti & Starke (1999), Déchaine & Wiltschko (2002), Harley & Ritter (2002), Ritter (1993, 1995), Gruber (2011), van Koppen (2012), for example. Also the literature on phi features on other exponents than pronouns is enormous. See for instance, Baker (2008), Preminger (2011) and references therein.

Part I

**Gender Features and
Presupposition**

Synopsis: In this part I discuss the nature of the inferences that gender features on pronouns give rise to. Following previous work, especially Cooper (1983), I claim that gender features on pronouns trigger presuppositions about the gender of their referents. Based on this observation, I use them as a window into the problem of presupposition projection. In particular, I point out that they have a property that poses a challenge for existing theories of presupposition projection, especially with respect to how presuppositions project in quantified sentences. I propose to depart from the popular treatments of presuppositions in the current semantic literature, and offer a novel analysis. The proposed analysis is shown to account for the different properties of different quantificational determiners in a uniform manner.

Organization: The organization of Part I is as follows. Empirical support for the claim that gender inferences of pronouns are presuppositions is presented in Section 2. Section 3 introduces the central topic of the present part, the problem of presupposition projection, and briefly reviews two representative approaches to tackle this problem. With this background, I will point out in Section 4 an important property of gender presuppositions of pronouns, which I claim poses a serious challenge to existing theories of presupposition projection. The problem is profound and originates from how presuppositions are conceptualized and modeled in these theories. Section 4.4 introduces Karttunen & Peters's (1979) theory of presuppositions for which gender presuppositions of pronouns pose a different problem called the binding problem. I will propose a novel solution to the binding problem in Section 5, and discuss the predictions and some additional issues of the proposed analysis. Section 6 is devoted to detailed examination of some of the previous theories of presupposition projection with respect to the problem of gender presuppositions of pronouns.

2 Gender Presuppositions of Pronouns

2.1 Gender Features as Presupposition Triggers

A simple sentence containing a feminine *she* like (22) necessarily implies that its referent, whoever that is, is female.

(22) She is drinking coffee.

Thus, this sentence cannot be used to describe a situation where a male person, say, John, is drinking coffee.

In what follows, I will mostly focus on feminine pronouns for it is uncontroversial (at least for English and other well studied languages) that their gender inferences are part of their lexically encoded, conventional meanings, which are of our primary interest here. Although a masculine pronoun *he* often gives rise to an inference that the referent is male too, in certain circumstances (in certain dialects of English), feminine and masculine pronouns are known to behave differently. This fact led some authors to argue the gender inferences of masculine pronouns are *not* part of their conventional meanings and only pragmatically inferred (Percus 2006, Heim 2008b, Sauerland 2003, 2008a,b, Singh 2011). I will remain neutral with respect to this analysis, and in order to avoid unnecessary complications, the key examples below are constructed with feminine pronouns.¹²

¹²I also disregard the gender neutral (or 'politically correct') use of feminine pronouns that can sometimes be found in a relatively formal register.

Let us begin with a basic question: what kind of meaning is the gender inference of a pronoun? Since Frege, it is widely acknowledged that meanings in natural language are multi-dimensional, and at least four types of meaning are standardly recognized in the current formal semantic literature:

1. Assertive/truth conditional/at-issue meaning¹³
2. Presupposition
3. Conversational implicature
4. Conventional implicature

These four types of meaning are primarily distinguished according to the following two criteria: (i) their pragmatic status, i.e. how they are used in actual conversations, and (ii) the way they semantically interact with other words and phrases (sometimes referred to as ‘projection’ especially for presupposition). I will first show that the gender inference of a feminine pronoun is not an assertive entailment, by demonstrating that it persists under the scope of various kinds of operators where assertive entailments disappear. Then I will argue that they show hallmarks of presuppositional inferences.

2.1.1 Assertive Meaning

There are a number of linguistic items under whose scope assertive entailments of an embedded sentence do not survive as entailments of the entire sentence. They include words and expressions like *if*, *it is false that*, *John doubts that* and *John hopes that*, etc. More concretely, take a simple sentence in (23).

(23) There is a llama in the Boston Common.

This sentence entails that there is a llama in Boston, given the fact that the Boston Common is in Boston. This entailment disappears when (23) is embedded under non-veridical operators, as in (24).

- (24)
- a. If there is a llama in the Boston Common, there must be an alpaca, too.
 - b. It is false that there is a llama in the Boston Common.
 - c. John doubts that there is a llama in the Boston Common.
 - d. John hopes that there is a llama in the Boston Common.

Clearly, none of these sentences entail that there is a llama in Boston. This is one of the defining features of assertive meaning.

Unlike assertive entailments, the inference regarding the gender of a pronoun’s referent persists under some of these operators. For example, the following sentences imply that the referent is female just as much as (22) does.¹⁴

(25) a. If she is drinking coffee, then I will have tea.

¹³I will use these terms interchangeably.

¹⁴For the other two operators in (24), which are both attitude predicates, the inference at first seems to survive as well, as demonstrated by (i) below.

- (i)
- a. John doubts that she is drinking coffee.
 - b. John hopes that she is drinking coffee.

- b. It is false that she is drinking coffee.

Thus, the projection behavior of the gender inferences of pronouns is different from the projection behavior of entailments in the dimension of assertive meaning.

Notice that the occurrence of *she* in (22) is a free pronoun. We should also ask what happens when a feminine pronoun is bound by a quantifier. For example, consider the following sentences containing bound occurrences of *her* and *herself*.

- (26) a. Every kid brushed her teeth.
b. Every student criticized herself.

We concentrate on the bound pronoun reading of *her* of (26a), which is pragmatically more salient than its free pronoun interpretation (cf. Rullmann 2003). (26b), on the other hand, has only a bound reading, and is unambiguous. This difference turns out to be immaterial for our purposes here, as non-reflexive and reflexive pronouns give rise to the same gender inferences (more data will be given below). After this section, I will mostly use the reflexive pronoun *herself* in the key examples of bound pronouns to eliminate the possibility of a free pronoun reading, but the exact same arguments can be made with non-reflexive pronouns under their bound readings.

Under the bound reading, (26a) means, roughly put, that each kid x brushed x 's teeth, and also has an inference that every kid is female. Similarly, (26b) means every student x criticized x and one can also infer that every student is female. Therefore in both cases the gender inference is universal with respect to the domain of quantification. Using the same test as above, we can show that these gender inferences of the quantificational sentences are not assertive entailments. That is, they survive as an entailment of the sentence when these sentences are embedded under the scope of operators like *if* and *it is false that*, as demonstrated below.

- (27) a. If every kid brushed her teeth, then the teacher was happy.
b. It is false that every kid brushed her teeth.
(28) a. If every student criticized herself, then the teacher was astounded.
b. It is false that every student criticized herself.

We conclude from the above observations that the meaning of gender features is not part of the assertive meaning. Then what is it? Following previous research (Cooper 1983, Heim & Kratzer 1998, Sauerland 2003, 2008b, Schlenker 1999, 2003b), I claim that the gender inferences of pronouns are presuppositional in nature. I will present below empirical evidence that bolsters this view. The alternative possibility that they are a kind of implicature will be discussed in Section 2.3.

However, the data about attitude contexts are rather complicated. One complication arises regarding the *de re/de dicto* ambiguity (Bonomi 1995, Cresswell & von Stechow 1982, Cresswell 1990, Fodor 1970, von Stechow & Heim 2007, Kaplan 1968, Keshet 2008, 2010, 2011, Montague 1973, Partee 1974, Percus 2000, Quine 1956, Romoli & Sudo 2009, Schwager 2011, Schwarz to appear). For instance, suppose John is known to have a false belief that there is a girl at the party, although there is none in reality. If this is an accepted assumption among conversational participants and the girl who John thinks is at the party is salient enough in the discourse, *she* can be used to talk about that girl. In this case, it does not make sense to ask whether the referent of *she* is actually female, because she does not exist in reality. However, this fact is only a complication and does not undermine the point I am making here, as it is sufficient that the sentences in (25) have readings where the gender inference survives. I will discuss the issue of *de re/de dicto* ambiguity with pronouns in Section 2.2 in more detail.

2.1.2 Presuppositions

Presupposition is a type of inference that sentences containing certain words and phrases called *presupposition triggers* are associated with. Here is a non-comprehensive list of presupposition triggers with some references to earlier works in formal semantics.¹⁵

- (29) a. Aspectual verbs: *stop, start, continue*, etc. (Karttunen 1971, Givón 1972)
- b. Implicative verbs: *manage, fail, forget* etc. (Karttunen 1971, Coleman 1975)
- c. Determiners: *the, every, all, most, both, neither, this*, etc. (Strawson 1950, Hawkins 1978)
- d. Factive attitude predicates: *know, aware, discover, realize*, etc. (Kiparsky & Kiparsky 1970)
- e. Factive emotive predicates: *glad, happy, sorry*, etc. (Kiparsky & Kiparsky 1970)
- f. Negative factive predicates: *pretend, deceive*, etc. (Lakoff 1970)
- g. Focus sensitive particles: *even, too, also, only*, etc. (Karttunen & Peters 1979)
- h. Cleft and pseudo-cleft constructions (Prince 1986)

In the present section I will use the inference of the aspectual verb *stop* as the representative of presuppositional inferences.

As remarked at the outset, different types of meanings are primarily distinguished from one another along the following two dimensions: (i) the pragmatic status and (ii) how they interact with various words and phrases. In what follows, I will contrast presuppositions with assertive entailments with respect to both of these properties, and show that the gender inferences of pronouns pattern like presuppositions triggered by *stop* in these respects.

A presuppositional inference has a clearly different pragmatic status from an assertive inference. Presupposition is typically a piece of information that is already taken to be true, or at least considered uncontroversial among the discourse participants at the time of the utterance of the sentence.¹⁶ On the other hand, assertive meanings are typically new information with respect to the discourse. Loosely speaking, assertive meanings convey some potentially controversial information regarding the topic that the conversation is about. To illustrate this difference, consider the following sentences.

- (30) a. Rafael is a former Mac user.
- b. Rafael stopped using Mac.

Both of these sentences entail that Rafael used Mac before and they mean roughly the same thing overall, but they differ in one crucial respect, namely, they have this inference that Rafael used to use Mac in distinct dimensions of meaning. To see this concretely, suppose that Rafael never actually used Mac before. In this situation, (30a) is plainly false, but felicitous, if the speaker somehow comes to think that he once used Mac but not anymore (and that this information is worth sharing with the conversational partners). On the other hand, one would hesitate to say that (30b) is an outright false sentence (feels “squeamish”

¹⁵In Section 4.1.4, I make some observations that cast doubt on the presuppositionality of some of these triggers, although unconclusively.

¹⁶The term presupposition is used to mean at least two closely connected theoretical concepts. Here what I mean is what is usually called pragmatic presupposition, as opposed to semantic presupposition (Stalnaker 1973, 1974, Gazdar 1979b, Soames 1979, 1982, 1989, Beaver 2001, von Stechow 2008; see Strawson 1950, Lasnik 1993, von Stechow 2004, Abrusán & Szendrői 2011 for discussion focusing on definite descriptions). This distinction will be elaborated below.

as von Stechow 2004 puts it), although it is surely not true. Rather, it sounds as if the speaker is making wrong assumptions. This qualitative difference of the inferences is attributed to the pragmatic difference of the two dimensions of meaning. Generally, assertive meanings are what is at stake and controversial, and they are judged true or false. On the other hand presuppositions are pieces of information that are assumed to be already true or at least uncontroversial in the conversational context. Our observation here suggests that the inference that Rafael used to use Mac is assertive for (30a) but presuppositional for (30b).

Let us apply this test to gender inferences of pronouns. Consider (31).

(31) She is sleeping.

Imagine someone utters this sentence while pointing at a sleeping baby who you know is a boy. In such a situation, the sentence would not be judged straightforwardly false, but one would feel that the speaker was making a wrong assumption about the gender of the baby.¹⁷ In other words, the gender information is necessarily taken to be uncontroversial, a hallmark of presuppositional meaning.

Similarly, the sentences in (32) which contain a bound feminine pronoun yield a feeling of squeamishness in contexts where the gender inference is violated, which is essentially of the same nature as the above example. Recall that these sentences are associated with universal inferences with respect to the domain of quantification that every kid/student is female. Thus in a situation where not every kid/student is female, the gender inference is violated. In such a situation, one would feel that the speaker's assumption about the gender of the kids/students in question is wrong, rather than the sentence is plainly false. This is especially eminent when the assertive meanings of these sentences are true. Intuitively speaking, what the speaker said in such a case is true in some sense but, he or she is making wrong assumptions.

(32) a. Every kid brushed her teeth.
b. Every student criticized herself.

Secondly, presuppositional inferences of a sentence are known to show a particular type of behavior, *projection*, when the sentence is embedded under certain linguistic operators. For example, negation generally does not negate presuppositions, and hence the presupposition seems to 'project out' of the scope of negation. Concretely, both (33a) and its negation (33b) imply that Rafael was a Mac user before (and he still is for (33b)).

(33) a. Rafael stopped using Mac.
b. Rafael didn't stop using Mac.

Compare this to the following pair involving *is a former Mac user* instead of *stopped using Mac*.

(34) a. Rafael is a former Mac user.

¹⁷Notice also that what the speaker wanted to convey in this situation is not taken to be false. It is just the assumption that she was making is false. This indicates an important property of gender presuppositions on pronouns, i.e. gender presuppositions can be true or false independently from the truth of the assertive meaning of a sentence. It should be mentioned in this connection that Stokke (2010) makes essentially the same observation but concludes that gender inferences are *not* presuppositional. His arguments are crucially built upon the commonly made assumption that presupposition failure necessarily renders the sentence neither true nor false, but as I will argue later, this assumption is grounded on a limited set of presupposition triggers and should be abandoned.

- b. Rafael is not a former Mac user.

As we already saw, (33a) and (34a) are very similar in meaning. But unlike (33b), (34b) does not imply that Rafael has been using Mac, and compatible with a situation where he never used it before. In other words, the inference that Rafael used to use Mac under negation in (34a), but not in (34b).

Similarly when the sentence (33a) is embedded in the antecedent of a conditional sentence, the inference that Rafael is a former Mac user still obtains, as demonstrated by (35).

- (35) If Rafael stopped using Mac, he must be using Linux now.

Again, compare this to a sentence with *is a former Mac user*, (36).

- (36) If Rafael is a former Mac user, he must be using Linux now.

This sentence, unlike (35), does not suggest that Rafael used to use Mac.

Let us call these embedding tests that distinguish presuppositions from assertive meanings *projection tests*. It is important to keep in mind in applying these projection tests that there are in fact readings of the sentences containing *stopped smoking* that are not associated with the inference in question, although such readings are relatively less prominent, and often require marked intonation, and/or contextual support. That these alternative readings exist is evidenced by the coherence of the following sentences.

- (37) a. Rafael did not stop using Mac, because he never owned a Mac.
b. If Rafael stopped using Mac, he must have told us. So I think he never owned a Mac.

If these sentences were obligatorily associated with the inference that Rafael used to use Mac, then they should be judged incoherent. Although the nature of these readings is not well understood and their analysis is controversial, their existence is well accepted and they certainly need to be taken care of when applying projection tests. Given this confound, the most reliable projection test for presupposition in my opinion is embedding under various attitude predicates. Under the scope of certain attitude verbs, presuppositions generate the inference that the attitude holder believes that the presuppositions are true.¹⁸ For example, all of the sentences below imply that Kate believes that Rafael used to use Mac.

- (38) a. Kate believes that Rafael stopped using Mac.
b. Kate doubts that Rafael stopped using Mac.
c. Kate hopes that Rafael stopped using Mac.
d. Kate asked if Rafael stopped using Mac.
e. Kate wonders if Rafael stopped using Mac.

Importantly, with predicates other than *believe*, assertive entailments and presuppositions can be easily distinguished, as assertive entailments never give rise to the inference that the

¹⁸Presupposition projection from attitude contexts are extensively discussed by Karttunen (1973, 1974), Karttunen & Peters (1979), Heim (1992), and Geurts (1998, 1999), among others. What is remarkable here is that in most cases, there is also an inference that the presupposition is actually true. Karttunen (1974), Karttunen & Peters (1979) and Heim (1992) argue that this inference is purely pragmatic and based on the inference about the attitude holder's beliefs, but Geurts (1998, 1999) raises an interesting empirical puzzle for such a view. I will briefly touch on this issue in Section 5.7.2.

attitude holder believes them. Compare the sentences in (38) and those in (39). Clearly, only (38a) entails that Kate believes that Rafael used to use Mac.

- (39)
- a. Kate believes that Rafael is a former Mac user.
 - b. Kate doubts that Rafael is a former Mac user.
 - c. Kate hopes that Rafael is a former Mac user.
 - d. Kate asked if Rafael is a former Mac user.
 - e. Kate wonders if Rafael is a former Mac user.

The sentences in (38b)-(38e) presumably also have alternative readings that do not entail that Kate believes that Rafael is a former Mac user, which are reminiscent of the meanings of (39a)-(39e). However, the fact that the former but not the latter have the readings that do give rise to the inference about Kate's belief, probably as a preferred reading, suggests that *stopped using Mac* is a presuppositional predicate, while *is a former Mac user* is not.

Let us now apply these projection tests to gender features on pronouns. Firstly, the inference that the referent of a free feminine pronoun is female survives under negation. For instance, both of the following sentences imply that the referent of the pronoun is female.

- (40)
- a. John criticized her.
 - b. John didn't criticize her.

Also, in the scope of the attitude verbs listed above, it can generate the inference that the attitude holder believes that the referent is female. A complication that arises here is that the gender presupposition is ambiguous between *de re* and *de dicto* readings in intensional contexts.¹⁹ In particular, under a *de re* reading, it is not required that the attitude holder knows who the referent of the pronoun is, and hence is compatible with he or she wrongly believing that the referent was male (we will come back to this in Section 2.2 below). For this reason, we will force a *de dicto* reading with a context and concentrate on this reading. One way to force a *de dicto* reading is to put the sentence in a context where the referent might not exist in reality, as in (41).

- (41) CONTEXT: Kate said that John attended a talk by some phonologist. We have no clue whether or not she's telling us the truth.
- a. Kate believes that John criticized her.
 - b. Kate doubts that John criticized her.
 - c. Kate hopes that John criticized her.
 - d. Kate asked if John criticized her.
 - e. Kate wonders if John criticized her.

These sentences in the given context give rise to the inference that Kate believes the phonologist is female, as expected under the hypothesis that gender features are presuppositional. Importantly, the inference does not behave like assertive entailments, so the gender information is not part of the what she doubts/hopes/asks about/wonders about.

The gender inference generated by a bound feminine pronoun shows the same behavior. It projects out of negation, as shown by the following sentences. The negative sentence has an additional complexity regarding the scope interaction of *every* and *not*, but this does not matter for my purposes here, and we will concentrate on the surface scope reading.

¹⁹See fn.14 above and Section 2.2 below. For the same reason, I omit a test with an *if* clause here.

- (42) a. Every kid brushed her teeth.
b. Every kid didn't brush her teeth.
- (43) a. Every student likes herself.
b. Every student doesn't like herself.

The positive and negative pairs here have the same gender inference that every kid/student is female, which again indicates that the gender inference is a presupposition.

Also in belief contexts, this inference becomes part of the attitude holder's belief, provided that the *de dicto* reading is forced. For example, the following sentences all suggest that John believes that every student is female, in the given context.

- (44) CONTEXT: John met new people today and said some of them are students, and some of them are professors. We do not know if he is right about that.
 - a. John believes that every student likes herself.
 - b. John doubts that every student likes herself.
 - c. John hopes that every student likes herself.
 - d. John asked if every student likes herself.
 - e. John wonders if every student likes herself.

To sum up the discussion so far, we saw above that gender inferences of feminine pronouns are not part of the assertive content, but pattern with presuppositional meanings in terms of their pragmatic status and projection properties. This view is indeed widely defended in the literature (Cooper 1983, Heim 2008b, Sauerland 2008b, Schlenker 1999, 2003a).

2.2 Some Exceptional Properties of Gender Presuppositions

Although the presuppositional analysis of gender inferences of pronouns is often upheld, it is less often discussed, if not unrecognized, that it is marred by some empirical complications. That is, as Cooper (1983) and Yanovich (2010) discuss, there are several places where the gender inferences of pronouns seem to behave differently from run-of-the-mill presuppositional inferences. I claim, nonetheless, that this does not threaten in any way the thesis that gender inferences of pronouns are presuppositional in nature.

2.2.1 Free Pronouns

Although concluding that gender features on bound pronouns are presuppositional, Cooper (1983) maintains that gender features on free pronouns do not show the projection properties of usual presuppositions. His arguments are based on the following examples.

- (45) a. She talked.
b. She didn't talk.
c. Bill said that she talked.
d. Bill hopes that she talked.
e. Bill regrets that she talked. (Cooper 1983:180)

Cooper (1983:181) remarks as follows.

According to my intuitions, which may not be universally shared, somebody who utters [(45c)], for example, is committed to the referent of *she* being female. [...]

it seems to me that for example [(45d)] can be used in a situation where Bill does not assume that she is female (Bill might have wanted her to talk because he could not figure out what sex she was just by looking).

It seems that (45c)-(45e) can indeed be read as suggesting that the referent of *she* is female, as clarified by the following example.

- (46) We went to a conference yesterday, and saw a strange linguist. Bill thought that she was a man.

The second sentence does not imply that Bill has an incoherent thought that the linguist in question is both male and female. Rather it reports that Bill mistook the linguist who we know is female for a man.

The availability of such readings is atypical of presuppositional inferences. Generally, presuppositions triggered by predicates like *stopped using Mac* become part of the belief of the attitude holder, as we already saw in the previous section, and as shown again in (47).

- (47) Bill thought that Rafael stopped using Mac.

If the same happened to (46), therefore, the second sentence would imply that Bill had a contradictory belief about the gender of the linguist, contrary to fact. This difference led Cooper (1983:181) to conclude that the gender inferences of free pronouns “behave neither like normal entailments nor normal presuppositions,” and he proposes that they should be regarded as a special kind of presupposition which he calls *indexical presupposition*. Thus for him, the gender inferences of free pronouns are qualitatively different from normal presuppositions.

Largely agreeing with Cooper, Yanovich (2010) provides more examples of the above sort that involve constructions from which typical presuppositions do not surface, while the gender presupposition of a free pronoun does. For example, when there is a presupposition trigger in the consequent of a conditional sentence, the presupposition does not have to survive as an inference of the entire conditional, if the assertive meaning of the antecedent entails the presupposition. Let us look at a concrete example of this. First as a baseline, take (48a) where *know* triggers a factive presupposition that the complement is true. This factive presupposition does not survive in a conditional like (48b), where the antecedent entails the presupposition that Bill is a smoker. In other words, the presupposition seems to be ‘filtered out’ by the antecedent.

- (48) a. John knows that Bill is a smoker.
b. If Bill and Mary smoke every hour, John knows that Bill is a smoker.

Yanovich (2010) observes that this filtering effect does not obtain with a gender presupposition of a free pronoun. For instance, the following conditional sentence containing *she*, whose intended referent is John, has a contradictory presupposition that John is female. Importantly, the gender presupposition could be filtered out by the antecedent, given (48b).

- (49) #If John were female, she would be popular among the boys.

Note that the judgments here are somewhat shaky, and it is not impossible to construct a better example like the following (contrary to what Yanovich 2010 seems to assume).

- (50) ?If John were a beautiful girl, all the boys would ask her out.

However, the contrast between gender inferences of free pronouns and the presupposition triggered by *know* is still eminent: Filtering effects are harder to obtain with gender presuppositions.

Similarly, presuppositions are known to not project out in a certain type of disjunction.²⁰ More specifically, when the negation of one of the disjuncts entails the presupposition of the other, the presupposition does not survive as an inference of the whole sentence. An example of such a case is given in (51). The relevant presupposition here is again the factive presupposition triggered by *know*.

(51) Either Bill is not a smoker, or John knows that he is.

In an analogous configuration, the gender presupposition of a free pronoun surfaces as the presupposition of the disjunction, unlike the factive presupposition of *know*. In order to create a relevant example where the two disjuncts have contradicting inferences about the gender of the same individual, we need a context where the speaker is ignorant about the individual's gender. In such a case, neither a masculine nor feminine pronoun can be used, as evidenced by (52).

(52) #I don't know if this person, Jesse, is a boy or girl, although I have met {him, her} several times.

As Yanovich (2010) observes, in a disjunctive sentence like (53), both masculine and feminine pronouns result in infelicity.

(53) #Either Jesse is really a boy, or {he, she} hangs out with boys.

If the gender inference patterned like a normal presupposition, the gender presupposition of *she* should be able to disappear, as it is entailed by the negation of the first disjunct. Again, a better example like the following offered to me by Martin Hackl (p.c.) can be constructed, suggesting that the difference between gender presuppositions of pronouns and more typical presuppositions like factive presuppositions is not so crisp.

(54) ?Either Jesse is a boy, or she is extremely good at pretending to be one.

Another set of examples that Yanovich discusses involve an epistemic possibility. As shown in (55a), for instance, the presupposition of *stopped* does not have to project out in this context. On the other hand, the gender presupposition of a pronoun again remains as the inference of the entire sentence, as the infelicity of (55b) indicates.

(55) a. I don't know if John was ever a smoker, but it's possible that he stopped.
b. #I don't know if Jesse is a boy or girl, but it's possible that {he, she} will join our party.

Just as before, it is not impossible to construct a better case, such as the one in (56) due to Martin Hackl (p.c.).

(56) ?I don't know if Jesse is a boy or girl, but it's possible that she is a girl.

²⁰Disjunctive sentences have rather complicated projection properties. I will not provide an in-depth discussion in the present dissertation. See, for example, Gazdar (1979b), Karttunen & Peters (1979), Soames (1979, 1982, 1989), Krahmer (1998), Geurts (1999), Beaver (2001), Beaver & Krahmer (2001), Schlenker (2008, 2009), Rothschild (2011).

2.2.2 Two Properties of Gender Presuppositions

Both Cooper (1983) and Yanovich (2010) conclude that the gender inferences of free pronouns are what they call indexical presuppositions, which are distinguished from normal presuppositions. I am not concerned here with what they mean by this theoretical term, but rather I would like to offer arguments to show that gender inferences of free pronouns are indeed bona fide presuppositions, and their exceptional projection properties are merely due to two peculiar properties with respect to (i) ‘local accommodation’ and (ii) *de re/de dicto* ambiguity. More specifically, I claim that the above observations fall out with two auxiliaries assumptions: (i) that gender presuppositions of pronouns are hard to ‘locally accommodate’ in the sense made clear below, and (ii) that they prefer *de re* construal. I conceive of these properties as pragmatic tendencies, and can be violated in certain contexts, which explains the non-crisp judgments we witnessed above. Although it is beyond the scope of this dissertation to explicate what causes pronouns to have these properties and where exceptions are found, an important consequence is that gender inferences of pronouns are otherwise presuppositional in the same sense as inferences engendered by other typical presupposition triggers.

Dispreference for Local Accommodation

As we saw, examples like (37) repeated below admit exceptional readings of presuppositions. That is, these are contexts where presuppositions usually project out, but in these examples, they do not.

- (37) a. Rafael did not stop using Mac, because he never owned a Mac.
b. If Rafael stopped using Mac, he must have told us. So I think he never owned a Mac.

One way to understand what is going on here is to assume that presuppositions can sometimes be treated as part of the assertive meaning. That is, the sentences in (57) capture the readings of (37).

- (57) a. Rafael did not use Mac before and stopped, because he never owned a Mac.
b. If Rafael used Mac before and stopped, he must have told us. So I think he never owned a Mac.

I will call these readings *local accommodation* readings. Later, I will suggest that they are indeed derived by treating presuppositions as part of assertive meanings (cf. Heim 1983, van der Sandt 1992, Krahmer 1998, Geurts 1999, Beaver & Krahmer 2001, Kadmon 2001, Sudo, Romoli, Hackl & Fox 2011), but at this moment, I use the term *local accommodation* somewhat pre-theoretically to designate certain readings of sentences containing presupposition triggers. As remarked above, local accommodation readings are generally more marked, and not the most prominent reading of a sentence, unless the more prominent reading or readings are obviated for independent reasons, e.g. they are contradictory as in (37) (see van der Sandt 1992, Beaver 2001, Kadmon 2001 for discussion).

Unlike the presupposition triggered by *stop*, local accommodation readings of gender presuppositions of free pronouns are harder, if not completely impossible, to obtain. Consider the following examples.

- (58) a. ??I do not know her personally, because he is a man.

- b. ??I don't know if Jesse is a boy or a girl. But if she is grumpy, I will take her to the zoo.

The local accommodation readings, if available, would be coherent here, as the felicity of the following sentences suggests.

- (59) a. It's not the case that that person is female and I know her personally, because he is a man.
b. I don't know if Jesse is a boy or a girl. But if Jesse is a girl and she is grumpy, I will take her to the zoo.

I do not try to explicate the observed resistance of local accommodation readings in theoretical terms here, but it should be recognized as a factor in evaluating gender presuppositions of pronouns in comparison to presuppositions triggered by other items that more easily give rise to local accommodation readings.

Preference for *De Re* Construal

Another property of pronouns has to do with *de re/de dicto* ambiguity. Generally, definite noun phrases show an ambiguity in intensional contexts.²¹ Take singular definite descriptions as an example, which are used to talk about a particular individual. The one in (60) picks out a specific girl who John liked, for instance.

- (60) The girl who John liked was drunk.

Interestingly, when this definite description is embedded in an intensional context, it gives rise to two possible readings. Consider (61).

- (61) Bill said that the girl who John liked was drunk.

Suppose that John liked Jane, but Bill wrongly thought that he liked Sue. Given this background information, (61) can be read as about Jane or about Sue. The former is called a *de re* reading, where the description is evaluated against what the speaker thinks is true, while the latter reading is called a *de dicto* reading, where the description is evaluated against what the attitude holder, Bill in this case, thinks is true.

The same ambiguity obtains in other intensional contexts, including the ones that Yanovich discusses. For example, in the following sentences, the definite description *the girl who John liked* can pick out the girl who John actually liked, which is the *de re* reading, or alternatively, it can pick out some hypothetical girl that we tentatively assume John liked, which is the *de dicto* reading.

- (62) a. If the girl who John liked was drunk, he didn't recognize her.
b. It's possible that the girl who John liked was drunk.

Under the *de dicto* reading of the definite description, these sentences are therefore compatible with there actually being no girl that John liked, and we merely thinking there might

²¹Not only definites, but a varieties of noun phrases give rise to a similar ambiguity as well. The literature on this topic is rather rich. See for example Bonomi (1995), Cresswell (1990), Cresswell & von Stechow (1982), Fodor (1970), von Fintel & Heim (2007), Keshet (2008, 2010, 2011), Maier (2009a), Montague (1973), Musan (1995), Partee (1974), Percus (2000), Quine (1956), Romoli & Sudo (2009), Schwager (2011), Schwarz (to appear).

be.

It is important to keep in mind that the presupposition of a definite description that is read *de re* behaves as if it projects out, even though it is in a context where presuppositions can be ‘filtered out’ and do not surface as part of the presuppositions of the entire sentence. More concretely, a singular definite description presupposes the existence of a unique individual who satisfies the description, and under the *de re* reading, its existence presupposition is part of the presuppositions of the entire sentence in the above examples. This is a systematic confound in assessing judgments of presuppositions of definite noun phrases in intensional contexts.

Given this background, it is unsurprising to find that the gender information of a pronoun also shows *de re/de dicto* ambiguity, since pronouns are definite noun phrases just as definite descriptions are. It turns out that, unlike definite descriptions, a truly ambiguous example is harder to construct with a pronoun, which I argue has to do with strong preference for *de re* readings that pronouns exhibit.

Let us first convince ourselves that there are *de re* and *de dicto* readings of pronouns. Under a *de re* reading, the gender presupposition of a pronoun should be an inference about what we know. In fact, most of the examples we have seen so far in this section involve *de re* pronouns in this sense. For instance, the pronoun in Cooper’s example, repeated here as (63), can be read *de re*, as he remarks in the quote cited above.

(63) Bill hopes that she talked.

Are there *de dicto* readings? We have actually already seen some cases of *de dicto* readings, e.g. (41) in the previous section. Another such example is given in (64).

(64) CONTEXT: Bill said that he attended a talk by some phonologist with John. We have no clue whether they actually attended such a talk. He might be telling us a lie.

Bill told us that John criticized her after her talk.

In this context, we do not know whether the phonologist really exists or not, but Bill says that she does. The inference that the gender feature on *her* gives rise to here is that according to Bill, the phonologist is female, which we do not have to endorse. This is a *de dicto* reading in the same sense as the *de dicto* reading of the definite description in (61) above. That the inference is relative to Bill’s story is shown by the infelicity of the following sentence in the same situation as (64).

(65) #Bill told us that she was a man.

Thus, there are *de dicto* readings of pronouns, but importantly, their distribution is more limited than one might expect. In the above example, the *de re* reading simply is not possible, as there is no *de re* referent, i.e. the existence of the phonologist is not accepted by the speaker or the other discourse participants. In such a context, *de dicto* readings are generally possible. However, when both *de re* and *de dicto* readings are in principle available, the former is by far the preferred reading. Again, I have no theoretical explanation to offer here, but this preference for *de re* construal needs to be recognized in applying projection tests to the gender presuppositions of pronouns.

2.2.3 Reconsidering the Data

Let us revisit the data we saw above with the above two properties of pronouns in mind. Cooper observes that the gender presuppositions seem to project out from attitude contexts. The relevant examples are repeated here.

- (66) a. Bill said that she talked.
b. Bill hopes that she talked.
c. Bill regrets that she talked.

Cooper judges these sentences in a neutral context, and in the passage quoted above, he seems to be assuming that the referent of *she* is somebody known in the context. In such a context, given the preference for *de re* readings, *she* strongly prefers a *de re* reading, in which case the presuppositional inference looks as if it exceptionally projected out. A similar remark applies to the case of conditionals and epistemic modality like (49) and (55b), repeated here.

(49) #If John were female, she would be popular among the boys.

(55b) #I don't know if Jesse is a boy or girl, but it's possible that {he, she} will join our party.

In both cases, the existence of the referent is accepted, so a *de re* reading should be an option, and given the strong preference for a *de re* reading, *she* prefers to be read *de re*, giving rise to the infelicity.

What about the case of disjunction below?

(53) #Either Jesse is really a boy, or {he, she} hangs out with boys.

It is a plausible analysis that the coherent reading of such an example requires local accommodation of the presupposition within the disjunct. That is, disjunction actually passes up presuppositions of the disjuncts, but when the presupposition is locally accommodated, such a reading disappears. For example, consider the acceptable example (51) repeated here.

(51) Either Bill is not a smoker, or John knows that he is.

This can be analyzed as involving local accommodation in the following manner, where the factive presupposition of *know* is locally accommodated within the second disjunct.

(67) Either Bill is not a smoker, or he is and John knows that he is.

This captures the reading of (51). Now consider (53) above. As remarked above, local accommodation of gender presuppositions of pronouns is extremely difficult, if not impossible. Given this property of gender presuppositions and the analysis of presuppositional properties of disjunctive sentences, the infelicity of (53) is not surprising. That is, the most salient reading of this sentence has the gender presupposition, which contradicts the context where the speaker does not know Jesse's gender.

2.2.4 Exceptional Violations of the Preferences

As remarked briefly above, there are cases that sound better than others. The relevant examples are repeated here.

- (50) ?If John were a beautiful girl, all the boys would ask her out.
- (54) ?Either Jesse is a boy, or she is extremely good at pretending to be one.
- (56) ?I don't know if Jesse is a boy or girl, but it's possible that she is a girl.

In these examples, the resistance of local accommodation and the preference for *de re* seem to be violated. I suggest that these two properties ultimately originate in the pragmatics of pronouns, and are violable in certain contexts. Although I have not been able to pin down the relevant pragmatic factors, let us look at a few more cases where gender presuppositions do not project out.

We saw in (64) above that if the referent of the pronoun is not agreed to exist in the context and hence the *de re* reading is blocked, the *de dicto* reading becomes available. Yanovich (2010) provides another such case where the gender presupposition is read *de dicto*. That is, when the gender is not known by the speaker, the antecedent of a conditional can filter out the gender presupposition of a pronoun in the consequent, as shown by (68).

- (68) I do not know if Jesse is a boy or a girl. If Jesse is a boy, I will take him to the zoo, but if Jesse is a girl, I will take her to the aquarium.

Also, even when the gender is known, if the identity is not fixed, a *de dicto* reading is available, as shown by (69).

- (69) John for some reason thinks that one of my three sons is a girl, and asked me if he can marry her.

To summarize, I have argued that gender inferences of free pronouns dislike local accommodation and there is strong preference for *de re* readings, although in certain cases these preferences can be overridden. It is not my purpose to give a theoretical explanation of these properties, but rather what is important is that the data we have seen so far does not contradict the view that the gender inferences of free pronouns are presuppositions.

2.2.5 Gender Presuppositions of Bound Pronouns

Let us now turn to bound pronouns. Cooper (1983) contends that the gender inferences of bound pronouns, unlike those of free pronouns, behave like normal presuppositions. We have seen a few cases of this sort in the previous section (where a *de dicto* reading of the quantifier was forced explicitly). On the other hand, Yanovich (2010) claims that the gender inferences of all pronouns, free or bound, are what he calls indexical presuppositions, and bound and free pronouns both resist embeddings unless certain conditions are met, which in our terms means that bound pronouns also resist local accommodation and prefer *de re* readings, just like free pronouns. Yanovich (2010) gives the following example to illustrate his point.

- (70) CONTEXT: Smith College, one of the Five Colleges of Western Massachusetts, is a women's college. Imagine that Smith has recently gone coed, but not everyone knows about it yet, and Beth reads a letter to some newspaper by a Smith alumna

who thinks that Smith is still a women's college. At the same time, Beth already knows that Smith is coed now.

Beth: *This alumna strongly believes it should be made an absolute principle that every Smith College student meet her adviser at least twice a week.

The logic here is that if *her*, which is bound by the universal quantifier *every Smith College student*, can be interpreted within the attitude context, as expected for normal presuppositions, the sentence should come out felicitous, as the gender inference is only attributed to the attitude holder, *this alumna*. However, this is not the case. Yanovich (2010) concludes from this example that the gender presuppositions of bound pronouns are also indexical presuppositions.

I would like to point out that we should be cautious about *de re/de dicto* ambiguity in this case too. In particular, in the present case, there are two relevant phrases that can potentially show this ambiguity: the quantifier and the bound pronoun. In (70), there is no reliable way to tell whether the quantifier is read *de re* or *de dicto* (although my gut feeling is that the discourse is about the Smith College students in the real world, and so the quantifier is *de re*), but if it is read *de re*, it is conceivable that the pronoun at least can, and possibly prefers to, be read *de re* as well. Whatever is going on in (70), the point here is that, given the *de re/de dicto* ambiguity, it does not necessarily lead to a view that gender presuppositions are qualitatively different from typical presuppositions. Indeed, when the relevant factors are properly controlled, the embedded readings emerge, as witnessed by the examples in (44) in the previous section, which are repeated here.

- (44) CONTEXT: John met new people today and said some of them are students, and some of them are professors. We do not know if he is right about that.
- a. John believes that every student likes herself.
 - b. John doubts that every student likes herself.
 - c. John hopes that every student likes herself.
 - d. John asked if every student likes herself.
 - e. John wonders if every student likes herself.

The trick here is that the context is set up so that the *de re* readings of the quantifier and the pronoun are precluded.

The upshot of the discussion in this section is that although gender inferences of pronouns sometimes do not pattern with other presuppositions in certain contexts like conditionals and attitude report constructions, this fact does not contradict at all the thesis that they are presuppositional in nature. Especially given that gender presuppositions dislike local accommodation readings and give rise to a *de re/de dicto* ambiguity, all one can conclude from their peculiar behavior in complex sentences is that they involve additional complications, which I believe are pragmatic in nature, rather than that they belong to a different category of meaning than typical presuppositional inferences. Although the nature of these properties of gender presupposition should be more thoroughly investigated, I will leave it for another occasion.

2.3 Conversational and Conventional Implicatures

I hope to have shown above enough empirical motivation for the analysis that the gender inferences of pronouns are presuppositional. For the sake of concreteness, in the present section, we evaluate alternative hypotheses that gender inferences are implicatures of some

sort. Broadly speaking, there are two kinds of inferences that are called *implicatures* in the contemporary semantic literature, namely conversational implicature and conventional implicature. Grice (1975) introduced these terms to cover the dimensions of meaning that are neither assertive nor presuppositional. Mainly interested in conversational implicatures, he did not clearly define what conventional implicatures are, but recent studies, especially the series of studies due to Chris Potts (Potts 2005, 2007a,b, 2008) and others (Harris & Potts 2009, McCready 2010, Schlenker 2010c,d, Gutzmann 2011) have carved out a set of semantic phenomena that can reasonably be classified as belonging to a dimension distinct from assertive meaning, presuppositions and conversational implicatures. I will demonstrate in this section that the gender inferences of pronouns do not pattern with either kinds of implicatures.

The hypothesis that gender inferences of pronouns are conversational implicatures can be easily dismissed. Conversational implicatures are by definition inferences that are made based on the assumptions about how cooperative conversations work, and are only suggested rather than implied by the sentence in a strict sense (Grice 1975; see also Gazdar 1979b, Levinson 1983, Sperber & Wilson 1986, Chierchia & McConnell-Ginet 2000, Kadmon 2001, Davis 2010). One characteristic of conversational implicatures, therefore, is its context sensitivity. For example, consider the following example modeled after Davis's (2010).

(71) I have to work on my dissertation.

Suppose Bill says this as a response to the question *Are you going to the party today?* One can reasonably infer that Bill cannot go to the party, although the sentence itself does not say anything about the party. Furthermore, this inference does not arise in a different context. For example, when someone asks what he is up to now, Bill can follow up (71) by saying, *Because I want to go to the party today.* In this case the inference that he cannot go to the party is absent. Furthermore, conversational implicatures are usually cancelable. Even in the first context, Bill can say, *But maybe I can go, if I can finish writing this section within an hour.*

Grice (1975) contends that such an inference are engendered based on assumptions about how the conversation should proceed among cooperative agents. Roughly put, assuming that Bill meant something informative in the first context, for example, the hearer infers that his utterance of (71) should be related somehow to going to the party, and furthermore that because he is saying that he has something he has to do, he probably means he cannot go to the party. In different contexts, the inference proceeds differently, because what it means to be cooperative and informative is different in different contexts. This explains the context sensitivity and optionality of conversational implicatures.²²

It is evident that the gender inference of a pronoun is context insensitive and non-cancelable and should be analyzed as part of the conventional meaning of the pronoun, unlike conversational implicatures. (72), for instance, demonstrates the non-cancelability.

²²Strictly speaking what is illustrated here is so-called *particularized conversational implicature*, which is uncontroversially a matter of pragmatics. On the other hand, so-called *generalized conversational implicature* is less context sensitive. What are typically considered as generalized conversational implicatures include the non-universal inference triggered by *some*, the non-factive inference triggered by non-factive attitude predicates like *think*, and the *exactly* readings of bare numerals. Some recent studies claim that at least some such inferences are actually grammatically derived, rather than pragmatically inferred (cf. Chierchia 2004, Chierchia, Fox & Spector to appear, Fox 2007, Fox & Hackl 2006). Although this grammatical view of generalized conversational implicatures has been controversial, it is easy to see that the gender inferences of pronouns are not generalized conversational implicatures, since they are not cancelable at all.

(72) The smartest student in my class likes herself. #In fact, he is a boy.

It might seem more plausible to analyze the gender inferences of pronouns as conventional implicatures than as conversational implicatures. Although conventional implicature is one of the ill-defined terms in the current semantic literature, and to make the matter worse, the distinction between conventional implicatures and presuppositions is sometimes considered unclear (cf. Karttunen & Peters 1979; see Potts 2005:Ch.2 for extensive discussion on this point). That said, it is sufficient for our purposes here to point out differences between gender inferences of pronouns, and one particular kind of inference that is considered to be a conventional implicature.²³

Unlike conversational implicatures, conventional implicatures are assumed to be part of conventional meanings, but unlike assertive meanings, they are in some sense backgrounded. Let us illustrate this with supplements, which Potts (2005) takes to be representatives of conventional implicatures, and which I use as the practical definition of conventional implicatures.²⁴

- (73) a. Ames was, as the press reported, a successful spy.
b. Ames, who stole from the FBI, is now behind bars.
c. Ames, the former spy, is now behind bars. (Potts 2005:13)

It is rather obvious that the inferences triggered by the supplements in these examples are not cancelable, and hence should be part of the conventional meanings of the sentences. Also, intuitively speaking, they are not the main points that these sentences are about and in some sense backgrounded. This intuition can be corroborated by some linguistic tests. For instance, supplements cannot be used to answer a question, as demonstrated by (74).

- (74) A: What was Ames's former job?
B: #Ames, a former spy, is now behind bars.

Compare this to (75).

- (75) B: Ames, who is now behind bars, is a former spy.

Also, a simple negation cannot target the content of the supplement.

- (76) A: Ames, the former spy, is now behind bars.
B: No, that's not true.

What (76B) means is that Ames is not behind bars, and does not deny that Ames is a former spy.

In these respects, presuppositions and conventional implicatures are very similar, and in fact sometimes these terms are conflated, tacitly or explicitly (Karttunen & Peters 1979). However, Potts (2005) established that at least the meanings of supplements belong to a different kind of semantic category from typical presuppositions. Below, we will review

²³Certain aspects of meanings of sentential connectives like *but*, *therefore*, etc. are what Grice (1975) originally raised as primary examples of conventional implicatures (see also Lakoff 1971), but this was later questioned (Bach 1999, Potts 2005). I leave open how such meanings should be analyzed.

²⁴Potts (2005, 2007a) extensively argue that the meanings of expressives such as *damn* and *bastard* should be classified as conventional implicatures too. However, this position is currently under debate, and in particular, some suggest that they should be analyzed as presuppositions (Lasnik 2007, Sauerland 2007, Schlenker 2005, 2007b). Due to this complication, I will not discuss expressives here.

some of the properties of supplements that distinguish them from presuppositions, and see that gender inferences of pronouns do not pattern with them.²⁵

Firstly, Potts (2005, 2007a,b, 2008) contends that supplements cannot be semantically embedded, and always survive as an inference of the entire sentence. Although whether this always holds or not has been debated (Schlenker 2010c,d, Nouwen 2011), it can be observed at least as a general tendency. Consider, for example, (77).

(77) John said that Bill, who is my best friend, is annoying.

This sentence does suggest that Bill is my best friend. Presuppositions, on the other hand, generally disappear in the complement of *say* (Karttunen 1974, Heim 1992). For example, (78) does not necessarily presuppose that the speaker used to smoke. Nor does it necessarily presuppose that John thinks so, as he might have been lying.

(78) John said that I stopped smoking.

Similarly, conditionals cannot ‘filter out’ the meanings of supplements, unlike presuppositions. When a presupposition is triggered in the consequent of a conditional sentence whose antecedent entails it, it does not survive as an inference of the whole sentence, as demonstrated by (79).

(79) If it was raining earlier, it stopped raining.

The meanings of supplements do not disappear in an analogous situation, but rather, the sentence becomes anomalous.

(80) #If Mary and Bill are my best friends, Bill, who is one of my best friends, will come to my birthday party.

How about gender inferences of pronouns? As we saw in the previous sections, they can be ‘filtered out’ in conditionals and semantically embeddable under attitude verbs. Recall that there is an additional complication regarding the preference for *de re* readings, but when this is properly controlled, embedded readings do emerge.

(81) a. If Jesse is a boy, I will give him a candy, but if Jesse is a girl, I will give her chocolate.
b. Context: We don’t know who this week’s colloquium speaker is.
John thinks that the speaker is female, and asked me if she is a phonologist.

Secondly, supplements generally cannot take quantificational subjects, while predicative presuppositions can.²⁶ Supplements are semantically predicative, but cannot combine with

²⁵Implicitly assuming what I call the Frege-Strawson view of presuppositions, Potts (2005) raises the following point as one of the differences between conventional implicatures and presuppositions: conventional implicatures are semantically independent from the assertive meaning, while presuppositions are ‘pre-conditions’ for the assertive meaning to have a truth value. However, as I will argue in Section 4.3.2, this is a common misconception that is perhaps due to the prevalence of presuppositional sentences whose assertive meaning entails the presupposition (hence when the presupposition is false, the assertion can only be false as well). See also Stalnaker (1973, 1974), Soames (1989), Dekker (2008), van Rooij (2005, 2010) for relevant discussion.

²⁶The interaction between quantifiers and supplements is not as simple as this, but these complications do not concern us here. What is crucial is that presuppositional predicates, unlike supplements, have no constraints on which quantifiers can be used with them. For constraints on quantifiers with supplements, see Constant (2012), del Gobbo (2003), Potts (2005), Nouwen (2007a, 2011), Wang, Reese & McCready (2005).

a quantificational expression like *most older people on the march* as in the following example.

- (82) *Most older people on the march, who, incidentally, left after Jesse Jackson, got home without too much trouble. (Potts 2005:127)

Obviously, presuppositional predicates have no such restrictions.

- (83) Most older people on the march stopped shouting.

Gender inferences of pronouns clearly differ from supplements and pattern like presuppositional predicates in this respect. Recall that a predicate containing a bound pronoun is associated with a gender inference about the subject. Such a predicate easily combines with any quantificational expression. The range of examples is limited in English, as it does not have gendered plural pronouns, but more examples can be found in other languages like Japanese, as shown in (84b).

- (84) a. At most one student criticized her advisor.
b. hotondo-no gakusei-ga kanojo-tachi-zishin-no shidookyookan-o hihanshita.
most-GEN student-NOM her-PL-self-GEN advisor-ACC criticized
'Most of the students criticized their[+female] own advisors.'

Thirdly, conventional implicatures generally convey new information, while presuppositions are bits of information that are usually already known.²⁷ For this reason, conventional implicatures expressing known information are infelicitous, which Potts calls an *antibackgrounding requirement*. He illustrates it with the following example.

- (85) Lance Armstrong survived cancer. #When reporters interview Lance, a cancer survivor, he often talks about the disease. (Potts 2005:34)

On the other hand, it is clear that gender inferences of pronouns are something that can be repeated (and must be repeated whenever a singular pronoun is used), and also do not convey new information.

For these reasons, I conclude that gender inferences of pronouns are distinct from what are called conventional implicatures.

2.4 Section Summary and Outlook

To recapitulate, the gender inferences of pronouns show the hallmarks of presuppositions, although there are complications regarding local accommodation and *de re* readings. The rest of this part of the dissertation focuses on the theoretical problem of presupposition projection, which will be introduced in the next section. I will especially focus on the interaction between presuppositions and quantificational noun phrases, which has been recognized as a particularly recalcitrant theoretical problem. The subsequent two sections contain the novel contributions that this dissertation makes to this topic. Specifically, in Section 4, I will argue that the gender presuppositions of bound pronouns pose serious challenges for existing theories of presupposition projection in quantified sentences (the details are given in Section 6). In particular, they lead us to question the widely held view

²⁷As is well known there are many instances of presuppositions conveying new information, generally discussed under the rubric of '(global) accommodation' (Beaver 2001, von Stechow 2000, 2008, Lewis 1979b, Simons 2003). These cases, however, are considered exceptional rather than the norm.

of presuppositions as pre-conditions for the sentence to have a truth value. In Section 5, I will propose a novel analysis that circumvents the problem of gender presuppositions and gives a uniform treatment of the projection properties of different quantificational determiners.

3 The Problem of Presupposition Projection

3.1 Partial Functions and Presuppositions

3.1.1 Using Partial Functions to Model Presuppositions

Having established that gender features carry presuppositional meanings, let us ask how we can model their gender presuppositions given the semantics of pronouns as variables introduced in Section 1. Heim & Kratzer (1998) offer a general way of formalizing presuppositional meanings. Although I will point out its fundamental problem in the next section, it is worth reviewing because of its popularity and also because it nicely illustrates the projection problem, the main topic of the present part. In the present section, I will give an overview of this analysis with some concrete examples, and discuss how the gender presuppositions of pronouns can be modeled in it.

Heim & Kratzer’s (1998) central tenet is that presuppositions are what makes the interpretation function $\llbracket \]$ partial. That is, $\llbracket \]$ is not defined for a sentence S , if S ’s presuppositions are not met. The guiding intuition here is that presuppositions of a sentence are pre-conditions for the sentence to have a truth value, a view that can be traced back to Frege’s work and was popularized by Strawson (1950). Therefore, if the presuppositions of S are not true, S will not have a truth value. In the end, I will criticize this view primarily using gender presuppositions as empirical motivation, but let us accept it for the moment, and delve into the details.

One of the core ingredients of the analysis is partial functions denoted by presuppositional predicates. For an illustration, let us take again the presuppositional predicate *stopped using Mac*, which is assigned the following partial function as its meaning (I will abstract away from the semantics of tense throughout the present dissertation).²⁸

$$(86) \quad \llbracket \text{stopped using Mac} \rrbracket^{w,g} \\ = \lambda x_e: x \text{ used Mac before in } w. x \text{ does not use Mac now in } w$$

I am following Heim & Kratzer’s (1998) notation where the presupposition is written between the colon and the dot. Thus the intended reading of (87) is that the function is defined only for those individuals x in D_e such that x used Mac before in w .²⁹

This partial function is used to make the interpretation function $\llbracket \]^{w,g}$ partial. Technically, it is achieved via the following version of Functional Application. Here w and g are an arbitrary possible world and an assignment function.

$$(87) \quad \textit{Functional Application} \\ \text{Assume that } \alpha \text{ is a constituent that has } \beta \text{ and } \gamma \text{ as its daughter constituents. } \llbracket \alpha \rrbracket^{w,g} \\ \text{is defined (or equivalently, } \alpha \in \text{dom}(\llbracket \]^{w,g})) \text{ only if the following three conditions} \\ \text{hold:}$$

²⁸Also I will argue in Section 4 that the truth conditional meaning of (86) is wrong, and should be: x is a former Mac user in w .

²⁹Strictly speaking, every functional denotation is strictly partial in Heim & Kratzer’s (1998) system, as they are all uniquely typed.

- $\llbracket \beta \rrbracket^{w,g}$ is defined,
- $\llbracket \gamma \rrbracket^{w,g}$ is defined, and
- $\llbracket \gamma \rrbracket^{w,g} \in \text{dom}(\llbracket \beta \rrbracket^{w,g})$.

If defined, $\llbracket \alpha \rrbracket^{w,g} = \llbracket \beta \rrbracket^{w,g}(\llbracket \gamma \rrbracket^{w,g})$.

Recall at this point that presuppositional inferences have a particular pragmatic character. Generally, the presuppositional inferences of a sentence must be accepted to be true and mutually recognized so by the members of the conversational party (Stalnaker 1973, 1974). Also important is the observation that presuppositional inferences stem from particular words or constructions used in the sentence.³⁰ For example, we have seen that *stopped using Mac*, unlike *is a former Mac user*, induces a presuppositional inference. This means that presuppositions must be encoded in the conventional meanings of relevant words and constructions in such a way that they trigger some pragmatic effects when these words and constructions are used. These two aspects of presuppositions are often distinguished and, following the convention, I will call them *semantic presupposition* and *pragmatic presupposition*.³¹ Pragmatic presupposition is a kind of inference associated with a sentence that needs to be accepted and taken to be true by the discourse participants, while semantic presuppositions of a sentence are one of its conventional semantic properties, and under the partial function approach, they are restrictions on the domain of the interpretation function $\llbracket \]$. Obviously these two notions should be closely tied together, and in particular, the semantic presuppositions of a sentence should have consequences on its pragmatic presuppositions (although the reverse might not be true). In order to ensure this, we postulate the following principle that is assumed to apply at the pragmatics-semantics interface. Following Stalnaker (1978), we model the common ground, the body of beliefs mutually shared and recognized so by the discourse participants, by a set of possible worlds C , called a *context set*.

(88) *Bridging Principle*

Sentence S can be felicitously uttered with respect to context set C and assignment function g , only if for all $w \in C$, $S \in \text{dom}(\llbracket \]^{w,g})$.

In order to see how this works more concretely, let us consider the following sentence.

(89) Rafael stopped using Mac.

Functional Application states that the sentence in (89) is in the domain of $\llbracket \]^{w,g}$ only if the following three conditions hold.

- (90) a. Rafael $\in \text{dom}(\llbracket \]^{w,g})$
 b. stopped using Mac $\in \text{dom}(\llbracket \]^{w,g})$
 c. $\llbracket \text{Rafael} \rrbracket^{w,g} \in \text{dom}(\llbracket \text{stopped using Mac} \rrbracket^{w,g})$

³⁰Stalnaker (2002) extensively argues against the idea that presuppositions need to be actually believed to be true by the discourse participants, and advocates a more complex view of discourse dynamics using the notion of ‘common belief’. However, as our main interest is the semantic aspects of presupposition, I will refrain from introducing this view, and stick to the classical, simpler view, hoping that this assumption does not have any significant ramifications on my proposal. See also Schlenker (2010a) for relevant discussion.

³¹Cf. Gazdar (1979b), Heim (1983), Soames (1979, 1982, 1989), Stalnaker (1973, 1974, 1978); see also the works cited in fn.16 above. Other relevant terms that can be found in the literature include *sentential presupposition*, *logical presupposition*, *speaker presupposition* and *utterance presupposition*. The dichotomy between semantic and pragmatic presuppositions is fine-grained enough for our purposes here.

To simplify the discussion, let us assume that (90a) and (90b) hold. (90c) is the one we are interested in here. According to the meaning given in (86) above, (90c) holds if Rafael used to smoke in w , which is the semantic presupposition of the sentence (89) with respect to w and g . By the pragmatic principle in (88), this semantic presupposition is turned into a pragmatic presupposition that it needs to be true in all the worlds of the context set. In other words, a felicitous use of the sentence (89) demands that it be part of the common ground that Rafael used Mac before. This is a desired outcome.

3.1.2 Gender Presuppositions of Pronouns

Let us now model gender presuppositions of pronouns under the partial function view introduced above. Recall from Section 1 that we are assuming that third person pronouns denote variables, and are interpreted via an assignment function g . Then, pronouns can be given the following semantics (cf. Heim & Kratzer 1998). Throughout this dissertation, I assume that morphological case is not semantically relevant, and furthermore that anaphors and non-anaphor pronouns have the same semantics.

$$\begin{aligned}
 (91) \quad a. \quad & \llbracket \text{he}_i \rrbracket^{w,g} = \llbracket \text{his}_i \rrbracket^{w,g} = \llbracket \text{him}_i \rrbracket^{w,g} = \llbracket \text{himself}_i \rrbracket^{w,g} \\
 & = \begin{cases} g(i) & \text{if } g(i) \text{ is male in } w \\ \text{undefined} & \text{otherwise} \end{cases} \\
 b. \quad & \llbracket \text{she}_i \rrbracket^{w,g} = \llbracket \text{her}_i \rrbracket^{w,g} = \llbracket \text{herself}_i \rrbracket^{w,g} \\
 & = \begin{cases} g(i) & \text{if } g(i) \text{ is female in } w \\ \text{undefined} & \text{otherwise} \end{cases} \\
 c. \quad & \llbracket \text{it}_i \rrbracket^{w,g} = \llbracket \text{its}_i \rrbracket^{w,g} = \llbracket \text{itself}_i \rrbracket^{w,g} \\
 & = \begin{cases} g(i) & \text{if } g(i) \text{ is non-animate in } w \\ \text{undefined} & \text{otherwise} \end{cases}
 \end{aligned}$$

Further complications arise in connection with other phi features, but for the moment we confine our attention to third person singular pronouns, especially feminine third person singular pronouns, and disregard the semantic import of other phi features entirely (see Part II for person and number features).

Let us look at an example to see how the gender presupposition of a pronoun becomes the presupposition of the whole sentence. Consider the following simple sentence with a free pronoun.

$$(92) \quad \text{She}_5 \text{ left.}$$

According to Functional Application in (87) above, $(92) \in \text{dom}(\llbracket \]^{w,g})$ only if the following three conditions all hold.

$$\begin{aligned}
 (93) \quad a. \quad & \text{she}_5 \in \text{dom}(\llbracket \]^{w,g}) \\
 b. \quad & \text{left} \in \text{dom}(\llbracket \]^{w,g}) \\
 c. \quad & \llbracket \text{she}_5 \rrbracket^{w,g} \in \text{dom}(\llbracket \text{left} \rrbracket^{w,g})
 \end{aligned}$$

For the sake of simplicity, let us assume that (93b) is satisfied for all w, g and also that $\llbracket \text{left} \rrbracket^{w,g}$ is defined for all $x \in D_e$. Then, given the semantic type of *she*, which is guaranteed to be e , (93c) holds, whenever (93a) does. What is important here is that according to the

semantics given in (91b), (93a) holds only if $g(5)$ is a female individual. Thus, it is part of the semantic presupposition of the sentence (92) that $g(5)$ is female. As in the previous case, this will become the pragmatic presupposition by the Bridging Principle, and hence a felicitous use of (92) requires that $g(5)$ be known to be female, as desired.

Consider now the sentence in (94) which involves a bound pronoun.

(94) Every student $\lambda 8$ t_8 likes herself₈.

Recall from Section 1, a binder index like $\lambda 8$ triggers the rule of Predicate Abstraction, which enables semantic binding. Here we need to change its definition slightly to accommodate the presuppositions, as in (95) (see Heim & Kratzer 1998).

(95) *Predicate Abstraction*

Let α be a constituent that has λi and β as its daughter constituents. Then $\llbracket \alpha \rrbracket^{w,g} = \lambda x_e : \beta \in \llbracket \rrbracket^{w,g[i \rightarrow x]}$. $\llbracket \beta \rrbracket^{w,g[i \rightarrow x]}$.

Let us consider the meaning of the predicate, $\lambda 8$ likes herself₈. According to Predicate Abstraction in (95), $\llbracket \lambda 8$ likes herself₈ $\rrbracket^{w,g}$ denotes the following function.

(96) $\lambda x_e : t_8$ likes herself₈ $\in \llbracket \rrbracket^{w,g[8 \rightarrow x]}$. $\llbracket t_8$ likes herself₈ $\rrbracket^{w,g[8 \rightarrow x]}$

This function is defined for an entity x of type e , if the following holds.

(97) t_8 likes herself₈ $\in \text{dom}(\llbracket \rrbracket^{w,g[8 \rightarrow x]})$

According to Functional Application in (87), (97) holds only if the following three conditions are met.

(98) a. herself₈ $\in \text{dom}(\llbracket \rrbracket^{w,g[8 \rightarrow x]})$
 b. likes $\in \text{dom}(\llbracket \rrbracket^{w,g[8 \rightarrow x]})$
 c. $\llbracket \text{herself}_8 \rrbracket^{w,g[8 \rightarrow x]} \in \text{dom}(\llbracket \text{likes} \rrbracket^{w,g[8 \rightarrow x]})$

As before, let us assume that the latter two conditions (98b) and (98c) are satisfied. What is of interest here is that given the semantics of *herself* in (91b), (98a) is the case if x is female in w . Since this needs to be true for (97) to be true, the predicate $\lambda 8$ likes herself presupposes that x is female. In other words, its denotation is the following:

(99) $\llbracket \lambda 8$ t_8 likes herself₈ $\rrbracket^{w,g} = \lambda x_e : x$ is female in w . x likes x in w

The next step in the interpretation of the sentence in (94) involves a quantifier. As we will see in the next subsection, it involves further complications that are not subsumed by the semantics given above, namely *presupposition projection* (being an introductory book, Heim & Kratzer 1998 is silent on this, perhaps deliberately). In fact, the rest of the present part of the dissertation is especially concerned with what kind of presuppositional inferences quantificational sentences like (94) are associated with, or in other words, how presuppositional predicates like (99) interact with quantificational expressions.

3.2 The Problem of Presupposition Projection

The partial function account of presuppositions presented in the previous section is attractive in that it computes the semantic presuppositions of a complex sentence from the partiality of its components in a compositional fashion. However, it faces a serious empirical

challenge. Briefly put, according to the rules above, the semantic presupposition of each component phrase necessarily percolates up and become part of the presupposition of the entire sentence, but this is not always the case. Let us see this problem more concretely with the following sentence.

(100) Rafael stopped using Mac.

As we have repeatedly seen above, this sentence presupposes that Rafael used to use Mac. Interestingly, when this sentence is embedded in a conjunctive sentence like (101), this inference disappears as the inference of the entire sentence.

(101) Rafael and Sam both had a Macbook before, but Rafael stopped using Mac.

This complex sentence does not pragmatically presuppose that Rafael used to use Mac, and can be felicitously uttered in a context in which this piece of information is not accepted by the conversational participants. However, this state of affairs is not predicted by the simple partial function view of presupposition introduced in the previous section. That is, since every semantic presupposition becomes a pragmatic presupposition by assumption, (101) does end up with the semantic presupposition that Rafael used to use Mac. Specifically, let us assume that the semantics of *but* is a normal conjunction operator.³² I assume that *but* syntactically combines with the second conjunct first, but nothing crucial hinges on this.

(102) $\llbracket \text{but} \rrbracket^{w,g} = \lambda q_t. \lambda p_t. p = 1 \text{ and } q = 1$

Then according to the rule of Functional Application, $\llbracket (101) \rrbracket^{w,g}$ is defined only if the following three conditions are met.

- (103) a. $\text{but} \in \text{dom}(\llbracket \rrbracket^{w,g})$
 b. $\text{Rafael and Sam both had a Macbook} \in \text{dom}(\llbracket \rrbracket^{w,g})$
 c. $\text{Rafael stopped using Mac} \in \text{dom}(\llbracket \rrbracket^{w,g})$

Let us zoom in on (103c), which has a semantic presupposition that Rafael used Mac before in w . By the Bridging Principle in (88), this turns into a pragmatic presupposition, and hence it is predicted that a felicitous use of (101) demands that the discourse participants already know that Rafael used to use Mac. However, there is no such pragmatic presupposition associated with (101).

Analogous problems arise with a number of other operators. For instance, the following complex sentences do not presuppose anything about what OS Rafael used to use in the past, but they are wrongly predicted to presuppose that Rafael used to use Mac for essentially the same reasons as above (modulo local accommodation).

- (104) a. Either Rafael has always used Linux, or he stopped using Mac.
 b. If Rafael is talking about Ubuntu, then he stopped using Mac.

These data illustrate the so-called problem of presupposition projection, which is the problem of constructing a general mechanism that predicts the presuppositions of a complex sentence from the syntax and semantics of its parts. The partial function view makes the

³²I disregard here several semantic properties of *but*, including a possible inference about the temporal order between the two conjuncts, and also the inference that two conjuncts are somehow in conflict with each other. Although these are essential part of the semantics of *but*, they are in principle orthogonal to the discussion here. See the works cited in fn.23.

simplest prediction that a complex sentence just inherits all the semantic presuppositions of its parts, but to account for the above data, something additional needs to be said.

Also, its predictions about the interaction between quantificational noun phrases and presuppositional predicates is unclear, as remarked at the end of the last subsection. In quantificational sentences like *every student stopped using Mac*, the relevant presupposition is predicative, e.g. $\lambda x. x$ used to use Mac, and it does not make much sense to say that it percolates up, and something additional needs to be assumed about how quantificational noun phrases combine with such predicates. We will see the problem of presuppositions in quantificational sentences in the next subsection in greater detail.

The field of presupposition projection is teeming with competing theories since the 1970s, when the problem was first explicitly introduced (Beaver 2001, Beaver & Krahmer 2001, Gazdar 1979a,b, Geurts 1999, Heim 1983, 1992, Karttunen 1973, 1974, Karttunen & Peters 1979, Krahmer 1998, Langendoen & Savin 1971, Peters 1979, van der Sandt 1992, Soames 1979, 1982, 1989; Gazdar 1979b, Soames 1989, Beaver 2001 contain a concise and comprehensive overview at the respective points). Furthermore, it has recently seen a surge of new theories galvanized by Philippe Schlenker's seminal work (Chemla 2009b, Fox 2008, 2010, George 2008a,b, Rothschild 2011, Schlenker 2007a, 2008, 2009, 2010a,b). Each of the modern theories is an embodiment of different conceptions of what semantic presuppositions are, but they all account for the projection properties of various sentential connectives in more or less equally well. However, quite interestingly, their predictions radically diverge when it comes to presuppositions of quantified sentences, which we are mostly concerned with for the rest of the current part of the dissertation (We will see the details of some of these theories in Section 6).³³ For the rest of this section, I will review the empirical aspect of the phenomenon in question in some detail.

3.3 Presupposition Projection in Quantified Sentences

While judgments of presuppositions of complex sentences involving sentential connectives such as *and*, *if* and *unless* are rather crisp, judgments of presuppositions of quantified sentences are sometimes unclear, and conflicting 'opinions' have been expressed by various authors (Cooper 1983, Heim 1983, Beaver 1994, 2001, Kadmon 2001, George 2008a,b, Charlow 2009, Fox 2010).

Let us schematically illustrate the problem, using the parlance of the generalized quantifier theory (Barwise & Cooper 1981, Keenan & Stavi 1986, Keenan 1986, Peters & Westerstål 2006). A quantificational determiner Q is assumed to take two predicates as its arguments, called its restrictor R and nuclear scope S . The main problem that we are after can be phrased as the following question: What inferences result when R and/or S are

³³As quantified sentences are the major topic of this part, I will not review the earlier theories of presupposition projection that are mostly concerned with projection properties of various sentential connectives and do not make clear predictions for quantified sentences. However it should be mentioned that some of them such as Langendoen & Savin (1971), Gazdar (1979a,b), and Soames (1979) are similar to Heim & Kratzer's (1998) partial function analysis in that the presupposition of atomic sentences are assumed to all project up to the top most node. In particular, Gazdar (1979b,a) and Soames (1979) aim at developing a rigorous pragmatic algorithm that eliminates certain semantic presuppositions of the atomic sentences in such a way that the problematic data mentioned above are accounted for. Thus, the above problems of presupposition projection for Heim & Kratzer (1998) might not necessarily be unsurmountable. However, it is not clear what these theories predict for quantified sentences, as the relevant presuppositions are not propositional. Furthermore, as I will claim in the next section, a partial function account has a serious undergeneration problem with respect to the gender presuppositions of bound pronouns.

presuppositional predicates?³⁴

We will concentrate for the moment on cases where the nuclear scope S has a presupposition p , which I represent as S_p . As it turns out, this case involves more variation across determiners than when the restrictor R has a presupposition, although the latter case is by no means trivial or easier to account for. At the heart of the debate is which quantificational determiners Q in sentence of the form $Q(R)(S_p)$ give rise to a ‘universal inference’ that every R is p . For example, consider the following sentences involving a presuppositional predicate *stopped smoking*. We exclusively focus on the presupposition of this predicate that the subject used to smoke.

- (105) a. Each of the students stopped smoking.
 b. None of the students stopped smoking.
 c. A student stopped smoking.

If the presupposition of the predicate projects universally through the universal quantifier in (105a), the resulting inference is a universal inference that every (relevant) student used to smoke. In the case, this is arguably also entailed by the assertive meaning of this sentence, and it is immediately not clear if it is also a presupposition (we will come back to this in Section 4.2). Consider now (105b). It is generally agreed that it is also associated with a universal inference, and quantitative data in controlled experiments corroborates this, which we will review shortly.³⁵ In this case, it is clear that this universal inference is not an entailment in the assertive dimension and should be coming from the interplay between the quantifier and the presupposition of the predicate. Next, consider (105c). Unlike the previous two cases, it has a much weaker inference, and can be felicitously uttered in a situation where not every student used to smoke. Therefore, unlike *none of the students*, a *student* does not give rise to a universal inference.

These judgment patterns are not unquestioned, however. Beaver (1994, 2001), for example, claims that the semantic presuppositions of all quantified sentences are existential (see also van der Sandt 1992, Kadmon 2001). Thus, according to him, all the sentences in (105) only presuppose that there is a student who stopped smoking. We will closely examine his empirical arguments in Section 3.3.3 below, but I think his data is confounded by extra factors. In particular, there are two aspects of the present phenomenon that make naive judgments nebulous.

One such factor is the possibility of a local accommodation reading, which I have repeatedly mentioned in the previous sections, especially in Section 2.2.2. That is, it seems that there is a reading that the predicate is read as if its presupposition is interpreted as part of the assertive meaning. This can affect the interpretation of a quantified sentence with a presuppositional predicate, especially when the quantifier is not upward monotonic. Although a local accommodation reading is presumably generally latent and dispreferred, it becomes especially evident in sentences like (106).

- (106) None of the students in my class stopped smoking, because none of them ever

³⁴As we will see in detail in Section 6, some such inferences are not always analyzed as presuppositions under certain theories, and in order to remain neutral, I will sometimes call them inferences rather than presuppositions.

³⁵It presumably also has a different, less salient reading involving local accommodation (cf. Section 2.2.2), which can be paraphrased as: None of the students used to smoke and stopped. This reading is not associated with a universal inference, and it is plausible that the universal inference feels less robust for (105b) than for (105a) for this reason. See the discussion below.

smoked before to begin with.

This sentence has a coherent reading, which is intuitively paraphrased by (107).

- (107) None of the students in my class are such that they used to smoke and stopped, because none of them ever smoked before to begin with.

This suggests that the presupposition of the predicate can optionally become part of the assertive meaning (cf. Heim 1983, Kadmon 2001). Local accommodation readings are often available, if less prominently, and should be always recognized as a possibility in assessing judgments. We will look at some more examples of this sort in Section 3.3.3 below.

A second factor that needs to be taken care of is implicit domain restriction. This is especially a concern when the quantifier does not have a partitive structure.³⁶ Consider, for example, the following sentence.

- (108) No students stopped smoking.

The universal inference for this sentence would be that every student used to smoke, but which students? It is uncontroversial that the domain of a natural language quantifier can be implicitly restricted (Westerståhl 1984, von Stechow 1994, Gawron 1996, Geurts & van der Sandt 1999, Stanley & Szabó 2000, Schwarzschild 2002, Martí 2003). For instance, it is evident that (108) can be interpreted as a statement about a certain group of students, rather than about all the students in the world, although no such domain is explicitly expressed by a linguistic means. This is a serious confound in judging whether a given quantificational sentence has a universal inference, since a seemingly non-universal inference can simply be due to domain restriction (Schlenker 2008, Rothschild 2011). For example, if (108) is taken to be about a subset of the students that used to smoke, then the universal inference would not say anything about those students that lie outside of this set. If such an implicit domain is available, therefore, the sentence should be judged compatible with a situation where some students never smoked before. It is unfortunate that no reliable way to controlling implicit domains is known in sentences like (108), but implicit domain restriction should also be acknowledged as an inevitable factor in judging presuppositions of quantified sentences.

Aiming at providing a broader empirical perspective, Chemla (2009a) and Sudo, Romoli, Hackl & Fox (2011) conducted controlled experiments and offer quantitative data of judgments regarding presuppositions in quantified sentences. Although the scopes of both of these studies are limited, they uncover important empirical aspects of the phenomenon in question. Specifically, the results indicate that *none of the NP* tends to give rise to a universal inference, while *some of the NP* less robustly does, but as the discrepant opinions in the literature suggest, the judgements are not at all black-and-white. Especially striking is that *some of the NP* and other partitive existential phrases sometimes give rise to universal inferences, although relatively less often than *none of the NP*. I believe that the variation in judgments is a reflex of the core properties of the presuppositions of quantified sentences, which ultimately need to be theoretically accounted for (I will propose my account in 5). In what follows, I will review the details of these experimental studies in detail.

³⁶I do not mean to suggest that a partitive structure completely eliminates the possibility of further domain restriction.

3.3.1 Chemla (2009a)

Both Chemla (2009a) and Sudo, Romoli, Hackl & Fox (2011) investigate which determiners give rise to universal inferences. Chemla (2009a) reports on two experiments that use *each* (*chaqun* in French), which at least truth-conditionally entails the universal inference, as a baseline and test which determiners are less likely to give rise to the same inference in comparison to it. Both experiments were conducted in French, but provided that no substantial crosslinguistic variation in the present phenomenon is currently known, I assume that his findings generalize to English and other languages too.

Experiment 1 of Chemla (2009a) looks at the following quantificational determiners: *each*, *no*, *less than three*, *more than three* and *exactly three*.³⁷ In each trial of Experiment 1, the subject saw two sentences, which I denote by *S* and *p* here, on a computer screen, and were asked to judge whether *S* suggests *p* and provide their answer by clicking either *Oui* (Yes) or *Non* (No). In the target items, *S* is a quantified sentence with a presupposition trigger in the nuclear scope of the quantificational determiner, and *p* is the universal inference. Chemla used the following five presupposition triggers in *S*: *know*, *be aware*, *stop*, *continue* and the possessive construction with *his*. Each subject provided judgments of the five determiners in ten different sentence frames. Also a partitive structure is always used in *S* to control the domain of quantification explicitly. An example of a pair of *S* and *p* looks like the following (adapted from Chemla 2009a:307):

- (109) *S*: None of these 10 students knows that his father is going to receive a congratulation letter.
p: The father of each of these 10 students is going to receive a congratulation letter.

Here, the relevant presupposition trigger is the factive attitude predicate *know*. Although there is at least one more presupposition trigger, namely the possessive pronoun *his*, in *S* here, this presupposition is universally satisfied (i.e. every student has a father) and hence should not interfere with the judgments of the former.

The results indicate that *no* is more likely to be associated with a universal inference than the existential determiners *less than three*, *more than three* and *exactly three*, and in fact resembles the baseline universal determiner *each*.^{38,39} This is summarized in Figure 3-1 taken from Chemla (2009a:312). The y-axis here is the rate at which the universal inference *p* was judged to be suggested by *S*.

Experiment 2 of Chemla (2009a) has essentially the same design as Experiment 1, except that instead of the binary judgment task it deploys a graded judgment task where participants were asked to judge how natural the inference from *S* to *p* is, and indicate it by the length of a bar on the computer screen. Experiment 2 also tests more quantificational determiners than Experiment 1: *each*, *no*, *most*, *few*, *many*, *less than six*, *more than six*,

³⁷The French determiners actually used in the experiments are: *chacun*, *aucun*, *moins de 3*, *plus de 3* and *exactement 3*.

³⁸Although Chemla reports repeated measures ANOVAs for both experiments, they are not appropriate for the kind of data that his experiments provide (binary responses in Experiment 1 and proportional responses in Experiment 2). Therefore I refrain from mentioning his statistical analyses.

³⁹Chemla also discusses a minor difference among the different presupposition triggers, e.g. *no* is less likely to have a universal inference with change of state predicates than with factive predicates or definite descriptions, but this could be given many alternative explanations and does not concern us here. Also in Experiment 2, he observes no significant difference among different presupposition triggers.

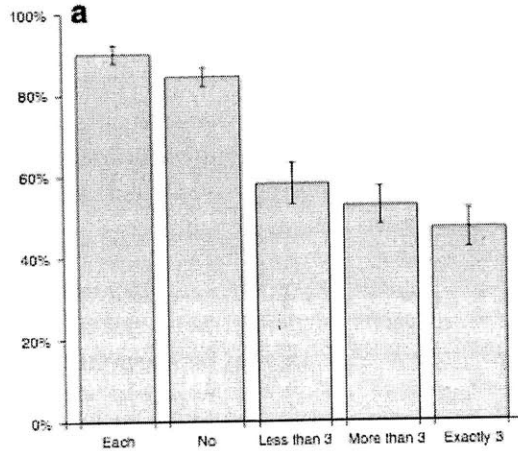


Figure 3-1: Results of Experiment 1 of Chemla (2009)

exactly six and *who*.⁴⁰ An example target sentence looks as follows (adapted from Chemla 2009a:316).

- (110) *S*: Among these 20 students, who knows that his father is going to receive a congratulation letter?
p: The father of each of these 20 students is going to receive a congratulation letter.

Furthermore, in addition to projection out of the nuclear scope, projection out of the restrictor is also tested. The test sentences used for these look as follows (adapted from Chemla 2009a:317).

- (111) *S*: Among these 20 students, most who know that their father is going to receive a congratulation letter take English lessons.
p: The father of each of these 20 students is going to receive a congratulation letter.

The results from 10 native speakers of French, summarized by the black line in Figure 3-2 (Chemla 2009a:320), reveal essentially the same tendency as in Experiment 1 for presuppositions triggered in the nuclear scope (as indicated by the overlaid bars). The y-axis is the robustness of inference indicated by the mean percentage of the filled area of the bar. As before, *no* is more likely to give rise to a universal inference from the nuclear scope than existential determiners like *many*, *less than six*, *more than six* and *exactly six*. Also, *most*, *few* and *who* seem to lie somewhere between these existential determiners and *no*.

When the presupposition trigger is in the restrictor of the quantificational determiner, universal inferences are less robust than when it is in the nuclear scope, which is indicated by the red line in the above graph. Interestingly, this tendency for non-universal inferences

⁴⁰The French determiners are: *chacun*, *aucun*, *la plupart*, *peu*, *beaucoup*, *moins de 6*, *plus de 6*, *exactement 6* and *qui*.

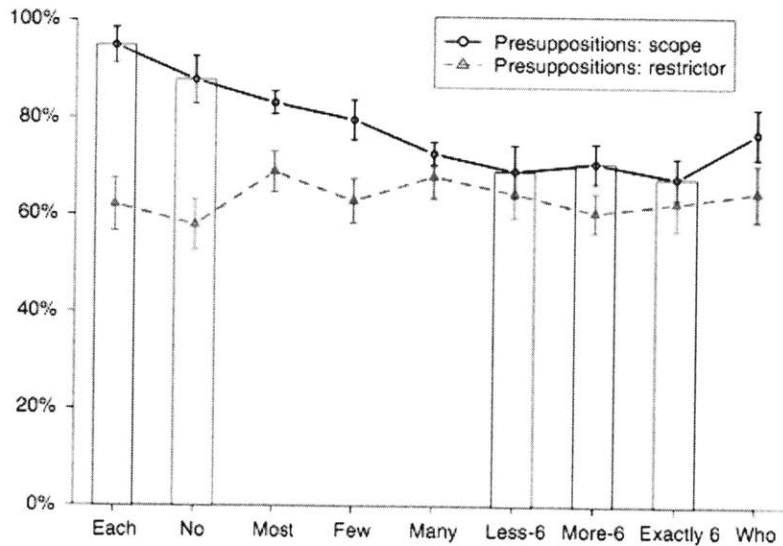


Figure 3-2: Results of Experiment 2 of Chemla (2009)

holds more or less uniformly across determiners, including the universal determiner *each*. We will come back to the discussion of projection out of the restrictor in Section 3.3.5 below.

Chemla’s experimental results are important in that they empirically validate the differences in projection properties of various quantificational determiners. Especially, *no* tends to give rise to universal inferences more than existential determiners in general when the presupposition is triggered in the nuclear scope. This state of affairs is unexplained under Beaver’s (2001) view that the presuppositions of quantificational sentences are existential across the board. In other words, Chemla’s experimental data provides empirical reason to assign different presuppositions to different quantificational sentences. Also, at the same time, it experimentally confirms the non-crisp nature of relevant judgments.

3.3.2 Sudo, Romoli, Hackl & Fox (2011)

Sudo, Romoli, Hackl & Fox (2011) also provide quantitative judgment data of presuppositions in quantified sentences. They point out that there are limitations of Chemla’s (2009a) experiments, namely, he only reports figures obtained by averaging across participants, and also the number of participants is relatively small, especially in his Experiment 2. It is in principle a possibility that different speakers exhibited different types of behavior in the experiments, but potential variations among speakers are impossible to extrapolate from the presentation of the data in Chemla (2009a). Sudo, Romoli, Hackl & Fox’s experiment is specifically aimed at investigating inter-speaker variation in the judgments.

Sudo, Romoli, Hackl & Fox use the ‘covered box’ task deployed by Huang, Spelke & Snedeker (to appear).⁴¹ In each trial, participants saw a sentence and a pair of pictures, and were asked to pick the picture that the sentence was about. Crucially, one of the

⁴¹See also Pearson, Khan & Snedeker (2010), Kotek, Sudo, Howard & Hackl (2011) and Romoli, Sudo & Snedeker (to appear) for further experiments using this task.

pictures was covered, and they were instructed to choose it only if the overt picture was not a possible match for the sentence. Each participant contributed one data point for each of the quantified sentences in (112). The relevant determiners are *some*, *none* in declarative sentences, and *any* in a polar question, and the presupposition trigger in question is always *both*.

- (112) a. Some of these three triangles have the same color as both of the circles in their own cell.
 b. None of these three circles have the same color as both of the squares in their own cell.
 c. Do any of these squares have the same color as both of the triangles in their own cell?

The overt picture in each of the target trials was designed in such a way that the universal inference triggered by *both* is not satisfied, so that the covered picture will be chosen if and only if the speaker obtains this universal inference. The pictures used in this experiment are given in Figure 3-3 below. Each picture contains three cells, each of which in turn contains

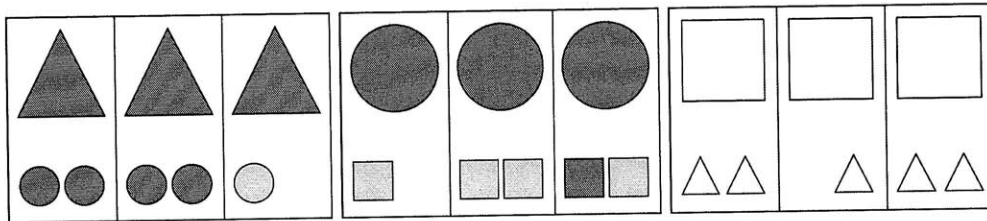


Figure 3-3: The overt pictures used in the three target trials of Sudo, Romoli, Hackl & Fox (2011).

exactly one ‘restrictor figure’ (e.g. a triangle for (112a)). Crucially, only two of the cells have exactly two nuclear scope figures (e.g. circles for (112a)). For (112c), the overt picture is colorless, and participants were instructed to imagine that somebody who is incapable of distinguishing colors is asking the question, and guess which picture they are asking about.

As there are three target items and two possible answers for each, there are eight answer patterns in total. The results from 186 native speakers of English are sorted into these eight patterns in Table 3.1 below, where \forall stands for the covered box response and \exists stands for the overt picture response.

	‘Some’	‘None’	‘?any’	# of Participants
1	\exists	\exists	\exists	60
2	\exists	\exists	\forall	49
3	\exists	\forall	\exists	21
4	\exists	\forall	\forall	47
5	\forall	\exists	\exists	2
6	\forall	\exists	\forall	1
7	\forall	\forall	\exists	2
8	\forall	\forall	\forall	19

Table 3.1: Results of Sudo et al.’s survey.

First of all, it is noticeable that about one third of the subjects chose the overt picture for all three target sentences (Pattern 1). Recall that the overt picture is not compatible with the universal inference. Thus these speakers judged that the target sentences have a reading that does not entail it. Furthermore, if we consider only *none*, 89 subjects chose the overt picture (Patterns 3, 4, 7 and 8), which at first blush seems to contradict the conclusion from Chemla’s (2009a) results to the effect that *no* is robustly associated with a universal inference. However, the high number of overt picture responses is in fact not so surprising here, given that this experiment is designed to put an inherent bias against the covered picture response. That is, the task demands the subjects to check if the overt picture can ever be chosen, which instructs them to not focus on the most salient reading, but also consider latent readings. By contrast, Chemla’s experiment only asks about the availability of the universal inference, and does not bias against it. Given this difference between the experiments, the results are not at all incompatible. Also given the design of Sudo, Romoli, Hackl & Fox’s (2011) experiment, what is suggested by the high number of overt picture responses is that the target sentences have two readings, a reading that entails the universal inference, and a reading that does not. One way to think about the latter reading is, as mentioned above, local accommodation under the quantifier is allowed, in which case the target sentences will be roughly synonymous with the following sentences.

- (113)
- a. Some of these triangles are such that they have exactly two circles in their own cell, and have the same color as them.
 - b. None of these three circles are such that they have exactly two squares in their own cell, and have the same color as them.
 - c. Are any of these squares such that they have exactly two squares in their own cell, and have the same color as them?

I believe that it is reasonable to assume that these readings are available, although they could well be relatively marked.

A striking fact that this study reveals is that 24 out of the 186 subjects chose the covered picture for the sentence with *some* in (112a). It is generally agreed that existentially quantified sentences have non-universal presuppositions, and Chemla’s experiments confirmed this intuition. However, the attention in the literature has been mainly paid to the question which determiners *must* have universal inferences, and less to the question which determiners *can*. Recall again that the design of the experiment puts a strong bias against the universal inference. The fact that 24 of the subjects nonetheless insisted on the covered picture suggests that (112a) can have a universal inference, although it certainly has a reading not associated with it. Notice also that this is in concert with Chemla’s (2009a) results as well. That is, in Chemla’s Experiment 1, the existentially quantified sentences formed with *less than three*, *more than three* and *exactly three* were judged as suggesting the universal inference about 50-60% of the time, and in Experiment 2, those formed with *many*, *less than six*, *more than six* and *exactly six* scored around 70% on average. Although these experiments do not provide an explicit baseline to measure the lack of universal inferences, these numbers are surprisingly high.⁴² This fact also supports a view that these existentially quantified sentences are ambiguous between two readings, one with and one

⁴²In both experiments Chemla (2009a) included sentences with scalar items that trigger scalar implicatures in place of presupposition triggers, which were expected to not give rise to universal inferences with the existential determiners. One might regard them as informal baselines for the lack of universal inferences, and indeed presuppositions and implicatures differ in ways expected here. See Chemla (2009a) for details.

without a universal inference.

It should also be remarked that there are very small numbers in the table above, namely, Patterns 5, 6 and 7 conspicuously have less participants. This suggests that when *some* is judged as carrying a universal inference, the other two target sentences must or tend to be judged so as well. Sudo, Romoli, Hackl & Fox (2011) take this tendency seriously, and provide a theoretical explanation couched in Fox's (2010) trivalent theory of presupposition projection, although I will not go into the details here (see in Section 6 for Fox's theory).

3.3.3 Beaver's Data and Local Accommodation in Quantified Sentences

Beaver (1994, 2001) claims that all quantificational sentence only have existential presuppositions, maintaining that there is no empirical evidence showing the existence of universal presuppositions. The experimental evidence provided by Chemla (2009a) and Sudo, Romoli, Hackl & Fox (2011) however shows that some determiners in fact do give rise to universal inferences unlike others, and hence Beaver's view where all quantificational determiners are equal is not warranted. Nonetheless, it is instructive to re-examine the examples that motivated Beaver's generalization.

Beaver (1994) concentrates on two presupposition triggers, a possessive noun phrase and a factive predicate *discover*. In (114) are some examples he discusses, where these two presupposition triggers are embedded in the nuclear scope of *no*. The contexts here are rather elaborate, but they are constructed so that the universal inference is incompatible with the information.

- (114) a. How many team members and cheerleaders will drive to the match?
A few of the 15 team members and none of the 5 cheerleaders can drive, but no team member will come to the match in her own car. So expect about 4 cars.
- b. How many of your employees with company cars had problems with their car radiators last year?
Although a few of the sales staff discovered problems with their car radiators last year, none of the management discovered that their car radiators had sprung even a single leak. The reason that none of the management had a single problem with their car radiator is that they are generally quite conscientious about car maintenance.

These examples are judged coherent, suggesting that there is no universal presupposition to the effect that all of the 15 team members have a car, and all of the management's car radiators sprang a leak, respectively.

However these data do not cogently show that the relevant quantifiers *no team member* and *none of the management* are not associated with universal inferences. Notice especially that (114b) does not even have an existential inference that some of the management had a leak in their car radiator. It is reasonable to assume that the lack of universal inferences in these sentences is due to local accommodation of the presupposition under the scope of the quantifier. According to this analysis, the relevant parts of the above examples are paraphrased as follows.

- (115) a. No team member is such that she has a car and will come to the match in her own car.
- b. None of the management are such that they had their car radiators spring a

leak and discovered it.

These sentences do not entail universal inferences.

This analysis furthermore explains the infelicity of the following examples Beaver (1994) himself adduces. These sentences involve universal quantifiers instead of *no NP* and *none of the NP*, and the infelicity suggests that they are associated with universal inferences.

- (116) a. How many team members and cheerleaders will drive to the match?
Few of the 15 team members and none of the 5 cheerleaders can drive, but every team member will come to the match in her car. So expect about 4 to drive.
- b. How many of the employees with company cars had problems with their car radiators last year?
Although few of the sales staff had any problems with their cars last year, all of the management discovered that their car radiators had sprung a leak. However, most of the management didn't have a single problem with their car radiator the whole year: they are generally quite conscientious about car maintenance.

Unlike in the case of (114), the sentences with or without local accommodation necessarily entail universal inferences which contradict what is given in the context.⁴³ Thus, once a mechanism of local accommodation is assumed, Beaver's (1994) data cannot be taken to be evidence for the lack of universal inferences.

Beaver (1994) also discusses projection of the presuppositions of quantified sentences, and observes that the following sentences do not have universal presuppositions (similar cases are also provide by Beaver 2001:221 which can also be explained by local accommodation).

- (117) a. How many team members will drive to the match?
I don't know for sure whether all of the team members own a car, I don't know for sure how many will drive. But, usually one or two (only one or two) go by public transport, so if every (no) team member turns up to the match in her own car, I'll be surprised.
- b. Do you expect any of your employees to have problems with their car radiators next year?
Usually there are one or two (only one or two) people who forget to put antifreeze in their cars. So if nobody (everybody) discovers that their radiator has a leak this year, I'll be surprised.
- (118) a. Will everybody on the team need their parking spaces this season, or do you think I can use one?
Last season the whole team used to drive to matches. But I suspect that this season there might be one or two that don't even own a car. Given also that recent pre-match traffic jams, I think it's safe to say that not every team member will come to the match in her car. So I guess we'll be able to find you a spare place.

⁴³An interesting problem raised by (114a) under this analysis is that the female presupposition of *her* seems to project universally, although the presupposition of the possessive construction is locally accommodated. This requires a mechanism that allows selective local accommodation.

- b. In the big freeze last year, all the company cars had radiator problems, and many of the sales staff complained about being given cars which were poorly maintained. Do you think the same will happen again?

It's possible. But recently we've been using a new product in all our cars, a chemical which when added to the radiator top-up tank, slowly re-seals any holes which form. So, regardless of whether everybody's car actually does develop radiator problems. I'm just about certain that not everybody will discover that their car radiator has a leak this year, and I expect far fewer complaints.

These examples do not exclude the possibility that presuppositions are locally accommodated. For instance, the local accommodation readings of the relevant sentences in (118) can be paraphrased as follows.

- (119)
- a. I think it's safe to say that not every team member have a car and will come to the match in it.
 - b. I'm just about certain that not everybody is such that his car radiator has a leak this year, and he will discover it.

Thus, once local accommodation is recognized, Beaver's data can be reconciled with the experimental data provided by Chemla (2009a) and Sudo, Romoli, Hackl & Fox (2011). Taken together, the discussion so far seems to me to be suggesting that such a reading is indeed available. In particular, part of the fuzzy judgments of presuppositions of quantified sentences, I believe, is due to the optional availability of a local accommodation reading. I take it incumbent on a theory of presupposition projection to be able to explicate local accommodation readings too.

3.3.4 Summary of Projection out of Nuclear Scope

The following empirical picture emerges from the above discussion of our native intuitions and the two quantitative studies. Negative quantifiers tend to give rise to a universal inference, as previously suggested by Cooper (1983) and Heim (1983). Although this is not the only reading, as Beaver (1994, 2001) observes, it seems to be the most salient one in most cases. However, importantly, the other non-universal reading that Beaver convincingly showed to exist needs to be accounted for as well. To this end, I submit that this reading is due to local accommodation of the presupposition of the predicate, which turns the presupposition to part of the assertive meaning.

Another finding is that the existential quantifiers seem to be ambiguous between two readings, one with and one without a universal inference. This again needs to be given a theoretical explanation. It should be kept in mind, however, that the existential quantifiers under discussion are all partitives, and non-partitive existential determiners were not tested in either of the two studies. This is for methodological reasons, namely, partitives allow us to explicit control the domain of quantification. Because the main interest is the universal inference relative to the domain of quantification, the domain of quantification needs to be carefully manipulated, as remarked above.

3.3.5 Projection out of Restrictor

Lastly, let us discuss the presupposition triggered in the restrictor of a quantificational determiner. Unlike the case of presupposition projection from the nuclear scope, the judgments of presuppositional inferences triggered in the restrictor are more or less uncontroversial. The general tendency is that the resulting inference is very weak regardless of the determiner involved, which Chemla's results basically confirmed (Beaver 2001, George 2008a, Schlenker 2008). For example, none of the sentences below give rise to the inference that all students used to smoke, let alone that all individuals used to smoke. Rather, they are felicitous in a context where there are only some who used to smoke.

- (120) a. Each of the students who stopped smoking came to the party.
b. None of the students who stopped smoking came to the party.
c. Some of the students who stopped smoking came to the party.

The same judgments obtain with non-partitive determiners.

- (121) a. Every student who stopped smoking came to the party.
b. No student who stopped smoking came to the party.
c. A student who stopped smoking came to the party.

This asymmetry between the restrictor and nuclear scope is also a data point that needs to be accounted for.

The observations made in this section set the stage for theoretical discussion. In the next section I will briefly introduce the central ideas of two major theories of presupposition projection that make clear predictions for quantified sentences.

3.4 Two Theories of Presupposition Projection in Quantified Sentences

As mentioned before, the current formal semantic literature abounds with theories of presupposition projection that are built upon different ways of modeling presuppositional inferences. In this section, I focus on two particular groups of theories that make explicit predictions about quantified sentences. The classification is based on how predicative presuppositions interact with quantificational noun phrases in these theories, rather than on the predictions themselves. I call the views of presuppositions that underly these two groups of theories, the *localist view* and the *trivalent view* of presuppositions.

3.4.1 Localist View

Recall that the problem of the naive partial function theory of presuppositions introduced in Section 3.2 above is that all the semantic presuppositions necessarily percolate up to the topmost level where the semantic presuppositions are evaluated and become pragmatic presuppositions. The key idea that the localist theories use to solve this problem is by having multiple places where the presuppositions are evaluated. To illustrate, let us take the following sentence again.

- (101) Rafael and Sam both had a Macbook, but Rafael stopped using Mac.

The idea is that the presuppositions of the second conjunct are evaluated only *after* the first conjunct is processed, at which point it is already known that Rafael had a Macbook before and used to use Mac. As a consequence, the presuppositions of the second conjunct are

guaranteed to be satisfied, and hence it follows that the entire sentence does not presuppose that Rafael used to use Mac.

This idea can be traced back to Stalnaker (1973, 1974, 1978) and was generalized to various sentential connectives by Karttunen (1973, 1974), but Heim (1983) is the first to apply it to quantified sentences.⁴⁴ Heim's (1983) theory of presupposition projection is couched in the framework of dynamic semantics proposed in Heim (1982). Keeping the formal details minimum (see Section 6.1.1), this theory treats the semantic function of a sentence as an update of a context, i.e. a partial function from contexts to contexts, and the presuppositions of an atomic sentence as conditions on which contexts the function can apply to. More specifically, if a sentence has a presupposition p , the function over contexts that the sentence denotes is only defined for contexts where p is known to be true. In this sense, this is an extension of the partial function view of presuppositions that presuppositions make meanings partial.

Let us see how this analysis might solve the projection problem posed by (101). Suppose the sentence is uttered against context C_0 . First, this context C_0 is updated with the function denoted by the first conjunct *Rafael and Sam both had Macbook*, yielding an intermediate context C_1 , which by definition is a context where it is known that the first conjunct is true. Importantly, the presupposition of the second conjunct *Rafael stopped using Mac* is true in C_1 . Therefore, its denotation can successfully apply to C_1 . As a consequence, whatever the original context is, the presuppositions of the second conjunct are always satisfied, capturing the fact that (101) as a whole does not presuppose that Rafael used to use Mac.

Heim (1983) extends this to quantified sentences by treating predicative meanings as semantically of the same type as sentences, i.e. partial functions from contexts to contexts. For example, let us consider the following sentence where the presupposition trigger is in the nuclear scope.

(122) Every student stopped smoking.

Roughly put, it is assumed that the quantificational determiner *every* takes the meanings of *students* and *stopped smoking* here, both of which are assumed to be partial functions from contexts to contexts, and then operates on the original context C_0 in the following manner: any way of introducing a student x to C_0 results in a context that can be successfully updated by the partial function denoted by *x stopped smoking*. In order for this to be possible, therefore, it needs to be known in C_0 that all the students used to smoke.

I would like to stress here one design feature of this theory, namely, the evaluation of the presupposition of *stopped smoking* takes place at the level of predicate, and whenever *x stopped smoking* applies to a context, the resulting context is one where the presupposition that x used to smoke is satisfied. What I call localist theories of presupposition projection in quantified sentences all share this feature: the presupposition of a predicate needs to be satisfied at the predicate level.⁴⁵

⁴⁴Later developments such as Beaver (1994, 2001), Schlenker (2007a, 2008, 2009, 2010a,b), Rothschild (2011) are all built upon essentially the same core idea, and I regard them as localist theories as well, although Schlenker's theories are technically and philosophically very different from the others (see Schlenker's original works; I will discuss the technical details in Section 6.2).

⁴⁵In this sense van der Sandt's (1992) theory is also a localist theory, although the presupposition of the nuclear scope in this theory can be satisfied at the restrictor level as well. I will discuss its predictions in Section 6.3.

3.4.2 Trivalent View

The trivalent view of presupposition projection (van Fraassen 1968, 1969, Peters 1979, Link 1986, Krahmer 1998, Beaver & Krahmer 2001, George 2008a,b, Fox 2008, 2010) shares with the partial function view such as Heim & Kratzer (1998) the core ideas of what presuppositions are, as trivalent logic that underlies it is closely related to bivalent partial logic (cf. Krahmer 1998). Unlike under the partial function approach, the trivalent view holds that all functions are assumed to be total (with respect to the input type), but truth conditions are enriched by a third truth value #. The semantic presuppositions of a sentence are modeled as conditions specifying when the sentence denotes #, and hence treated as part of the (enriched) truth conditions. For example, *John stopped smoking* has the following denotation.

$$(123) \quad \llbracket \text{John stopped smoking} \rrbracket^{w,g} = \begin{cases} 1 & \text{if John used to smoke and not anymore in } w \\ 0 & \text{if John used to smoke and still does in } w \\ \# & \text{otherwise} \end{cases}$$

Under this theory, the projection problem is solved by devising an appropriate meaning for the connectives. For example, the following denotation of *but* correctly captures that (101), repeated below, does not have a presupposition.

$$(124) \quad \llbracket \text{but} \rrbracket^{w,g}(q)(p) = \begin{cases} 1 & \text{if } p = q = 1 \\ 0 & \text{if } p = 0 \text{ or } (p = 1 \text{ and } q = 0) \\ \# & \text{otherwise} \end{cases}$$

(101) Rafael and Sam both had a Macbook, but Rafael stopped using Mac.

That is, $\llbracket \text{but} \rrbracket^{w,g}(q)(p) = \#$ just in case $p = 1$ and $q = \#$, but when p entails the presuppositions of q , this never happens, as when $p = 1$, q is bound to be either 1 or 0.

This theory is globalist in the sense that the semantic presuppositions are converted to pragmatic presuppositions at the topmost level. Specifically, a sentence S , simple or complex, incurs a presupposition failure in a context, if it denotes #. Presuppositions of quantified sentences are treated in the same manner as well. For example, the presuppositional predicate *stopped smoking* has the following denotation, which can combine with a quantifier in the usual way.

$$(125) \quad \llbracket \text{stopped smoking} \rrbracket^{w,g} = \lambda x_e. \begin{cases} 1 & \text{if } x \text{ used to smoke and not anymore in } w \\ 0 & \text{if } x \text{ used to smoke and still does in } w \\ \# & \text{otherwise} \end{cases}$$

For instance, *every student stopped smoking* receives the following denotation.

$$(126) \quad \llbracket \text{every student stopped smoking} \rrbracket^{w,g} = \begin{cases} 1 & \text{if every student used to smoke and not anymore in } w \\ 0 & \text{if every student used to smoke and at least one of them still does in } w \\ \# & \text{otherwise} \end{cases}$$

The predicted presupposition here is every student used to smoke, which is a universal inference.

Although it might not be clear from the presentation above, trivalent theories generally make a number of interesting predictions for the presuppositions of quantified sentences involving different quantificational determiners that are different from the predictions of the localist theories, the details of which are given in Section 6.4.

Notice importantly that the assertive meaning of the presuppositional predicate in (125) necessarily entails the presuppositional meaning, in the sense that whenever the predicate is true of x , the presupposition is also true. This is an inevitable feature of this theory, stemming from the way presuppositions are modeled as part of the assertive meaning.

In the present section, we have very briefly reviewed two types of theories of presupposition projection in quantified sentences. Both of these approaches are fashioned so that the presuppositions of presuppositional predicates are necessarily entailed by their assertive meanings. I will show in the next section that there are predicates that cannot have such an entailment relation between the two dimensions of meaning, and they cause empirical problems for these theories.

4 Two Types of Presuppositional Predicates and Theoretical Problems

4.1 Two Types of Presuppositional Predicates

The main purpose of the present section is to connect the two topics we have discussed so far, namely the observation that the gender information of pronouns is presuppositional in nature, and the problem of presupposition projection in quantified sentences. I will first claim that predicates containing bound pronouns should be analyzed as having an assertive meaning that does not entail the gender presupposition, while predicates like *stopped using Mac* should be given an assertive meaning that does entail its presupposition. Then I will point out that predicates like the former pose a serious challenge for existing theories of presupposition projection. The problems are rather fundamental, stemming from the general idea of what presuppositions are, and I will propose to abandon the Frege-Strawson view that presuppositions are pre-conditions for sentences to have a truth value.

4.1.1 *Stopped Using Mac*

The literature on presupposition projection mostly focuses on presupposition triggers such as *stop*, *know*, and possessive constructions. As we have repeatedly seen, the sentence *Rafael stopped using Mac*, for example, presupposes that Rafael used to use Mac in the past. Therefore, an utterance of *Rafael stopped using Mac* is infelicitous, if this piece of information is not known. As we saw in Section 2, the presupposition is triggered as part of the conventional meaning of the word *stop*, and regardless of the subject, the predicate *stopped using Mac* induces the presupposition that the subject used to use Mac. One way to analyze this meaning of this predicate is given in (127) (cf. (86) above).

- (127) $\llbracket \text{stopped using Mac} \rrbracket^{w,g}(x)$
- a. **Assertive meaning:** x does not use Mac now in w
 - b. **Presupposition:** x used to use Mac before in w

According to this analysis, the assertive meaning of this predicate only says that x does not use Mac now, but together with the presupposition, it expresses the transition from x

using Mac to x not using Mac, which is what the sentence intuitively means.

Alternatively, it is also possible to analyze the assertive meaning of this predicate as directly expressing the change of x 's action, as in (128).

- (128) $\llbracket \text{stopped using Mac} \rrbracket^{w,g}(x)$
- a. **Assertive meaning:** x used to use Mac but does not anymore in w
 - b. **Presupposition:** x used to use Mac in w

Under this analysis, the assertive meaning of *stopped using Mac* entails its presuppositional meaning.

Empirical differences between these two analyses above are not immediately obvious, and to the best of my knowledge, have scarcely been addressed in the literature, especially in connection with quantified sentences (but Fillmore 1972, Gazdar 1979b, Karttunen & Peters 1979, Beaver 2001, van Rooij 2005, 2010 contain relevant discussion). In fact, in most cases, these two analyses make the same predictions. Consider, for instance, a positive sentence with a proper name like the following.

- (129) Rafael stopped using Mac.

In this case, it is completely harmless to have the inference that Rafael stopped using Mac in both assertive and presuppositional meaning, as in the second analysis. Similarly, the two analyses have no problem analyzing the negation of this sentence.

- (130) Rafael didn't stop using Mac.

According to the first analysis (127), the assertive meaning of this sentence is simply that Rafael uses Mac now, and the presupposition is that he used to. This captures the meaning of (130). Under the second analysis in (128), the assertive meaning is that Rafael is not a former Mac user, which does not entail that he uses Mac now. However, since the presupposition projects out from negation, a felicitous use of (130) requires it to be known that he used to before, and as a consequence, the overall meaning is that it is not the case that Rafael does not use Mac now, i.e. he still uses Mac.

Furthermore, it should be pointed out at this moment that the predictions of the two sentences are indistinguishable for quantificational subjects that are associated with universal inferences. For example, consider (131).

- (131) None of the students stopped using Mac.

Given the universal inference that all of the students used to use Mac, both analyses make the same prediction: the sentence is felicitous only if all the students used Mac before, and that the sentence is true just in case they are all non-Mac users now.

The difference between the two analyses, however, crops up with non-monotonic quantificational subjects that is not associated with a universal inference like *exactly one student*. Consider the following sentence.

- (132) Exactly one student stopped using Mac.

The intuitive meaning of (132) is that there is only one student who changed his OS from Mac, and the others are either still using Mac or never used it in the first place. However, this is only captured by the second analysis where the assertive meaning entails the presuppositional meaning. Before clarifying why, there are several premises about the semantics

of *exactly one student* that should be made explicit now. Firstly, the sentence (132) does not require every student used to use Mac in the past, and can be uttered in a situation where not every student was a Mac user. This is a general property of quantifiers of the form *exactly one NP* that they do not require every individual in the restrictor to satisfy the presupposition triggered in the nuclear scope, which, as we saw already in Section 3.3, was confirmed by Chemla’s (2009a) experimental results. Rather, they only require the unique individual who satisfy both the NP and VP denotations to satisfy the presupposition. Secondly, the quantifier *exactly one student* has a denotation along the following lines.

$$(133) \quad \llbracket \text{exactly one student} \rrbracket^{w,g} \\ = \lambda P_{\langle e,t \rangle}. \quad \text{there is } x \text{ such that } x \text{ is a student in } w \text{ and } P(x) = 1, \text{ and} \\ \text{there is no other } y \text{ such that } y \text{ is a student in } w \text{ and } P(y) = 1$$

With these assumptions in mind, let us analyze the meaning of the sentence (132) with the two analyses of the predicate. According to the first analysis (127), where the assertive meaning does not entail the presupposition, (132) is true just in case there is one former Mac user among the students, and all the other students currently use Mac. It is already clear that this analysis does not capture the correct truth conditions of the sentence. That is, it is wrongly predicted to be *false* in a situation where there is only one former Mac user among the students, but there is another student who never used Mac. Crucially, the presuppositions are satisfied in this situation by the unique former Mac user. On the other hand, according to the second analysis (128), the predicted meaning is that there is one former Mac user, and all the other students either never used Mac or still use it. This is intuitively correct, and according this meaning, the sentence is *true* in the situation described above. Therefore, for *stopped using Mac*, there is reason to analyze its assertive meaning to be entailing its presuppositional meaning.⁴⁶

4.1.2 *Criticized Herself*

I demonstrate now that not all predicates can be analyzed as involving an entailment between the two dimensions of meaning. Our primary example is predicates containing bound pronouns with gender presuppositions. Although I will later show that there are other such predicates, I think the gender presuppositions triggered by pronouns illustrate the point most perspicuously.

Let us consider the meaning of *criticized herself*. On the assumption that the gender presupposition triggered by *herself* percolates up as the presupposition of this entire predicate, *criticized herself* should presuppose that the subject is female. This is a desirable analysis as it captures the infelicity of sentences like (134).

(134) #That man criticized herself.

Also the presuppositional inferences of quantificational sentences like (135) are expected, given the inferences that other presuppositional predicates like *stopped using Mac* give rise

⁴⁶ An alternative would be to devise a semantics for *exactly one* different from (133) which would give rise to the correct inference. Although such a move is possible, the semantics of all non-upward monotonic quantifiers (that are not associated with universal inferences) must be revised accordingly. I leave this possibility open here, because predicates whose assertive meaning does entail the presupposition do not cause a theoretical problem, as we will see shortly, and also because I do not give a theoretical explanation for the difference between the two types of presuppositional predicates in this dissertation.

to. More concretely, (135a) presupposes that all relevant students are female, while (135b) only presupposes that there is some female student.

- (135) a. None of the students criticized herself.
 b. A student criticized herself.

This is parallel to the inferences of (136).

- (136) a. None of the students stopped using Mac.
 b. A student stopped using Mac.

A promising analysis of the meaning of this predicate, therefore, looks like (137).

- (137) \llbracket criticized herself $\rrbracket^{w,g}(x)$
 a. **Assertive meaning:** x criticized x in w
 b. **Presupposition:** x is female in w

Notice that according to this analysis, the assertive meaning does not entail the gender presupposition. I claim that this analysis is correct, and unlike *stopped using Mac*, it is not possible to analyze the meaning of *criticized herself* as involving an entailment relation between the assertive meaning and presuppositional meaning. Specifically, I claim that the alternative analysis in (138) leads to wrong predictions.

- (138) \llbracket criticized herself $\rrbracket^{w,g}(x)$
 a. **Assertive meaning:** x is female and x criticized x in w
 b. **Presupposition:** x is female in w

Roughly put, the reason why (138) is wrong is the following: with non-upward monotonic subjects that do not give rise to universal presuppositions, such as *exactly one student*, wrong truth conditions are predicted by the second analysis (138). Let us consider a concrete example in (139).⁴⁷

- (139) Exactly one student criticized herself(, namely Mary)

The first analysis (137), where the entailment does not hold, predicts that (139) is true if and only if one student x criticized x , and no other student y criticized y . Also one gets an inference that x is a female student by presupposition projection. Although how exactly this inference comes about via presupposition projection is not immediately clear at this moment, let us suppose that this can be done. How about the alternative analysis in (138) where the assertive and presuppositional meanings stand in an entailment relation? It predicts that the sentence in (139) is true if and only if one student x is female and criticized x , and no other student y is female and criticized y . Evidently these truth conditions are too weak. More specifically, this analysis wrongly predicts that the sentence is true in a situation where only one female student, say Mary, criticized herself, but many of the male

⁴⁷(138) might sound a bit artificial, but I will stick to it for its simplicity. Here are some more examples that illustrate the same point that sound more or less natural.

- (i) a. Exactly one student brought lunch with her.
 b. Exactly one student introduced herself to me.
 c. Exactly one student brushed her teeth.

students also criticized themselves. Intuitively, however, the sentence is judged false in this situation.⁴⁸

From these observations, I conclude that the assertive meaning of *criticized herself* does not entail the gender presupposition, unlike in the case of *stopped using Mac*.

4.1.3 Other Non-upward Monotonic Quantifiers

Incidentally, the exact same argument could be made with other non-upward entailing quantifiers than *exactly one student*, but since English does not mark gender features on plural pronouns, relevant examples can only be constructed with singular quantifiers, which include *exactly one NP*, *only one NP* and *at most one NP*. In languages like Japanese, on the other hand, plural pronouns may have gender features, and more quantifiers can be used to make the point.⁴⁹ For example, a Japanese reflexive plural pronoun *kanojo-tachi-jisin* carries a female gender feature, and can be bound by a non-upward monotonic quantifier, as demonstrated by (140).

- (140) Go-nin-ika-no gakusei-ga kanojo-tachi-zishin-no hahaoya-ni denwa-shita.
 5-CL-at.most-GEN student-NOM her-PL-self-GEN mother-DAT telephone-did
 ‘At most five students called their[feminine] mother.’

The relevant quantifier here is downward monotonic, and the sentence is judged false if there are five female students who called their mother, and more than one male student who called his mother. By the same logic as above, the predicate here cannot be analyzed as having an assertive meaning that entails that the subject is female, since that meaning would make the sentence true in such a situation. Similar arguments can be made with non-monotonic quantifiers like the following as well.

- (141) a. guu-suu-nin-no gakusei-ga kanojo-tachi-zishin-o hihanshita.
 even-number-CL-GEN student-NOM her-PL-self-ACC criticized
 ‘An even number of students criticized themselves[feminine].’
 b. zen’in-dewanai nan-nin-ka-no gakusei-ga kanjo-tachi-zishin-o hihanshita.
 all-not what-CL-KA-GEN student-NOM her-PL-SELF-ACC criticized
 ‘Some but not all of the students criticized themselves[feminine].’

As expected, the obtained inference is that the relevant students who criticized themselves are female and also male students matter for the truth conditions. I take these examples

⁴⁸There is a complication that a reading that is true in this situation might exist, which is expected if local accommodation of the gender presupposition is possible. But the availability of this reading is not an issue, and is orthogonal to the argument being made here. As discussed in Section 2.2, local accommodation of gender presuppositions of pronouns is harder than one might expect, and as a matter of fact, many speakers seem to be unable to get the local accommodation reading of (139). Yet, there are sentences where local accommodation of the gender presupposition is relatively easier. For example, consider the following example. I thank Irene Heim (p.c.) for suggestions on this.

- (i) CONTEXT: The students are not permitted to bring their makeup kit to school, but Mary brought hers yesterday. Today nobody did, so the teacher says to his colleague:
 None of my students brought her makeup kit today.

⁴⁹In languages with a grammatical gender system such as French, Russian and Hebrew, there are non-trivial complications regarding the gender feature of the restrictor (see Yatsushiro & Sauerland 2006 for relevant discussion). I will leave this for future research.

to be suggesting that one cannot attribute the relevant property to the semantics of *exactly* and *at most*. The phenomenon is more general.

4.1.4 Other Presuppositional Predicates

The main point I am making here is that there are two types of presuppositional predicates. One class of presuppositional predicates have an assertive meaning that entails the presuppositional meaning, such as *stopped using Mac*. The other class of presuppositional predicates have an assertive meaning that does not entail the presuppositional meaning, such as *criticized herself*. Which predicates belong to which class is a question that needs to be answered in a theory of presupposition triggering, a theory of which predicates have what presuppositions and why, and is far beyond the scope of this dissertation. Nonetheless, it is of some interest to see more instances of presuppositional predicates with respect to the entailment between the two dimensions of meaning. In particular, it is important to convince ourselves that the lack of entailment is not a peculiar property of the gender presuppositions of pronouns, and is observed with a wider range of presuppositional predicates, because it is sometimes believed that gender features on bound pronouns are not interpreted on the pronouns themselves in some cases. Although I do not think such an analysis is well motivated (see Section 13.7.1 in Part II), and also it is not trivial at all how it would explain the observations we made above, it would not be able to explain other presupposition triggers that give rise to presuppositions that are not entailed by assertive meanings.

Most of the predicates that the literature on presupposition projection has focused on can be shown to belong to the first group, and have an assertive meaning that entails the presupposition. For example, let us consider the following predicates.

- (142) a. x likes both of x 's sisters.
 Presupposition: x has exactly two sisters.
 b. x knows that they got accepted by MIT.
 Presupposition: x got accepted by MIT.
 c. x curtsied.
 Presupposition: x is female.
 d. x is a widow.
 Presupposition: x is female.

That these are presuppositional inferences can be shown by the universal inferences of the following sentences (modulo local accommodation).

- (143) a. No student likes both of his sisters.
 b. No student knows that they got accepted by MIT.
 c. No student curtsied.
 d. No student is a widow.

When combined with *exactly one student* or other non-upward monotonic quantifiers, these predicates results in truth conditions that are insensitive to the students who do not satisfy the presuppositions, just as in the case of *stopped using Mac*. For instance, in order to evaluate the truth of (144a), below, what one needs to do is to look at all the students who have exactly two sisters, and check how many of them like both of their sisters.

- (144) a. Exactly one student likes both of his sisters.

- b. Exactly one student knows that they got accepted by MIT.
- c. Exactly one student curtsied.
- d. Exactly one student is a widow.

Notice that *curtsied* discussed by Beaver (2001) and *be a widow* involve the same gender presupposition as *criticized herself*, but the fact that male students do not matter for the truth conditions of (144c) and (144d) implies that the assertive meanings of the former predicates do entail their gender presuppositions, unlike *criticized herself* but *stopped using Mac*.⁵⁰ Since these predicates are compatible with plural subjects, we could use other quantifiers, such as the ones in (145), to illustrate the same point.

- (145)
- a. Fewer than 5 students like both of their sisters.
 - b. At most 10 students know that they got accepted by MIT.
 - c. Few students curtsied.
 - d. Some but not all of the students are widows.

Again, the truth conditions of these sentences are not affected by individuals who do not satisfy the presupposition.

Are there other presuppositional predicates whose presuppositions are independent from their assertive meanings? I argue below that the following presupposition triggers give rise to presuppositions that are not entailed by assertive meanings.

- *Didn't stop using Mac*
- *Manage* and other implicative verbs
- *Even* and additive/hard presupposition triggers
- Honorific predicates in Japanese
- Singular definite descriptions

As the rest of this subsection is primarily descriptive, the reader can jump to Section 4.2 without missing any theoretical points.

Negation of *Stopped Using Mac*

We convinced ourselves above that *stopped using Mac* should be analyzed like (128), which is repeated below, where the assertive meaning entails the presuppositional meaning.

- (128) $\llbracket \text{stopped using Mac} \rrbracket^{w,g}(x)$
- a. **Assertive meaning:** x used to use Mac but does not anymore in w
 - b. **Presupposition:** x used to use Mac in w

Based on this predicate, one can create a predicate that does not have such an entailment relation. For example, *didn't stop using Mac* should have the following meaning, given that negation only affects the assertive component (cf. Section 2.1.2).

- (146) $\llbracket \text{didn't stop using Mac} \rrbracket^{w,g}(x)$

⁵⁰ Also the gender inferences of *curtsied* and *is a widow* might be easier to accommodate than those of pronouns. Consider the following example from Gazdar (1979a:77).

- (i) Hilary isn't a widow, he's a widower.

- a. **Assertive meaning:** x is not a former Mac user in w
- b. **Presupposition:** x used to use Mac in w

Notice that the assertive meaning of this negative predicate does *not* entail the presupposition, as it is true of an individual who has never used Mac.

Again, using the non-upward monotonic quantifier *exactly one student*, one can show that the lack of entailment here is desired. Consider the following sentence.

(147) Exactly one student did not stop using Mac.

It can be fairly reliably inferred from this sentence that all the other relevant students are former Mac users, which is predicted by the analysis in (147). That is, the sentence says that there is a student who was and is still using Mac, and all the other students *are former Mac users*.⁵¹

Now consider an alternative analysis of *didn't stop using Mac* where the assertive meaning entails the presupposition.

- (148) $\llbracket \text{didn't stop using Mac} \rrbracket^{w,g}(x)$
- a. **Assertive meaning:** x used to use Mac and is not a former Mac user in w
 - b. **Presupposition:** x used to use Mac in w

This analysis predicts a weaker reading than the analysis in (147), that is, (147) is true if and only if one student continues using Mac, but the other students are either former Mac users or never used Mac at all, which does not entail that all students were using Mac. Thus, (148) fails to account for the robust universal inference associated with (147). Therefore, negative predicates like *didn't stop using Mac* involve an assertive meaning that does not entail the presupposition.

The point here generalizes to negation of other presuppositional predicates such as the following (again modulo local accommodation).

- (149) a. Exactly 5 students did not know that their mother was sick.
 b. Fewer than 10 of the students don't like both of their sisters.

Both of these sentences seem to have universal inferences more robustly than their positive counterparts.

Before moving on, however, one complication should be mentioned here. That is, the alternative analysis in (148) might be able to account for the above intuitions with an auxiliary assumption. Recall from Section 3.3 that at least partitive existential quantifiers like *some of the students* optionally give rise to universal inferences. Given the lack of evidence for or against it, it is not outlandish to assume that a non-partitive quantifier

⁵¹Notice, however, that there is again a possibility of local accommodation between the quantifier and negation, which would not result in this inference. That is, a paraphrase of that reading would be the following.

- (i) Exactly one student used to use Mac and did not stop using it.

Although the possibility of such a reading is certainly a potential confound, what is of importance here is the comparative judgment that (147) has a universal inference more robustly than its positive counterpart, which also has a local accommodation reading.

Also, strictly speaking, (i) is a case of 'intermediate accommodation': the presupposition triggered by *stop* gets converted to an assertive meaning after projecting out of the negation. Intermediate accommodation of this sort is a theoretical possibility under certain theories of presupposition projection, but its empirical status is not well understood. See van der Sandt (1992), Geurts (1999), Beaver (2001) for discussion.

like *exactly one student* also is sometimes associated with a universal inference. If so, then the relevant reading can be attributed to the optional universal inference. That is, if it is presupposed that all the relevant students used to use Mac, the sentence has the same truth value under the two analyses. Nonetheless, however, I would like to remark that the universal inference of (147) seems to be more robust than its positive counterpart, i.e. (150a) is associated with a universal inference, if possible at all, less robustly than its negation (150b).

- (150) a. Exactly one student stopped using Mac.
 b. Exactly one student did not stop using Mac.

Since the judgments are subtle, this should be tested with experimental methods, but I leave it for future research.

Manage and Other Implicative Verbs

Karttunen & Peters (1979) claim that *manage to VP* triggers the presupposition that the subject had a difficulty in the event described by *VP* (see also Karttunen 1971, Coleman 1975, Karttunen & Peters 1975, Beaver 2001).⁵² For example, (151) implies that it required some effort for John defend his dissertation in June.

- (151) John managed to defend his dissertation in June.

Karttunen and Peters' analysis is essentially the following.

- (152) $\llbracket \text{manage} \rrbracket^{w,g}(P)(x)$
 a. **Assertive meaning:** $P(x) = 1$
 b. **Presupposition:** P is difficult for x in w

According to this semantics, (152) presupposes that it was hard for John to defend his dissertation in June, and asserts that he did nonetheless. That this inference regarding the difficulty of the embedded event is widely considered to be a presupposition, as it passes projection tests. For example, it survives under negation, and also becomes part of the attitude holder's belief under *doubt*, as shown below.⁵³

- (153) John didn't manage to defend his dissertation in June.
Presupposition: It was hard for John to defend his dissertation in June.
- (154) Mary doubts that John managed to defend his dissertation in June.
Presupposition: Mary believes that it is hard for John to defend his dissertation

⁵²This is meant to be a rough approximation of the meaning of *manage*. Karttunen & Peters (1979:p.23,fn.9) remark: "In many cases of conventional implicature [\approx presupposition] it is difficult to express precisely what is being implicated." Coleman (1975) is a more in-depth investigation, which raises some examples that are not amenable to the analysis in (152). However, a rough analysis of *manage* is enough for our purposes here. The same remark applies to other implicative verbs like *fail*.

⁵³Karttunen (1971) points out that another inference that John made some attempt obtains as part of the presupposition triggered by *manage*, which becomes especially prominent when the sentence is negated as in (153). That is, the sentence is awkward if John did not try at all. However, as Coleman (1975) points out, this inference does not exist in some cases, e.g. when the subject is not animate, which suggests that this might not be encoded in the conventional meaning of *manage*. Coleman further claims that the inference is sometimes better characterized as low likelihood, rather than as difficulty. In the present dissertation, I will not delve into the details, and focus on the difficulty inference. See also the previous footnote.

in June.

Importantly, according to this analysis, *manage to VP* should have a presupposition that is not entailed by the assertive meaning. Thus, in our test with non-monotonic quantifiers with a non-universal inference, the difficulty inference of *manage to defend his dissertation in June* should behave like the gender presupposition of *criticized herself*. Consider the following sentences, for example.

- (155) a. Exactly one student managed to defend their dissertation in June.
b. Fewer than 5 of the 10 Ph.D. candidates managed to defend their dissertation in June.

According to the analysis above, the predicted presuppositional inference for (155a), for example, is that at least for the one student, defending their dissertation in June was not easy. However, it seems that the inference of (155a) actually has a more generic flavor, and suggests that the action denoted by VP is hard for a class of people that includes the subject, i.e. for Ph.D. candidates in general, defending their dissertation in June is hard. The same remark applies to (155b).

One might wonder if this is due to this particular embedded predicate. That is, it is natural to infer that if defending their dissertation in June is hard for one Ph.D. candidate, it should be hard for the others too. However, it appears that similar generic inferences obtain in the following examples as well.

- (156) a. Fewer than 5 of the 30 children managed to finish their lunch.
b. Not many of my relatives managed to graduate from high school.
c. Few of the patients managed to walk to the elevator.
d. Exactly one of the students managed to go home by bus.

The embedded predicates of these sentences describe actions that are easily imagined to be easy for some, but not for others. For instance, walking to the elevator is hard for certain patients, but not for others depending on their condition. Nonetheless, the inferences that these sentences are associated with are about the general difficulty of these actions, rather than the difficulty for the ones who actually did perform them.

Furthermore, the same generic inferences are observed for upward monotonic existential quantifiers too. Thus, unlike with predicates like *stopped smoking*, the relevant inferences of the following sentences are not completely existential.^{54,55}

⁵⁴Karttunen & Peters's (1979) famous example, given in (i), that they use to illustrate the so-called 'binding problem' (see Section 4.4) contains *manage*.

- (i) Someone managed to succeed George V on the throne of England. (Karttunen & Peters 1979:53)

They claim that this sentence sounds odd, because it implies that Edward VIII had difficulty ascending the throne, contrary to the historic facts. However, given the discussion above, the sentence is potentially anomalous for another additional reason. That is, due to the generic inference that suggests that there were other people for whom succeeding George V was hard, which is unnatural in the context of succession to the throne, because the person next in line is usually predetermined.

⁵⁵Danny Fox (p.c.) raised the following example that might sound less generic, but I am not completely sure about the judgment.

- (i) CONTEXT: There were 10 children in the gym today. Some were rather tall and could easily touch the ceiling. They didn't bother to try. The kids who needed to jump in order to touch the ceiling made various attempts.

- (157) a. A patient managed to walk to the elevator.
 b. Some children managed to touch the ceiling.
 c. One of the boys managed to walk home.
 d. Two students managed to go home by bus.

It is possible, therefore, that the relevant inference of *manage to VP* is inherently generic in the following way (cf. recent studies on predicates of personal taste such as Moltmann 2010, Pearson 2012).

- (158) $\llbracket \text{manage} \rrbracket^{w,g}(P)(x)$
 a. **Assertive meaning:** $P(x) = 1$
 b. **Presupposition:** P is difficult generally for the class of people including x in w

If this analysis is on the right track, the relevant truth conditional effect in our test with non-upward monotonic quantifiers is at least extremely hard, and perhaps impossible to detect. Recall that in a context where the presupposition is satisfied by all the individuals in the restrictor, it is not possible to tell whether or not the predicate has the assertive meaning that entails the presupposition. Since the generic inference in examples with quantificational subjects generally amounts to something equivalent to a universal inference, the effect is hardly observable.

There are several other predicates that seem to be associated with such generic inferences. For example, the class of predicates that Karttunen (1971) calls implicative verbs generally pattern with *manage* and give rise to generic inferences in quantificational sentences (see also Coleman 1975). In general, implicative verbs add an extra presuppositional inference, and do one of two things in the assertive dimension: some of them leave the assertive meaning intact (e.g. *manage*, *remember*), while others negate it (e.g. *fail*, *forget*). Let us look at *fail* and *remember*. First, observe the inferences with proper names.

- (159) a. John failed to recognize me.
 b. John remembered to check the course website.

The sentence (159a) is associated with an inference that it is easy for John to recognize me, and the sentence asserts that despite the lack of difficulty, John did not recognize me. The sentence (159b) implies that John was supposed to check the course website, and asserts that he did. These inferences survive under negation, as illustrated by (160).

- (160) a. John didn't fail to recognize me.
 b. John didn't remember to check the course website.

With quantificational subjects, they give rise to generic inferences that are akin to universal inferences, as demonstrated by (161).

- (161) a. Some of us failed to recognize me.
 b. Few of the students remembered to check the course website.

In addition to implicative verbs, other predicates that are associated with difficulty/unlikelihood inferences, such as *scrape by*, *get by*, etc., also appear to give rise to generic inferences in

2 of the 10 children who were in the gym today managed to touch the ceiling.

quantificational sentences (although they are not classified as implicative verbs, as they do not take infinitival complements).

- (162) a. Two of the artists scraped by.
 b. Many of us got by in one way or another.

I leave open the question why the presuppositional inferences these predicates trigger with quantificational subjects are generic, but would like to stress the following two points: (i) that their presuppositions are not entailed by their assertive meanings, but (ii) due to the generic inference, our test with non-upward monotonic quantifiers does not clearly elucidate this property.

***Even* and Additive/Hard Presupposition Triggers**

Even is often analyzed as involving two presuppositional inferences, scalar and additive presuppositions (Karttunen & Peters 1979, Rooth 1985, Wilkinson 1996, Rullmann 1997, Giannakidou 2007, Guerzoni 2003, Crnić 2011). Assuming that it is a sentential operator, the following analysis is often upheld. C here is a contextually salient set of propositions (cf. Section 8.1 in Part II).

- (163) $\llbracket \text{even} \rrbracket^{w,g}(C)(p)$
 a. **Assertive meaning:** $p(w) = 1$
 b. **Scalar Presupposition:** p is less likely than all $q \in C$ distinct from p
 c. **Additive Presupposition:** There is $q \in C$ distinct from p such that $q(w) = 1$

For example, consider (164).

- (164) Even John showed up.

This sentence is true if and only if John showed up, but it is also associated with additional inferences that John was unlikely to show up and also that somebody who is not John showed up as well.⁵⁶

According to the above analysis, *even* is an item that adds presuppositions without affecting the assertive meaning of its argument. Thus it should be able to construct a predicate containing it whose assertive meaning does not entail its presupposition. Here is an attempt.

- (165) Some of the 10 students even invited John.

Let us focus on the scalar presupposition here. Assuming that *some students* takes scope over *even* in (165), the predicate it combines with should have the following denotation.

- (166) $\llbracket \text{even invited John} \rrbracket^{w,g}(x)$
 a. **Assertive meaning:** x invited John
 b. **Scalar Presupposition:** It is less likely for x to invite John than other people

⁵⁶The additive inference sometimes fails to obtain in some examples. See Rullmann (1997), Schwarz (2005), Crnić (2011) for discussion.

Given that *some of the 10 students* does not need to be associated with a universal inference, the predicted inference for (165) is that some students were unlikely to invite John. Suppose now that there are 10 students, 5 of whom hate John. So for them, John is the last person that they would invite. The other 5 students are good friends with John, so they are very likely to invite him. Suppose now that three of the 10 students invited John, and it was surprising for us that they were all from the former group. In this context, (165) is predicted to be felicitous and true. Although the judgments are subtle, I think it is.

Here are some more attempts to consolidate this intuition. Let us use non-upward monotonic quantifiers. Again, the reading we are after is the one where the quantifier takes scope over *even*.

- (167)
- a. Few of the patients even ate a hamburger.
 - b. Fewer than five of my cousins even called their mom.
 - c. Exactly 10 of the 50 students even walked home.

These examples appear to have inferences that are expected for presuppositional predicates combined with the relevant quantifiers. That is, (167a) suggests that those patients who did eat a hamburger were unlikely to do so. Crucially, the sentence is false when there are many patients who have no problem with their stomach, hence were likely to eat hamburgers, and actually did. This suggests that the unlikelihood inference is not part of the assertive meaning. Similarly (167b) has an inference that those cousins of mine who called their mom were unlikely to do so. Again, the sentence is false in a situation where two of my cousins who are unlikely to talk to their mom called her and in addition five other cousins who have a very good relationship with their mother and often call her did at the relevant time. Again, this is not captured if the assertive meaning entails the scalar inference. Finally, (167c) suggests that there were 10 students for whom walking home was hard. Suppose that there are 20 students who live on campus, and for whom walking home is very easy, and 30 others who live off campus and usually take the metro to commute. Today, due to an accident the metro was not running the whole day, and exactly 10 of the students who live off campus managed to walk home. Crucially, if in addition the on campus students walked home, the sentence is judged false. This intuition is not captured if the scalar inference is also part of the assertive meaning.

In addition, some of the so-called hard presupposition triggers, such as additive particles like *also*, generally create predicates with independent assertive and presuppositional meanings, as their sole function is to add presuppositions. For example, *John also swam* asserts that John swam and presupposes that John did some other salient activity. Clearly, there is no entailment relation between the assertive and presuppositional meanings here.

However, there is a potential confound with them. Charlow (2009) claims that hard presupposition triggers give rise to universal inferences in all quantificational sentences, regardless of the quantifier. He gives the following examples. The context is setup so that the universal inference is incompatible with it.

- (168)
- Just five of those 100 students smoke. They all smoke Newports.
 - a. #Fortunately, none of those 100 students also smokes Marlboros.
 - b. #Unfortunately, some/at least two of those 100 students also smoke Marlboros.

(168a) is as expected, since *none* should give rise to a universal inference. However, (168b) is not expected, as it should have a weaker inference and thus be compatible with the given situation.

However, the data Charlow offers is confounded by the fact that the *of*-phrase is intuitively speaking not perfectly felicitous. That is, as the topic seems to shift towards the students who smoke after the first sentence, it is more natural to use *of the 5 students* in (168). Let us try to eliminate this confound. Consider the following examples.

- (169) In each year, less than half of the students drink.
- a. 1/3 of the 8 first years also smoke.
 - b. Two of the 8 first years also smoke.
 - c. Few of the 8 first years also smoke.
- (170) Less than half of the students in each year have been to Paris.
- a. 1/3 of the 8 first years have also been to Toulouse.
 - b. Two of the 8 first years have also been to Toulouse.
 - c. Few of the 8 first years have also been to Toulouse.

I believe that these sentences are coherent, which contradicts Charlow's generalization that hard presupposition triggers always give rise to universal inferences, but as the empirical facts are not entirely clear at this moment, I will not give a definitive answer here. However, if my observation is correct, these predicates also have assertive meanings that do not entail their presuppositions.

Honorific Predicates in Japanese

An honorific predicate like *irassharu* 'come' in Japanese can be shown to have assertive and presuppositional meanings that are independent from each other. For example, the following sentence has an inference that the speaker respects the referent of the demonstrative subject.

- (171) ano hito-ga irasshat-ta.
 that person-NOM came.HON-PAST
 'That person came.'

Previous studies, most notably Potts & Kawahara (2004) and Potts (2005), claim that the honorific inferences triggered by such (subject) honorific predicates in Japanese are conventional implicatures, rather than presuppositions (see also Kim & Sells 2007 for Korean honorifics). Their claim is motivated by the following two observations in particular: (i) honorifics cannot take scope below linguistic operators, and (ii) honorifics cannot be combined with quantificational subjects, both of which are features of conventional implicatures like supplements as we saw in Section 2.3.⁵⁷ However, there are counterexamples against both of these points.

Firstly, Potts & Kawahara themselves point out that there are some cases where honorifics seem to be embedded. The following example is a case in point.⁵⁸

⁵⁷Potts & Kawahara (2004) also mention two more features: honorific meanings are not used to update the common ground (IMMEDIACY), and honorifics are hard to paraphrase (DESCRIPTIVE INEFFABILITY). These, however, do not themselves motivate their analysis and also do not contradict my alternative analysis that honorific meanings are presuppositional. See also Potts (2007a) on the properties of (what he regards as) conventional implicatures.

⁵⁸Their original example uses an anti-honorific which expresses the speaker's negative attitude toward the subject. They appear to assume that honorifics cannot be embedded unlike anti-honorifics, but this is not true as the examples here demonstrate.

- (172) Taro-wa [watasi-no shiranai dareka-ga nani-o mesiatagat-ta ka] kiitekita.
 Taro-TOP [I-GEN not.know someone-NOM what-ACC eat.HON-PAST Q] asked.me

‘Taro asked me about someone I do not know what he ate.’

The subject of the honorific predicate here is someone that the speaker does not know, for whom the speaker would not use an honorific predicate. (172) has an inference that Taro respects that person, which suggests the honorific feature is interpreted in the scope of the attitude predicate. The conditional sentence in (173) illustrates the same point that honorifics can be semantically embedded.

- (173) sono ronbun-no chosha-ga yuumeina kyoozyu-nara, LSA-ni irassharu hazuda.
 that article-GEN author-NOM famous prof-if, LSA-to come.HON definitely

‘If the author of that article is a famous professor, he will definitely come.HON to the LSA.’

This sentence has a reading that does not imply that the speaker respects the author of the article, but she will if the author is a famous professor.

However, a caveat is in order. It is certainly true that honorifics tend to get the highest scope, as Potts & Kawahara (2004) observe. For example, (174) is usually read that the speaker respects the referent of the subject *ano hito* ‘that person’.

- (174) Taro-wa [ano hito-ga irasshatta ka] kiitekita.
 Taro-TOP [that person-NOM came.HON Q] asked.me

‘Taro asked me if that person came.’

This point can be strengthened by changing the matrix subject to somebody with a high social status, in which case the matrix predicate will also be an honorific.

- (175) shushoo-wa [ano hito-ga irasshatta ka] o-kik-ininat-ta.
 prime.minister-TOP [that person-NOM came.HON Q] HON-ask-HON-PAST

‘The prime minister asked if that person came.’

Here, the referent of the matrix subject would not use an honorific to the referent of the embedded subject, but the sentence is clearly felicitous with honorific predicates in both clauses. Thus, the embedded one should also reflect that speaker’s perspective.

Quite interestingly, the environments where the embedded readings of honorifics are available seem to correspond to the environments when the gender presuppositions of pronouns can be read *de dicto*. Recall from Section 2.2 that the gender presuppositions of pronouns prefer to be read *de re*, creating an impression that their gender presuppositions fail to be filtered out in intensional contexts. The same goes with honorifics. They seem to prefer *de re* readings in intensional contexts, except in cases like the examples above. Again I do not give precise accounts of this preference for *de re*, but it is sufficient to show that in certain conditions are met, honorifics are embeddable.

Now let us turn to Potts & Kawahara’s (2004) second point that honorifics are incompatible with quantificational subjects. They give the following examples to buttress their claim (glosses and translations are changed from the original for the sake of uniformity with the rest of this dissertation).

- (176) a. ??hotondo-no kyoozyu-ga [*pro* sono kurasu-o o-oshie-ninat-ta to]
 most-GEN professor-NOM [*pro* that class-ACC HON-teach-HON-PAST C]
 omotteiru.
 think
 ‘Most of the professors think that they taught.HON that class.’
 (Potts & Kawahara 2004:258)
- b. ??dono kyoozyu-mo [*pro* sono kurasu-o o-oshie-ninat-ta to] omotteiru.
 which professor-∀ [*pro* that class-ACC HON-taught-HON-PAST C] think
 ‘Every professor thinks that he taught.HON that class.’
 (Potts & Kawahara 2004:266)

The unacceptability of these examples is attributed to the incompatibility between the quantificational subject and the honorific predicate in the embedded clause. If this is true, it gives credibility to their claim that honorific meanings are conventional implicatures, just like supplements. However, more simple sentences like (177) are clearly felicitous.

- (177) a. onna-no hito-ga choodo 3-nin irasshatta.
 female-GEN person-NOM exactly 3-CL came.HON
 ‘Exactly three ladies came.HON.’
- b. onna-no hito-ga saidai 10-nin irasshatta.
 female-GEN person-NOM at.most 10-CL came.HON
 ‘At most ten ladies came.HON.’
- c. onna-no hito-ga takusan irasshatta.
 female-GEN person-NOM many came.HON
 ‘Many ladies came.HON.’
- d. daitasuu-no onna-no hito-ga irasshatta.
 majority-GEN female-GEN person-NOM came.HON
 ‘A majority of ladies came.’
- e. sanjup-paasento-no onna-no hito-ga irasshatta.
 30-%-GEN female-GEN person-NOM came.HON
 ‘30% of the women came.’

Then why are the sentences in (176) infelicitous? I claim that their unacceptability simply stems from the lack of an honorific marking on the matrix predicate. In fact, if *omotteiru* is replaced with its honorific form *o-omoi-ninatteiru*, the sentences become perfectly acceptable. This makes sense given that not using an honorific form triggers an inference that the speaker lacks respect toward the referent of the subject, and hence using an honorific form in one clause but not in another with the same subject generates a contradictory inference.⁵⁹

For these reasons, Japanese honorific predicates do not pattern with conventional implicatures, but rather behave like presuppositions, especially gender presuppositions. In fact, they give rise to inferences expected for presuppositions in quantificational sentences. (177a), for example, is associated with a non-universal inference, and can be uttered by a student who are reporting that three female professors came, and other ladies including female students have not come yet. Crucially the sentence is false if there is a female stu-

⁵⁹Note that honorifics prefer *de re* readings by default, and therefore the inference that the embedded honorific predicate generates in (176) is not about self-respect, but about the speaker’s attitude.

dent, for whom the speaker would not use an honorific, came in addition to the three female professors.

Given the above observations, an honorific predicate can be analyzed as follows.⁶⁰

- (178) $\llbracket \text{irasshatta} \rrbracket^{w,g}(x)$
- a. **Assertive meaning:** x came
 - b. **Presupposition:** The speaker respects x

Thus, an honorific predicate has an assertive meaning that does not entail the honorific presupposition.

Singular Definite Descriptions

Singular definite descriptions carry two presuppositions.⁶¹ In a simple sentence like (179), the definite description *the paper I wrote this semester* has an existential presupposition that there is a paper I wrote this semester, and a uniqueness presupposition that there is exactly one such paper.

- (179) I published the paper I wrote this semester.

Both of these inferences survive under negation, and in conditional antecedents, as demonstrated by (180).

- (180) a. I didn't publish the paper I wrote this semester.
b. If I publish the paper I wrote this semester, I will be famous.

Other projection tests for presuppositions also indicate that these inferences are indeed presuppositions. Note that in intensional contexts, *de re* and *de dicto* readings should be taken care of, although the preference of *de re* readings is not particularly strong for definite descriptions unlike for pronouns.

Let us focus on the uniqueness presupposition here (see Section 4.3.2 for the existence presupposition). I claim that the uniqueness presupposition of a singular definite description is not entailed by the sentence. This can be seen in the following examples.

- (181) a. Fewer than 5 of the 10 students published the paper that they wrote this semester.
b. Some but not all of my friends talked to their sister recently.

Let us consider (181a). Suppose that there are 10 students, and they all wrote papers this semester. 4 of them wrote just one paper, but the others wrote more than one. Because the ones who wrote only one spent more time on it, the quality of their papers was high, and three of them published their paper. If nobody else published their papers, the sentence

⁶⁰When embedded under attitude predicates, e.g. (174), the attitude expressed becomes that of the attitude holder, rather than that of the speaker. I will not give an analysis of this 'shifting effect' here, but this is highly reminiscent of 'indexical shifting' which I will discuss in a considerable depth in Part III. I suggest here that the shifting effect of honorifics is amenable to the same analysis as indexical shifting, but leave the formulation of a precise analysis for future research.

⁶¹I thank Danny Fox (p.c.) for directing my attention to definite descriptions. The literature on the presupposition of definite description is particularly copious. To list a few, Russell (1905), Strawson (1950), Hawkins (1978), Heim (1982), Kadmon (1990), Hawkins (1991), Heim (1991), von Stechow (2004), Abrusán & Szendrői (2011).

(181a) is true. Now consider that in addition to these three people, three other students who wrote more than one paper published all of them. In this situation, (181a) is false. This indicates that the assertive meaning of the predicate *published the paper that they wrote this semester* does not entail the uniqueness presupposition. Similarly, (181b) has a reading that the ones who recently talked to their sister only have one sister, while the others who have not spoken to their sisters might have more than one.

4.2 Revisiting Universal Quantifiers

We have established in the previous subsection that there are presuppositional predicates whose assertive meaning does not entail the presupposition, e.g. *criticized herself*. Before going back to the theoretical discussion, I would like to point out here that such predicates can be used to discern the presuppositions of universally quantified sentences. I noted earlier in Section 3.3 that (182) entails the universal inference that every student used to use Mac.

(182) Every student stopped using Mac.

If the assertive meaning of *x stopped using Mac* entails that *x* was using Mac, the universal inference should be entailed in the assertive domain, and therefore it is not clear whether the presupposition of (182) is also universal (Beaver 1994, 2001; Chemla's (2009a) baseline with *each* also has a universal inference entailed in the assertive domain.).

On the other hand, using predicates like *criticized herself*, we can bring into light the presuppositions of universally quantified sentences. Here are some examples.

- (183)
- a. Every student criticized herself.
 - b. Each of the students didn't stop using Mac.
 - c. All the students published the paper that they wrote this semester.

Intuitively, these sentences are associated with universal inferences. That is, (183a) suggests that every student is female, (183b) suggests that every student used and still use Mac, and (183c) suggests that every student wrote exactly one paper this semester. These inferences cannot be entailments of their assertive meanings, which are paraphrased by (184).

- (184)
- a. Every student *x* criticized *x*.
 - b. Each of the students either never used Mac or has been using Mac.
 - c. All the students published the paper or papers that they wrote this semester.

Thus, I conclude that universally quantified sentences are associated with universal inferences (contrary to Beaver 1994, 2001).

4.3 Undergeneration Problem for Localist and Trivalent Theories

In this section I will point out that the lack of entailment between the assertive and presuppositional meanings of *criticized herself* and other predicates causes a problem for localist and trivalent views of presupposition projection. The nature of the problem is the same for both views, namely that they are not expressive enough to correctly capture the assertive meaning of sentences like (185).

(185) Exactly one student criticized herself.

This is an undergeneration problem, since the correct assertive meaning of (185) cannot be derived under these views. As we will see, this undergeneration problem elucidates a fundamental flaw, which is built into the way in which presuppositions are modeled under these theories. More specifically, the problem stems from what I call the Frege-Strawson view of presuppositions that maintains that presuppositions are pre-conditions for sentences to have truth values. Thus, I propose to abandon this long-held view.

4.3.1 The Undergeneration Problem

Recall that localist theories of presupposition projection features local evaluation of presuppositions (Heim 1983, van der Sandt 1992, Beaver 1994, 2001, Schlenker 2008, 2009). In particular, in quantificational sentences, presuppositions are evaluated at the level of predicate. In Section 3.4.1 we briefly introduced Heim’s (1983) theory that analyzes the meaning of a sentence as a partial function from contexts to contexts. To be more precise, contexts are modeled as sets of pairs $\langle f, w \rangle$ of an assignment function f and a possible world w . The presuppositions of a sentence are restrictions on the domain of the function that the sentence denotes. For example, the sentence *It stopped raining* is defined for a set C of pairs $\langle f, w \rangle$ only if for each $\langle f, w \rangle \in C$, it is true that it used to rain in w (see Section 6.1 for a more detailed review).

Heim (1983) extends this idea to quantificational sentences by treating predicates as functions from contexts to contexts too. An important feature of such functions in this setting is its ‘eliminativity’, i.e. $\llbracket S \rrbracket(C) \subseteq C$ for all sentences S and contexts C , whenever defined (Groenendijk & Stokhof 1991b). Therefore, the meaning of a predicate S_p with a presupposition p necessarily entails p . What this means is that under this theory, all predicates necessarily entail their presupposition. However, as we saw above, the entailment cannot hold for predicates like *criticized herself*. More concretely, localist theories wrongly predict the same assertive meaning as (186b) for (186a) (although they are predicted to have different presuppositions).

- (186) a. Exactly one student criticized herself.
 b. Exactly one student is female and criticized herself.

An analogous undergeneration problem arises in trivalent theories of presupposition projection championed by Krahmer (1998), Beaver & Krahmer (2001), George (2008a,b), and Fox (2008, 2010) (also Peters 1979, Cooper 1983). Recall that these theories encode the presupposition of a sentence in its truth conditions by enriching the latter with a third truth value $\#$. For example, *criticized herself* is analyzed as follows.

$$(187) \quad \llbracket \text{criticized herself} \rrbracket^{w,g} = \lambda x_e. \begin{cases} 1 & \text{if } x \text{ is female and } x \text{ criticized } x \text{ in } w \\ 0 & \text{if } x \text{ is female and } x \text{ did not criticize } x \text{ in } w \\ \# & \text{otherwise} \end{cases}$$

Again, this predicate necessarily entails the gender presupposition, in the sense that whenever it is true of an individual x , it is also true that x is female. Therefore, the meaning of the sentence (186a) cannot be adequately captured, and the two sentences in (186) would be given the same truth conditions.

Although I illustrated the undergeneration problem with the gender presuppositions of bound pronouns, the exact same problem arises with any presuppositional predicates that have independent assertive and presuppositional meanings. As we observed above, there

are a number of such presuppositional predicates, and therefore, a solution to the problem needs to be general enough to cover a variety of presupposition triggers, and cannot be specific to gender features on pronouns.

4.3.2 Implications of the Problem

The undergeneration problem for the localist and trivalent views illustrates the need for a more expressive theory. In particular, in order to analyze the meaning of a sentence like *Exactly one student criticized herself*, we need a theory that is expressive enough so that the assertive meaning of the predicate, $\lambda x. x$ criticized x , is completely dissociated from its presuppositional meaning, $\lambda x. x$ is female, as the truth conditions of the sentence should be just based on the former. In other words, the problem stems from the way in which presuppositions are represented under these theories: the two dimensions of meanings are so tied together that there is no way to access to the assertive meaning independently of the presuppositional meaning, in particular the former cannot be true without having the latter also true.

It is worth mentioning that this feature of the localist and trivalent theories is actually intended. In particular, the proponents of these views assume that there are only three cases to consider: (i) the presupposition is false (presupposition failure), (ii) the presupposition is true and the assertion is true, and (iii) the presupposition is true but the assertion is false. Notice that (i) can in principle be broken down into cases where the assertion is true and false, but it is widely considered by linguists and philosophers alike that there is no need for this decomposition. It is often said that presuppositions are pre-conditions for a sentence have a truth value, and hence the above trichotomy, a view that Frege and Strawson popularized. Beaver (2001:39), for example, maintains this position, saying: “There are no obvious empirical reasons for using more than three truth values in the treatment of presupposition, and thus Occam’s razor commonly makes trivalent semantics the preferred basis for a multivalent treatment of presupposition.” Indeed, with predicates like *stopped using Mac*, there is no need to consider cases where the presupposition is false but the assertion is true, because this case is logically impossible: When the presupposition is false, the assertion is bound to be false too (cf. see Beaver 2001:42 for relevant discussion). Similarly for the existence presupposition of definite descriptions, which early discussion on presupposition in philosophy of language focused on. That is, when the existence presupposition is false, the sentence usually cannot be true (but see the discussion below on the so-called ‘referential’ use of definite descriptions).

The gender presuppositions of pronouns are, however, empirical evidence showing the shortcoming of the trichotomy and the necessity of the distinction between the two subcases of presupposition failure. As mentioned above, in order to correctly capture the truth conditions of *Exactly one student criticized herself*, it is necessary to refer to the property of criticizing oneself without demanding the argument of the predicate to be female. To put it differently, we want to have a four-valued denotation like the following.⁶²

$$(188) \quad \llbracket \text{criticized herself} \rrbracket^{w,g}$$

⁶²Cooper (1983) advocates a theory with four truth values, but his way of defining the four values does not break down the two subcases of presupposition failure, and his theory is very close to trivalent theory in its predictions. For example, *criticized herself* would be given the following denotation.

$$(i) \quad \llbracket \text{criticized herself} \rrbracket^{w,g}$$

$$= \lambda x_e. \begin{cases} 1 & \text{if } x \text{ is female and } x \text{ criticized } x \text{ in } w \\ 0 & \text{if } x \text{ is female and } x \text{ did not criticize } x \text{ in } w \\ \#^1 & \text{if } x \text{ is not female and } x \text{ criticized } x \text{ in } w \\ \#^0 & \text{if } x \text{ is not female and } x \text{ did not criticize } x \text{ in } w \end{cases}$$

Compare this to the trivalent denotation in (187) above. In addition to 1 and 0, the two subcases of # are distinguished here. With this denotation, we can account for the truth conditions of the sentence *Exactly one student criticized herself* as follows. The sentence means that there is one student for whom this predicate returns 1, and for all the others, it returns either 0 or #⁰.

In the case of *stopped using Mac*, on the other hand, #¹ never arises as illustrated by (189).

$$(189) \quad \llbracket \text{stopped using Mac} \rrbracket^{w,g} \\ = \lambda x_e. \begin{cases} 1 & \text{if } x \text{ is a former Mac user in } w \\ 0 & \text{if } x \text{ was using Mac and still is in } w \\ \#^1 & \text{if } x \text{ never used Mac and is a former Mac user in } w \\ \#^0 & \text{if } x \text{ never used Mac and is not a former Mac user in } w \end{cases}$$

That is, #¹ is guaranteed to be contradictory.

The need to distinguish the two subcases of presupposition failure can also be illustrated by the following example, repeated from (31). Suppose that someone utters this sentence while pointing at a sleeping infant, who we know is a boy.

(190) She is sleeping.

There is a sense in which this sentence is true in the given context, although the speaker is making a wrong assumption about the gender of the infant. Now consider a different situation where the boy is not sleeping. Then, the intuition is that the sentence is false and the speaker's assumption is also false. This again shows that these two cases of presupposition failure should be somehow distinguished in a theory, or in other words, the presupposition failure does not imply that the sentence does not have a truth value (for relevant discussion, see Robert Stalnaker's seminal works, such as Stalnaker 1973, 1974, 1978, and also Dekker 2008, van Rooij 2005, 2010, Soames 1989). However, the partial function and the trivalent view do not have enough expressive power to do so, as these two cases are collapsed into one, presupposition failure.⁶³

Although it might be less perspicuous than our truth conditional test with a non-upward

$$= \lambda x_e. \begin{cases} 1 & \text{if } x \text{ is female and } x \text{ criticized } x \text{ in } w \\ 0 & \text{if } x \text{ is female and } x \text{ did not criticize } x \text{ in } w \\ \# & \text{if } x \text{ is not female in } w \\ \% & \text{if } x \text{ is female and } x \text{ criticized } x \text{ and did not criticize } x \text{ in } w \end{cases}$$

Note that the truth value % seems to be always contradictory and absurd, but Cooper (1983) proposes to use it to analyze the so-called metalinguistic negation. However, importantly, Cooper's four valued semantics runs into the same undergeneration problem as the two subcases of presupposition failure are not distinguished.

⁶³This is rather a problem of the partial function view, rather than that of the localist view, and certain theories such as Schlenker (2007a, 2008) and van der Sandt (1992) are in principle expressive enough to distinguish the two cases of presupposition failure, as under these theories presuppositions are represented independently of the assertive meaning. However their accounts of quantificational sentences are still inadequate as the entailment between the two dimensions of meaning is required at a local level. See Section 6 for details.

monotonic quantifier, this test easily applies to a varieties of presupposition triggers. For example, consider a sentence containing *even*.

(191) Even John passed the test.

Suppose that John is actually the smartest student in class, and hence was most likely to pass the relevant test, and furthermore assume that he actually did. In such a situation, what is conveyed by (191) is clearly true, but the speaker of the sentence seems to make a wrong assumption about John's smartness. Again this is a case where a fourth truth value is necessary. Similarly, consider (192) in a situation where the test was actually very easy for everybody including John.

(192) John managed to pass the test.

If John indeed passed, then (192) is in some sense true, but the assumption about the difficulty of the test is wrong.

Furthermore, as Dekker (2008) and van Rooij (2010) point out, Donnellan's (1966) examples of the 'referential' use of definite descriptions can be considered as a case where the existence presupposition of a definite description is false but the assertion is true. Here is an example modeled after Donnellan's oft-quoted one.

(193) CONTEXT: At a party and, seeing an interesting-looking person holding a martini glass, one says:
The man drinking a martini is tall.

Suppose that no one is actually drinking martini, and the man in question is only drinking sparkling water, but the speaker mistook it for a martini. Donnellan (1966) point is that in such a situation, even if the description is false of the individual, the relevant man is picked out by the definite description. Crucially, the existence presupposition of the definite description is not met, as no one is drinking a martini. Nonetheless, one can say the sentence is true or false. That is, if the relevant man is tall, then what the speaker meant by the sentence is true, and if he is short, it is false. This illustrates that the existence presupposition that there is an individual that meets the description is not entailed. Indeed, what is entailed by the assertive meaning of (193) is the existence of the referent, rather than the existence of an individual satisfying the description.

That said, since the description is used as a clue to infer who the referent is, in most cases the referent does satisfy the description, giving an impression that the existence presupposition is entailed by the assertive meaning of the sentence. Such cases are the central concern of philosophers of language and linguists until Donnellan (1966), which I believe led such prominent figures like Frege and Strawson to assume that there is no need to distinguish two subcases of presupposition failure.

To summarize, the undergeneration problem for the localist and trivalent views has its origin in the lack of appropriate expressive power, namely, they do not draw a distinction between the two cases of presupposition failure with respect to the truth and falsity of the assertive meaning. This is a widely credited view that traces its origin to the early discussion of definite descriptions in philosophy of language such as Frege (1892) and Strawson (1950). However, as I pointed out above, it is misguided by the crucial property of those presupposition triggers that philosophers and linguists primarily focused on, namely their presuppositions are (usually) entailed by their assertive meanings. As a consequence, presupposition failure entails the falsity of the assertive meaning. However, once we look at

other presupposition triggers such as the gender presupposition of pronouns, *even*, and *manage*, it becomes evident that the assertive meaning and presupposition can be true and false independently, and cannot be intertwined like the partial function view and the trivalent view of presupposition contend.

Thus, I conclude that we need a more expressive theory of presupposition. Among the existing ones, Karttunen & Peters's (1979) two dimensional theory is appropriate in this respect. However, it is known to face a different kind of problem, which we discuss in the next section.

4.4 Two Dimensional Theory and the Binding Problem

Karttunen & Peters (1979) is one of the earliest theories of presupposition projection in the framework of model theoretic semantics. Since its birth, this theory has been repeatedly criticized for mainly two reasons (Gazdar 1979b, Soames 1979, 1982, Cooper 1983, Heim 1983, Soames 1989, Beaver 2001). One is its empirical problem called the *binding problem* in quantified sentences, which I introduce below. Another problem is more conceptual and has to do with its insufficient restrictiveness: It is a very powerful theory and does not make clear predictions about the projection properties. As we will see, this is rooted in the fact that under this theory, the assertive meaning and presupposition of a lexical item can be specified completely independently without recourse to each other. I will mainly focus on the empirical problem here, and come back to the discussion of this conceptual problem in Section 5.7.1.

Karttunen & Peters's (1979) key idea is that the meaning of a sentence has two separate dimensions, one for the assertive meaning and one for the presuppositional meaning.⁶⁴ This theory is expressive enough to not run into the undergeneration problem pointed out above, as it treats truth and falsity of the two kinds meanings separately, and hence is equipped with the necessary four truth values.

More specifically, Karttunen & Peters (1979) assign each sentence a pair of propositions, one representing the assertive meaning, and one representing the presuppositions. Karttunen & Peters's (1979) original implementation is a direct extension of Montague's (1973) framework, but the technical details of the framework are immaterial here, and in order to keep the uniformity with the rest of this dissertation, I will present their idea in a different form.

To illustrate the idea concretely, let us take the sentence in (194) that contains a presupposition trigger *stop*.

(194) Rafael stopped using Mac.

This sentence is given a pair of propositions as its meaning, one for the assertive meaning and one for the presuppositional meaning. I will denote these two dimensions of meaning

⁶⁴An earlier formulation presented in Karttunen & Peters (1975) is three-dimensional as the 'heritage function' introduced below is treated in a separate dimension from the presupposition, but as far as I can see, this is a minor technical point. It should also be mentioned that multidimensional semantics has been propounded elsewhere, e.g. Rooth (1985, 1992a), Potts (2005), Maier (2009a), AnderBois et al. (2010), McCready (2010), but the non-assertive domain of these systems is not meant to be a model of presupposition. Cancellation models like Soames (1979) and Gazdar (1979b) are two dimensional as well, but they do not explicitly deal with presuppositions in quantified sentences, and it is far from trivial how they would deal with this issue. Dekker (2008) and van Rooij (2005, 2010) are recent formal multi-dimensional semantics for presuppositional phenomena, but their predictions for quantificational sentences are not entirely clear. I leave detailed examination of their theories for future research.

by $\llbracket \cdot \rrbracket_A$ and $\llbracket \cdot \rrbracket_P$, where $\llbracket \alpha \rrbracket_A^{w,g}$ is the assertive meaning of expression α and $\llbracket \alpha \rrbracket_P^{w,g}$ is its presupposition with respect to w and g . Thus for (194), the two meanings look like the following.

- (195) a. $\llbracket (194) \rrbracket_A^{w,g} \Leftrightarrow$ Rafael is a former Mac user in w
 b. $\llbracket (194) \rrbracket_P^{w,g} \Leftrightarrow$ Rafael used to use Mac in w

The following bridging principle relates the semantic presupposition to the pragmatics of presupposition.

- (196) Sentence S uttered with respect to context set C and assignment function g is felicitous only if for all $w \in C$, $\llbracket S \rrbracket_P^{w,g} = 1$.

This captures the pragmatic presupposition of (194) that a felicitous use of it requires an agreement among the discourse participants that Rafael used to use Mac.

An attractive feature of Karttunen & Peters's (1979) theory is that it provides a way to arrive at such two dimensional sentential meanings in a compositional fashion. In order to do so, they assume that not only sentences but every phrase is associated with two meanings, $\llbracket \alpha \rrbracket_P^{w,g}$ and $\llbracket \alpha \rrbracket_A^{w,g}$. I will use the notation $\llbracket \alpha \rrbracket^{w,g} := \langle \llbracket \alpha \rrbracket_P^{w,g}, \llbracket \alpha \rrbracket_A^{w,g} \rangle$ for convenience. The two denotations in (195) are decomposed into the meanings of its parts as in (197).

- (197) a. $\llbracket (194) \rrbracket_A^{w,g} \Leftrightarrow \llbracket \text{stopped using Mac} \rrbracket_A^{w,g}(\llbracket \text{Rafael} \rrbracket_A^{w,g})$
 b. $\llbracket (194) \rrbracket_P^{w,g} \Leftrightarrow \llbracket \text{stopped using Mac} \rrbracket_P^{w,g}(\llbracket \text{Rafael} \rrbracket_A^{w,g}) \wedge \llbracket \text{stopped using Mac} \rrbracket_H^{w,g}(\llbracket \text{Rafael} \rrbracket_P^{w,g})$

The assertive meaning in (197a) is straightforward, while the presuppositional meaning (197b) needs some explanation. $\llbracket \text{stopped using Mac} \rrbracket_P^{w,g}$ is the presupposition triggered by the predicate *stopped using Mac*, i.e. $\lambda x. x$ used to use Mac in w . In order to get the presupposition that Rafael used to use Mac, this function should be applied to the assertive meaning of *Rafael*, rather than its presupposition. This is what is going on in the first conjunct of (197b). Additionally, the second conjunct of (197b) determines how the presuppositions of the argument expression *Rafael*, if any, are going to look like in the entire sentence, which in this case should be simply passed on. For example, if one believes that *Rafael* presupposes that its referent is male, this presupposition should be part of the presuppositions of the entire sentence. Thus, the first conjunct of (197b) is the presupposition newly introduced by the predicate *stopped using Mac*, and $\llbracket \text{stopped using Mac} \rrbracket_H$ in the second conjunct specifies the projection property of this predicate with respect to its argument.

More generally, in order to analyze the meaning of a given expression α one needs to specify three things: (i) the assertive meaning $\llbracket \alpha \rrbracket_A$, (ii) the presupposition it triggers $\llbracket \alpha \rrbracket_P$, and (iii) its projection property $\llbracket \alpha \rrbracket_H$. Let us now look at how this theory copes with the problem of presupposition projection.

4.4.1 Sentential Operators

Under Karttunen & Peters's (1979) theory, the projection problem of presuppositions boils down to the problem of specifying $\llbracket \cdot \rrbracket_H$ for the relevant operators. For example, the lexical entry for the sentential *but* can be analyzed as (198). For the sake of simplicity, I assume that *but* itself does not introduce any presuppositions.

- (198) a. $\llbracket S_1 \text{ but } S_2 \rrbracket_A^{w,g} \Leftrightarrow \llbracket S_1 \rrbracket_A^{w,g} \wedge \llbracket S_2 \rrbracket_A^{w,g}$
 b. $\llbracket S_1 \text{ but } S_2 \rrbracket_P^{w,g} \Leftrightarrow \llbracket \text{but} \rrbracket_H^{w,g}(\llbracket S_1 \rrbracket^{w,g}, \llbracket S_2 \rrbracket^{w,g}) \Leftrightarrow \llbracket S_1 \rrbracket_P^{w,g} \wedge (\llbracket S_1 \rrbracket_A^{w,g} \rightarrow \llbracket S_2 \rrbracket_P^{w,g})$

This analysis correctly predicts that the presuppositions of *stop* does not survive in the following sentence.

- (199) Sam and Rafael used to have a MacBook, but Rafael stopped using Mac.

Specifically, the presuppositions of (199) are predicted to be the presuppositions of the first conjunct *Sam and Rafael used to have a MacBook* conjoined with the implication if Sam and Rafael used to have a MacBook, then Rafael used to use Mac, which is a tautology. Therefore, the sentence as a whole does not have any non-trivial presupposition.

Other sentential connectives can be dealt with in a similar way. Assuming that *if* is a material implication,⁶⁵ the following lexical entry captures the projection properties of *if*. Again I assume for simplicity's sake that *if* itself does not introduce any new presupposition.

- (200) a. $\llbracket \text{if } S_1, \text{ then } S_2 \rrbracket_A^{w,g} \Leftrightarrow \llbracket S_1 \rrbracket_A^{w,g} \rightarrow \llbracket S_2 \rrbracket_A^{w,g}$
 b. $\llbracket \text{if } S_1, \text{ then } S_2 \rrbracket_P^{w,g} \Leftrightarrow \llbracket S_1 \rrbracket_P^{w,g} \wedge (\llbracket S_1 \rrbracket_A^{w,g} \rightarrow \llbracket S_2 \rrbracket_P^{w,g})$

Focusing on the presuppositional component, '*if* S_1 , *then* S_2 ' is predicted to inherit the presuppositions of S_1 and the part of presuppositions of S_2 that is not entailed by the assertive meaning of S_1 . For instance, the following sentence is predicted to lack a non-trivial presupposition, which is intuitively correct.⁶⁶

- (201) If Sam and Rafael both had a Macbook before, then Rafael stopped using Mac.

Other sentential operators can be given a case-by-case treatment under this theory. See Karttunen & Peters (1979) for disjunction and attitude predicates.

4.4.2 Quantificational Sentences and the Binding Problem

Karttunen & Peters (1979) themselves do not discuss the projection properties of quantificational sentences in detail, but their framework is general enough to accommodate them. Assuming that universally quantified sentences are associated with universal presuppositions (see Section 4.2), the following meaning for *every student* suggests itself.

⁶⁵This is obviously oversimplification, which presumably nobody endorses, but it does not harm the discussion here. That is, since the projection behavior and the truth-conditional aspect of *if* are basically independent from each other under this theory, any meaning of *if* can be substituted here without affecting the presuppositions. Importantly, this illustrates the unsatisfactory feature of this theory that later researchers have pointed out: it is merely describing the projection property of the connectives rather than explaining it. We will come back to this point in Section 5.7.1.

⁶⁶As Karttunen & Peters (1979) themselves acknowledge, this analysis leads to the well-known problem that the predicted presuppositions are too weak in most cases of conditionals. For example, (i) suggests that Rafael used to use Mac, rather than that if he is using Ubuntu, he used to. But the latter is what the theory predicts.

- (i) If Rafael is using Ubuntu now, then he stopped using Mac.

This problem was dubbed the *proviso problem* by Geurts (1999), and has been extensively discussed in the recent literature on presupposition projection (Pérez-Carballo 2009, Schlenker 2011a,b, Singh 2007, 2008, van Rooij 2007). This dissertation has nothing to add to this debate.

- (202) Every student stopped using Mac.
- a. $\llbracket (202) \rrbracket_A^{w,g} \Leftrightarrow$ for each student x , x is a former Mac user in w
 - b. $\llbracket (202) \rrbracket_P^{w,g} \Leftrightarrow$ for each student x , x used to use Mac in w

This seems to be a reasonable meaning.

Let us now consider an existentially quantified sentence. Assuming that they have existential presuppositions, the following meaning for *a student* naturally comes to mind.

- (203) A student stopped using Mac.
- a. $\llbracket (203) \rrbracket_A^{w,g} \Leftrightarrow$ for some student x , x is a former Mac user in w
 - b. $\llbracket (203) \rrbracket_P^{w,g} \Leftrightarrow$ for some student x , x used to use Mac in w

This analysis captures that a felicitous use of the sentence *A student stopped using Mac* requires it to be common assumption that there is at least one student who was using Mac.

However this meaning of *a student* causes an empirical problem when the two dimensions of meaning do not stand in an entailment relation, as Karttunen & Peters (1979) themselves point out (see also Cooper 1983, van der Sandt 1992, Krahmer 1998, Beaver 2001, Dekker 2008, van Rooij 2005, 2010). Notice that in (203), the assertive meaning entails the presuppositional meaning, which turns out to be necessary to account for existentially quantified sentences under this theory. However, the entailment relation does not always hold, as we saw in the preceding sections. For instance, with *criticized herself*, the presupposition is not going to be entailed by the assertive meaning.⁶⁷

- (204) A student criticized herself.
- a. $\llbracket (204) \rrbracket_A^{w,g} \Leftrightarrow$ for some student x , x criticized x in w
 - b. $\llbracket (204) \rrbracket_P^{w,g} \Leftrightarrow$ for some student x , x is female in w

This presupposition is evidently too weak, as it can be satisfied by any female student, and does not require the student who criticized themselves to be female.

This problem, dubbed the *binding problem*, arises with any predicate that does not have an assertive meaning that entails the presuppositional meaning, so even the negation of *stopped using Mac* gives rise to the same problem. Specifically, with the uncontroversial assumption that negation passes up the presupposition, *A student didn't stop using Mac* would be given the following analysis.

- (205) A student didn't stop using Mac.
- a. $\llbracket (205) \rrbracket_A^{w,g} \Leftrightarrow$ for some student x , x isn't a former Mac user in w
 - b. $\llbracket (205) \rrbracket_P^{w,g} \Leftrightarrow$ for some student x , x used to use Mac in w

The presupposition (205b) is satisfied by anybody who was using Mac, even by somebody who is still using it, and the assertion (205a) can be satisfied by something who never used Mac before. Again this is much weaker than what the sentence intuitively means.

Karttunen & Peters (1979) characterize the binding problem as a general problem of any two dimensional theory, in the following quote (see Cooper 1983 and van der Sandt

⁶⁷Karttunen & Peters (1979) illustrate the problem with *manage*, but as pointed out in Section 4.1.4, it seems to trigger a generic inference, unlike the presuppositions of *stop* and gender presuppositions, which potentially masks the problem. See fn.54.

1992 for a similar remark). Note that they call what we call presuppositions, conventional implicatures.

While the problem of giving a correct account of the conventional implicatures of sentences containing expressions with indefinite reference (including indefinite reference by past or future tenses) is quite a challenging one, it is not peculiar to the formal framework we present here for describing those implicatures. Instead the problem arises directly from the decision to separate what is communicated in uttering a sentence into two propositions. In particular, it exists in connection with the notion of conversational implicature and also with any theory of presupposition that separates these from truth conditions (i.e. does not treat them simply as conditions for having a determinate truth value).

As we concluded above, however, the two dimensions of meaning should be represented separately, as Karttunen & Peters's (1979) propose, and hence what we need is a solution to the binding problem. In the next section, contrary to Karttunen and Peters' negative remark, I will propose a solution, which, I will argue, makes desirable predictions for presuppositions of quantified sentences.

5 Anaphoric Presuppositions and a Uniform Treatment of Presuppositions in Quantified Sentences

5.1 Idea in a Nutshell

In this section I propose a solution to the binding problem. Recall that the gist of the problem is that when the two dimensions of meaning are both existentially quantified, they can be about two distinct individuals. My solution to this problem is to treat the presupposition of a quantified sentence as non-quantificational, and anaphoric to the assertive meaning.⁶⁸ The rough idea is illustrated by the following example.

- (206) [[A student criticized herself]]^{w,g}
- a. **Assertive meaning:** there is a student x such that x criticized x in w
 - b. **Presupposition** x is female in w

The presupposition here is not quantificational and involves an anaphoric subject x , which is a free variable resolved to the student who criticized herself mentioned in the assertive meaning. As a consequence, the assertion and presupposition are about the same individual, as needed. Notice that the resulting presupposition is 'non-universal' in the sense that only the student who criticized herself is presupposed to be female, which is what we want in this case.

How does this interpretation come about? In particular, what does it mean for a presupposition to be anaphoric to the assertion? In what follows, I will illustrate how such presuppositions containing anaphoric elements are evaluated in a small fragment using the simple example (206) above. Then in the subsequent section, I will extend the analysis to

⁶⁸Beaver (2001) points out that the binding problem does not arise as long as the overall assertive meaning entails the presupposition, as we saw above in (203). Karttunen & Peters's (1979) system is flexible enough to devise an analysis of quantificational determiners that necessarily result in an assertive meaning that entails the presupposition. Although such a theory would circumvent the binding problem, it would be just describing the projection properties of the determiners. By contrast, as I will show in the next section, the analysis put forward here makes testable predictions that are borne out.

other quantificational determiners, and show that their projection properties nicely fall out from the assumption that their presuppositions are anaphoric to their assertive meanings in the same manner.

5.2 Cross-sentential Anaphora and Presupposition

Essentially, the anaphoric relation between the assertion and presupposition that I propose for quantificational sentences is that of cross-sentential anaphora with a quantificational antecedent. Cross-sentential anaphora involving quantificational antecedents has been extensively studied in the literature, and I will borrow technical machinery from previous studies for the purposes of formalization.

Approaches to cross-sentential anaphora can be broadly classified into two kinds: D/E-type pronoun approaches (Evans 1980, Heim 1990, Elbourne 2005) and dynamic semantics (Heim 1982, Kamp 1981, Groenendijk & Stokhof 1990, 1991a, Kamp & Reyle 1993, van den Berg 1996, Nouwen 2003a,b, 2007b, Brasoveanu 2007, 2010). Since the latter offers a rigorous treatment of plural inter-sentential anaphora, and quantificational dependency that will be useful in dealing with presuppositions of sentences containing various types of quantificational expression, I will use a version of dynamic semantics as my metalanguage. However, the choice here is arbitrary, and it is simply left open how the same idea can be formalized with D/E-type pronouns.

5.2.1 Dynamic Predicate Logic

A principled account of singular cross-sentential anaphora with an existential antecedent is one of the earliest achievements of dynamic semantics. The phenomenon is exemplified by (207).

(207) A student is singing. He is loud.

The intended referent of the pronoun *he* here is the student mentioned in the first sentence. The meaning of this sequence of sentences is paraphrased by a single sentence in (208).

(208) A student is singing and is loud.

Thus, semantically it seems that *he* in the second sentence of (207) is bound by the quantifier *a student*. However, there is a crucial syntactic difference between (207) and (208), namely, in (207), there is no way that *a student* is syntactically taking scope over *he* under the standard assumptions about quantifier scope and sentence structures. Dynamic semantics offers a way to construe the sequence of sentences in (207) in such a way that it results in the same meaning as the single sentence (208), capturing an anaphoric relation between the pronoun *he* and its antecedent *a student*.

Several different formalizations of dynamic semantics that are capable of cross-sentential anaphora like (207) are available in the literature. Here, I will use Groenendijk & Stokhof's (1991a) Dynamic Predicate Logic (DPL), as its syntax is fairly simple, i.e. DPL has the same syntax as the standard Predicate Logic (PL). The mini-discourse (208) is assigned the following DPL sentence.⁶⁹

(209) $\exists x[\mathbf{student}(x) \wedge \mathbf{singing}(x)] \wedge \mathbf{loud}(x)$

⁶⁹We are not concerned here with subsentential compositionality, and simply assume that the English sentence in (207) is somehow mapped to (209). See Section 5.6.2.

In PL, the last occurrence of the variable x is not bound by $\exists x$ and consequently interpreted as a free variable. On the other hand, the semantics for DPL is devised so that all occurrences of x in (209) will be semantically dependent on $\exists x$. Here is the detail. DPL sentences are interpreted with respect to a first-order model $M = \langle D, W, I \rangle$ where D is a non-empty set of individuals, W is a non-empty set of possible worlds such that $W \cap D = \emptyset$, and I_w is an interpretation function relative to a possible world $w \in W$.⁷⁰ Crucially, unlike in PL, each DPL sentence is interpreted as a relation between pairs $\langle f, w \rangle$ of an assignment function f and a possible world w . More specifically, the expressions that appear in (209) are interpreted in the following manner. Here, I use the infix notation where $\langle f, w \rangle \llbracket \phi \rrbracket \langle g, v \rangle$ means $\langle \langle f, w \rangle, \langle g, v \rangle \rangle \in \llbracket \phi \rrbracket$.

Definition 1 DPL Semantics

$$\begin{aligned} \langle f, w \rangle \llbracket \exists x[\phi] \rrbracket \langle g, v \rangle &\Leftrightarrow \exists h[\forall y \neq x[f(y) = h(y)] \text{ and } \langle h, w \rangle \llbracket \phi \rrbracket \langle g, v \rangle] \\ \langle f, w \rangle \llbracket P(x_1, \dots, x_n) \rrbracket \langle g, v \rangle &\Leftrightarrow w = v \text{ and } f = g \text{ and } \langle f(x_1), \dots, f(x_n) \rangle \in I_w(P) \\ \langle f, w \rangle \llbracket \phi \wedge \psi \rrbracket \langle g, v \rangle &\Leftrightarrow \exists h \exists u[\langle f, w \rangle \llbracket \phi \rrbracket \langle h, u \rangle \llbracket \psi \rrbracket \langle g, v \rangle] \end{aligned}$$

According to this semantics the so-called ‘donkey equivalence’ holds: $\exists x[\phi] \wedge \psi$ is semantically equivalent to $\exists x[\phi \wedge \psi]$.⁷¹ As a consequence, all the occurrences of x are dependent on $\exists x$ in (209), capturing the intended meaning.⁷² I will make use of this mechanism to enable an anaphoric link between the assertion and the presupposition.

5.2.2 Update Rule

In our limited fragment here, each English sentence S is assigned a pair of DPL sentences as its meaning. Let us call these two DPL sentences $\tau(S)$ and $\pi(S)$, which represent the assertive meaning and presupposition of S , respectively. To be more concrete, let us analyze the following sentence involving a gender presupposition.

- (210) A student criticized herself.
 a. $\tau(210)$: $\exists x[\text{criticized}(x, x)]$
 b. $\pi(210)$: **female**(x)

Crucially, the same variable x is used in both dimensions, which I assume is ensured in syntax (see Section 5.6.2).

⁷⁰ Although Groenendijk & Stokhof’s (1991a) original formulation is extensional and DPL formulas are interpreted as relations between assignments, we will include possible worlds as well, as presuppositions are essentially intensional phenomena (cf. Heim 1982, 1983).

⁷¹ Proof:

$$\begin{aligned} &\langle f, w \rangle \llbracket \exists x[\phi] \wedge \psi \rrbracket \langle g, v \rangle \\ \Leftrightarrow &\text{ There is } \langle h, u \rangle \text{ such that } \langle f, w \rangle \llbracket \exists x[\phi] \rrbracket \langle h, u \rangle \llbracket \psi \rrbracket \langle g, v \rangle \\ \Leftrightarrow &\text{ There is } f' \text{ such that for all } y \neq x, f(y) = f'(y), \text{ and there is } \langle h, u \rangle \text{ such that } \langle f', w \rangle \llbracket \phi \rrbracket \langle h, u \rangle \llbracket \psi \rrbracket \langle g, v \rangle \\ \Leftrightarrow &\text{ There is } f' \text{ such that for all } y \neq x, f(y) = f'(y), \text{ and } \langle f', w \rangle \llbracket \phi \wedge \psi \rrbracket \langle g, v \rangle \\ \Leftrightarrow &\langle f, w \rangle \llbracket \exists x[\phi \wedge \psi] \rrbracket \langle g, v \rangle \end{aligned}$$

⁷² A corollary of this is that there is no need to assign a scope to an existential quantifier, and $\exists x$ can be thought of as a sentence (random assignment): $\langle f, w \rangle \llbracket \exists x \rrbracket \langle g, v \rangle \Leftrightarrow w = v \text{ and } \forall y \neq x[f(y) = g(y)]$.

Following Heim (1982, 1983) among others, I assume that a conversational context is modeled as a set C of pairs $\langle f, w \rangle$ of an assignment function and a possible world. What is new in the present system is that the update by the assertive meaning is performed *before* the presupposition is processed. As a consequence, the presupposition will be able to refer to the anaphoric information of the updated context.

More precisely, the update of a context C with a sentence ϕ proceeds as follows. I use the following notations: $C^L = \{f : \exists w[\langle f, w \rangle \in C]\}$ and $C^R = \{w : \exists f[\langle f, w \rangle \in C]\}$.

Definition 2 2D Update

1. Update C with $\tau(\phi)$ distributively
 $C' = \{\langle f', w' \rangle : \exists \langle f, w \rangle \in C[\langle f, w \rangle[\tau(\phi)]\langle f', w' \rangle]\}$
2. Check if there's any updated assignment f' that satisfies $\pi(\phi)$ with all the worlds of C^R :
 - return $C'' = \{\langle f', w' \rangle \in C' : \forall w \in C^R[\langle f', w \rangle[\pi(\phi)]\langle f', w \rangle]\}$
if there is $f' \in C'^L$ such that for all $w \in C^R$, $\langle f', w \rangle[\pi(\phi)]\langle f', w \rangle$
 - presupposition failure otherwise

The context is updated with the assertive meaning first, and then the presupposition is checked with assignment functions $f' \in C'^L$. Crucially each $f' \in C'^L$ carries the anaphoric information of the assertive meaning. The presuppositions are evaluated against all the worlds C^R of the original context C , which captures the pragmatic status of presuppositions, i.e. they need to be already part of the common ground when the sentence is asserted. If the context C satisfies the presupposition, then the update of the context is finally performed, returning C'' , which is a subset of C' where the presupposition is true. Notice that $C'' = C'$ whenever the assertion entails the presupposition, while $C'' \subset C'$ can be true when the entailment does not hold (although $C'' = C'$ can accidentally be true).

Let us consider the sentence in (210) for an illustration. Let C be the initial context, before the utterance of (210), and assume that it is not known whether any students criticized themselves in C so that the assertion is informative.⁷³ That is, in some of the worlds in C^R , some students (some of them being female) criticized themselves, and in others none did. After the update with the assertive meaning (210a), the pairs $\langle f, w \rangle$ where no students criticized themselves in w are eliminated from C . Thus, each $\langle f', w' \rangle$ of the intermediate context C' is such that $f'(x)$ is some student who criticized himself or herself in w' . Importantly, at this point, there is no constraint on the gender, so there might be some f' such that $f'(x)$ is a male student. Now using these assignment functions f' , we check whether $f'(x)$ satisfies the gender presupposition with respect to all the worlds of the original context C . The gender presupposition here amounts to the requirement that $f'(x)$ is known to be female in C . Assuming that some female students are known to be female, and in some worlds of C' a female student criticized herself, there must be such an assignment function f' . In the final output context C'' , we discard those pairs $\langle f', w' \rangle$ of C' where f' assigns

⁷³When it is known that no students criticized themselves, or no female students criticized themselves, the assertion is infelicitous. Similarly, when it is already known that a female student criticized herself, the assertion will be under-informative and is infelicitous. I assume that these cases are excluded by independent pragmatic principles requiring the assertion to be informative relative to the current common ground. Also notice that what the actual world looks like is irrelevant for the update rule, and what matters is truth and falsity *in the discourse*, rather than truth and falsity in the actual world. This is as it should be, given that presuppositions are evaluated relative to a discourse rather than what the reality is.

x a male student. Consequently, the presupposition is effectively existential: it is required that there is at least one f' that assigns x an individual who is known to be female, and who could have criticized herself. In other words, presupposition failure arises only when it is already known that it is impossible for any female student to have criticized herself.

This illustrates how presuppositions of quantified sentences can be anaphoric to their assertive meanings. Our small fragment here can only deal with singular indefinites, but I will show in what follows that the same idea can be extended to other quantifiers. Furthermore, as I will show below, different projection properties of different quantifiers can all be accounted for using anaphoric presuppositions.

5.3 Toward a Uniform Account of Presuppositions in Quantified Sentences

The core idea of the proposal is that the assertion and presupposition of a quantified sentence stand in an anaphoric relation that is essentially analogous to cross-sentential anaphora with a quantificational antecedent. In the present section I claim that other quantifiers than singular existential quantifiers such as *a student* can also be analyzed in the same way, and moreover that the analysis makes desirable predictions. I will remain pre-theoretical here, mainly focusing on the parallelisms at an observational level between the two phenomena, presuppositions in quantified sentences, and cross-sentential anaphora with quantificational antecedents, and give a formalization in later sections.

Let us look at some concrete examples of the predicted correlation between the projection and anaphoric properties of several quantificational noun phrases. Firstly, universal quantifiers give rise to universal presuppositions from a presupposition triggered in the nuclear scope, as we saw in Section 4.2 above. According to the present analysis, the presupposition of (211) involves an anaphoric subject as in (211).

- (211) Every student criticized herself.
- a. **Assertive meaning:** Every student x criticized x
 - b. **Presupposition:** x is female

Assuming that the anaphoric term x in the presupposition is number neutral, we correctly capture the seemingly ‘universal’ projection through *every student*. That is, the anaphoric subject x in the presupposition is resolved to all of the students, as this is the only anaphoric relation that a universal quantifier licenses across sentences. More concretely, in the following sequence of sentences, cross-sentential anaphora with *every student* results in a ‘universal’ reading where *they* is interpreted as all the relevant students.

- (212) Every student criticized John. They were aggressive.

Notice also that the pronoun in the second sentence needs to be plural, and a singular pronoun would not be interpreted as co-varying with *every student*. The same holds for other forms of universal quantifiers such as *all of the students* and *each of the students*. This makes sense given that the cross-sentential anaphora needs to be resolved to the plurality consisting of all the students.

Similarly, *no student* is correctly predicted to give rise to a universal presupposition, as cross-sentential anaphora involving *no student* as the antecedent results in reference to the set of all individuals who satisfy the restrictor, i.e. the relevant students in this case. From now on, let us call anaphora to the set of individuals in the restrictor denotation *restrictor*

anaphora. More concretely, as we saw in Section 3.3, the sentences like (213) presuppose that every student is female (modulo local accommodation; cf. fn.48).

- (213) a. No student criticized herself.
b. None of the students criticized herself.

Correspondingly, cross-sentential anaphora with *no* or *none* only supports restrictor anaphora, and results in a universal reading (Kamp & Reyle 1993, Nouwen 2003a,b, 2007a,b). In the following examples, for instance, *they* in the second sentence is resolved to all the relevant students.

- (214) a. No student criticized John. They are not smart enough.
b. None of the students criticized John. They are not smart enough.

As in the previous case with a universal quantifier, a singular pronouns in the same position would simply be unable to receive a bound pronoun reading. This makes sense, given that the restrictor contains more than one individual.

Let us now turn to non-universal presuppositions. One example of such a case is *a NP*, and as demonstrated in the previous section, the analysis proposed here predicts an existential presupposition that at least one student is female. For example, (215) does not require that every student is female.

- (215) A student criticized herself.

This is expected, as cross-sentential anaphora with an antecedent of the form *a NP* refers to the individual that satisfies both the restrictor and the nuclear scope, which I will call *nuclear scope anaphora*. Consider the following example.

- (216) A student criticized John.
a. He was aggressive.
b. #They are not so smart.

He is felicitous and refers back to the student who criticized John. On the other hand, restrictor anaphora is impossible even with a plural pronoun *they*.⁷⁴

To summarize the predictions of the proposed theory, those quantifiers that support restrictor anaphora cross-sententially give rise to universal presuppositions, and those that support nuclear scope anaphora cross-sententially give rise to non-universal presuppositions. So far, we have only seen those quantifiers that only have, or at least strongly prefer, one of these possibilities, but there are quantifiers that are ambiguous. For example, as discussed in Section 3.3, partitive existential quantifiers like *some of the NP* generally can have an inference weaker than a universal inference, but also can have a universal inference. For example, the following sentences have a universal presupposition more robustly than a non-partitive sentence with *a NP* like (215).

- (217) a. Some of the students stopped smoking.

⁷⁴Unsurprisingly, when the relevant students are salient enough, e.g. they were mentioned in a prior discourse, *they* can refer to them. What is important is the anaphoric property of the sentence (216) itself, and anaphora licensed by something else needs to be disregarded. That said, it is perhaps practically impossible to imagine a completely neutral context in this regard, as there are always some assumptions that need to be made to make sense of a sentence, but the judgments should be assessed with contexts that are as neutral as possible in mind.

- b. One of the students stopped smoking.
- c. At least three of the students stopped smoking.
- d. At most five of the students stopped smoking.

As expected, in the case of cross-sentential anaphora, these quantifiers seem to support restrictor anaphora, as well as nuclear scope anaphora. For example, as shown in (218), both nuclear scope anaphora (218a) and restrictor anaphora (218b) are possible, which in this case are distinguished by the number specification of the pronoun.⁷⁵ Compare this to (216), where only nuclear scope anaphora is licensed.

- (218) One of the students criticized Mary.
- a. He is not so smart. (NUCLEAR SCOPE ANAPHORA)
 - b. They are not so smart. (RESTRICTOR ANAPHORA)

The underlying idea is that these quantifiers express a relation between two (sets of) individuals, namely the restrictor individuals and the nuclear scope individuals, and the anaphora can be resolved to either of these.

Additionally, other non-existential partitive quantifiers also result in ambiguous presuppositions (cf. Chemla 2009a).

- (219) a. Most of the students stopped smoking.
 b. Few of the students stopped smoking.
 c. Many of the students stopped smoking.
 d. Less than 30% of the students stopped smoking.

Again, as expected, these quantifiers support both types of cross-sentential anaphora. Here is a case of *most NP*.

- (220) Most of the students criticized John. They are not so smart.
- a. They = all the students (NUCLEAR SCOPE ANAPHORA)
 - b. They = the students who criticized John (RESTRICTOR ANAPHORA)

It is a possibility that other non-partitive existential quantifiers like *one NP*, *at least three NPs*, etc. prefer non-universal presuppositions and correspondingly nuclear scope anaphora cross-sententially, just like *a NP*, but the judgments should ultimately be assessed quantitatively in controlled experiments, which I leave for future research. I would like to mention, however, that it is a desirable feature of the proposed analysis that it makes predictions regarding the subtle differences among existential quantifiers, including *a NP* vs. *some of the NPs*.

Also potentially testable is the relevance of monotonicity. Schlenker (2008:200) remarks: “Although [Chemla’s (2009a)] data do not show any clear contrasts between *at least three* and *at most three*, introspective judgments (which remain to be confirmed) suggest that for some triggers the monotonicity of the quantifier affects the pattern of projection: universal inferences appear to be more easily obtained from the scope of negative than from the scope of non-negative quantifiers.” If his intuition is correct, what is expected under my account is that restrictor anaphora is relatively more frequent with negative quantifiers than with positive quantifiers. Verification of this prediction requires quantitative data, as Schlenker suggests in this quote, and is left for future research.

⁷⁵The so-called ‘singular *they*’ is ignored here. See Section 12.1.5.

5.4 Some Complications

We have seen above the basic cases where the correlation between presupposition projection and cross-sentential anaphora nicely holds. However, there are several places where the parallelism breaks down, three of which I will discuss below. Importantly, they are merely complications essentially stemming from the pragmatic flexibility of pronominal anaphora, and do not undermine the proposed analysis of presupposition projection. Specifically, they are all cases where cross-sentential anaphora involves some extra discourse move which I claim is not licensed in the case of presupposition resolution, since the relation between the assertive meaning and the presupposition of a single sentence is not completely identical to the relation between two independent sentences in a discourse. In particular, in the latter case, several additional pragmatic inferences can be drawn in processing the second sentence after the first sentence is processed, which give rise to more possibilities for anaphora resolution.

5.4.1 Complement Anaphora

Some sentences with negative determiners such as *few* are known to allow so-called *complement anaphora* cross-sententially, where a pronoun in the second sentence is resolved to the individuals in the restrictor who do *not* satisfy the nuclear scope. This is illustrated by the following examples, where *they* can be read as the students who did not show up.

- (221) a. Few students showed up today. They were all sick.
b. Only one student showed up today. They were all sick.

On the other hand, presuppositions can never be about the complement of the nuclear scope. More concretely, (222) cannot be read as presupposing that those that did not criticized themselves are female.

- (222) Only one of the students criticized herself.

Thus the parallelism between inter-sentential anaphora and presupposition that is predicted by my theory seems to fail here. However, I claim that this is not necessarily a problem, given that complement anaphora requires a extra pragmatic mechanism. Specifically, Nouwen (2003a,b) claims that complement anaphora involves a mechanism that amounts to inferring a possible salient antecedent that is similar in nature to what is going on in the following example (see also Hardt 2004).

- (223) John kept on staring at the newly-wed couple. She resembled a childhood sweetheart of his. (Nouwen 2003a:105)

The antecedents of the pronouns in the second sentence here, *she* and *his*, are not explicitly mentioned anywhere, but they are inferable from the first sentence, i.e. the bride and the groom, respectively. Nouwen (2003a,b) extensively argues that complement anaphora involves such an inference process as well, and when an appropriate inference is not available, it is not licensed.

Adopting Nouwen's analysis of complement anaphora, I suggest that an inference that gives rise to a possible antecedent for complement anaphora is inherently unavailable in the case of presupposition resolution. To wit, the relation between the assertion and presupposition is not that of a real discourse, and no extra pragmatic inference that would license

complement anaphora is allowed there.

5.4.2 Projection out of Questions

Presuppositions of *wh*-questions are not well discussed in the previous literature (but see Chemla 2009a, Fox 2010, Schlenker 2009), but the proposed analysis can be straightforwardly extended to projection through *wh*-phrases, since *wh*-phrases can be seen as quantificational noun phrases. However, there is a complication concerning the corresponding cross-sentential anaphora that is worth discussing here.

Firstly, it seems that *wh*-phrases generally give rise to universal presuppositions. For instance, all of (224), asked in a neutral context, presuppose that all the relevant people are female.

- (224) a. Which student criticized herself?
b. Which of the students criticized herself?
c. Who criticized herself?

What does my analysis predict for such cases? It is uncontroversial that presuppositions project out of questions in general (cf. Beaver 2001). For example, the factive presupposition triggered by *realize* projects out in both *wh*- and polar questions. Thus, all of the following examples presuppose that it was raining.

- (225) a. John realized that it was raining.
b. Who realized that it was raining?
c. Did John realize that it was raining?

According to the analysis put forward here, therefore, the presupposition of the questions in (224) is that *x* is female, and what *x* can be resolved to depends on the anaphoric properties of the quantifier in the assertive meaning. What are the anaphoric properties of *wh*-phrases?

Cross-sentential anaphora involving *wh*-antecedents are not well discussed in the literature, but there seem to be cases of nuclear scope anaphora with *wh*-antecedents. For example, the plural pronouns in the second sentences of (226) can be interpreted as the students who smoke/criticized John.

- (226) a. Which students smoke? I will go smoke with them.
b. Which students criticized John? They must have been aggressive.

If nuclear scope anaphora is available, our theory make wrong predictions that the sentences in (225) can have non-universal inferences.

Notice importantly that *wh*-questions are generally associated with an existential inference that there are some individuals who satisfy both the restrictor and the nuclear scope. In (226a), for example, one can infer that the questioner assumes or at least considers it fairly likely that there are some smokers among the students. Then it is conceivable that the pronoun is resolved to these students mentioned in the existential inference. Although this inference is sometimes considered to be a presupposition (Belnap 1969, Dayal 1996, Rullmann & Beck 1998, Lahiri 2002), there is good reason to doubt that it is part of the conventional meaning of a *wh*-question. For example, it is cancelable as demonstrated by (227).

- (227) Which students smoked after the talk? Was there any of them?

Here the existence inference should be in conflict with the second question. That is, with a question that does have the same existence inference as a genuine presupposition results in infelicity, as demonstrated by (228).

(228) Who knows that some students smoked after the talk? #Was there any of them?

Also, one can easily answer a *wh*-question with *no NP*, which would amount to the denial of the inference.

(229) A: Which students smoked after the talk?
B: None of them did.

Although presuppositions can be denied, the denial in (229B) seems to have a different pragmatic status from a typical denial of a presupposition which is exemplified by (230).

(230) A: Mary knows that some students smoked after the talk.
B: No, that can't be right, because none of them did.

Thus, I think it is reasonable to consider that the existence inference of a *wh*-question is a pragmatic inference of some sort, rather than a presuppositional inference. I further assume that nuclear scope anaphora in (226) is mediated by this pragmatic inference. More concretely, they can be paraphrased by (231).

(231) a. I assume that there are some students who smoke. Which ones are they? I will go smoke with them.
b. I assume that there are some students who criticized John. Which ones are they? They must have been aggressive.

Although I leave open exactly how these inferences are generated, but for my purposes here, what is crucial is the assumption that this pragmatic inference is an inference of a sort that is unavailable between the assertion and presupposition. Assuming that nuclear scope anaphora is unavailable otherwise, therefore, the only available antecedent for the anaphoric presupposition in a *wh*-question is the set of individuals who satisfy the restrictor. Thus, (224) are all associated with universal inferences.

A similar remark applies to polar questions with existential quantifiers. Sudo, Romoli, Hackl & Fox (2011) provide experimental evidence suggesting that sentences of the following sort give rise to universal inferences.

(232) Did any of the students criticize herself?

Again, nuclear scope anaphora seems to be available in the case of cross-sentential anaphora.

(233) Do any of the students smoke? I will go smoke with them.

However, the nuclear scope anaphora reading of (233) seems to involve an extra existential inference, just as in the case of *wh*-questions. An intuitive paraphrase of (233) involves an implicit conditional with a *yes* answer, as in (234).

(234) Did any of the students smoke? If yes, I will go smoke with them.

I cannot offer a detailed analysis of such pragmatic inferences here, but it is sufficient for our

purposes here to assume that the relevant pragmatic mechanism is not available in the case of presupposition resolution. As a result, on the assumption that nuclear scope anaphora is unavailable otherwise, the only possible antecedent for the anaphoric presupposition in (232) is the restrictor set, which results in a universal inference.

5.4.3 Projection out of Conditional Antecedents

Lastly, let us consider cases where a quantificational sentence is embedded in the antecedent of a conditional. When an existential sentence appears in a conditional antecedent, a universal presupposition obtains, as exemplified by (235). I use the quantifier *any of the NP* to force the narrow scope reading with respect to *if*.

- (235) a. If any of the students criticizes herself, I will be surprised.
b. If any of the students stop smoking, I will be surprised.

Just as in the case of questions, it is widely observed that *if* passes up the presuppositions of the embedded clause. According to the analysis put forward here, the presupposition of these sentences contain an anaphoric element that needs to be resolved, i.e. *x* is female and *x* used to smoke, respectively, and since what is observed is a universal presupposition, restrictor anaphora should be the only option for cross-sentential anaphora in the same configuration.

However, contrary to this expectation, nuclear scope anaphora is possible in sentences like (236).

- (236) If any of the students show up, let me know. They will get their homework back.

Here, *they* can be read as referring to the students who show up. Such anaphora is called modal subordination and extensively studied in the literature (for example, see Roberts 1989, Kadmon 2001, Brasoveanu 2007). Although I will not go into the details here, modal subordination arguably involves some extra pragmatic inference. In fact nuclear scope anaphora is not freely possible in this configuration, and (237), for example, only has a restrictor anaphora reading.⁷⁶

- (237) If any of the students show up, let me know. They have been absent lately.

Thus, existential sentences embedded in *if*-conditionals only support nuclear scope anaphora in special contexts where modal subordination is possible. Again, assuming that whatever licenses modal subordination is not available between the assertion and presupposition, the only available antecedent for the anaphoric presupposition in (235) is the restrictor individuals. Consequently a universal inference is predicted.

5.5 Additional Data

5.5.1 Projection out of Restrictor

The analysis proposed above can straightforwardly extended to cover presuppositions triggered in the restrictors of quantificational determiners. Generally, a presupposition triggered in the restrictor of a quantificational determiner results in a weak inference, regardless of what the quantificational determiner is, unlike in the case of presuppositions triggered in

⁷⁶I thank Irene Heim (p.c.) for the example.

the nuclear scope (Beaver 1994, 2001, George 2008a, Chemla 2009a). I claim that this is because an individual or individuals satisfying the restrictor of a quantificational determiner are always anaphorically accessible from the presupposition, as their existence is either already presupposed or asserted.

Let us first look at non-downward monotonic existential determiners such as (238).

- (238)
- a. Some students who stopped smoking drank.
 - b. Many students who stopped smoking drank.
 - c. Exactly five students who stopped smoking drank.
 - d. Between five and ten students who stopped smoking drank.

None of these sentences have a universal inference that all of the students used to smoke or an absurdly strong universal inference that all individuals in the universe, students or not, used to smoke. This state of affairs is expected under the proposed analysis, as these determiners are symmetric, and hence the predictions are the same before. For instance, the meaning of (238a) is analyzed as follows.

- (239)
- a. **Assertive meaning:** There are some students X who are former smokers and drank.
 - b. **Presupposition:** X used to smoke.

The free variable X in the presupposition (239b) is resolved to the existentially quantified variable X in (239a). Notice that due to the conservativity of the determiner, X is a member of the intersection of the restrictor and the nuclear scope. As a consequence, the resulting inference is weaker than universal, as expected.

Turning now to downward monotonic existential determiners, they also give rise to weak inferences, as demonstrated in (240).

- (240)
- a. Few students who stopped smoking drank.
 - b. At most five students who stopped smoking drank.
 - c. No more than five students who stopped smoking drank.

For instance, (240a) is analyzed as follows.

- (241)
- Few students who stopped smoking drank.
 - a. **Assertive meaning:** There are few students X who are former smokers and drank.
 - b. **Presupposition:** X used to smoke.

Again, X in (241b) can be resolved to X in (241a), just as the corresponding cross-sentential anaphora is licit. For example, *they* in the second sentence of (242) can be resolved to the few students who used to smoke mentioned in the first sentence.

- (242)
- Few students are former smokers. But they drink a lot.

Notice here that in (241), the assertive meaning (241a) itself does not exclude the possibility that there are no students who are former smokers and drank, but, in order for the anaphora to succeed, there must be some such students. In other words, (241) is predicted to be associated with an existential inference. This appears to be a correct prediction. That is, (241) has an existential inference more robustly than (243), which does not involve a presupposition but has a similar assertive meaning (although (243) also has an existential

inference that is due to a scalar implicature).

(243) Few students who are former smokers drank.

Also notice that (242) also has an existential inference, when *they* is resolved to the students who are former smokers. This inference becomes less robust when the second sentence is absent.

Finally, determiners like *every*, *no* and *most* presuppose the existence of the restrictor set, and the individuals talked about in the assertive meanings are guaranteed to exist. I assume that these quantifiers contain an anaphoric term that functions as their domain of quantification. Then, the presupposition triggered by *stop* is completely idle, as demonstrated below.

(244) Every student who stopped smoking drank.

- a. **Assertive meaning:** All of *X* drank.
- b. **Presupposition:** *X* are students who are former smokers, and *X* used to smoke.

(245) No student who stopped smoking drank.

- a. **Assertive meaning:** None of *X* drank.
- b. **Presupposition:** *X* are students who are former smokers, and *X* used to smoke.

(246) Most of the students who stopped smoking drank.

- a. **Assertive meaning:** Most of *X* drank.
- b. **Presupposition:** *X* are students who are former smokers, and *X* used to smoke

As a consequence, these sentences are practically synonymous with the following sentences, which is intuitively correct.

- (247)
- a. Every student who is a former smoker drank.
 - b. No student who is a former smoker drank.
 - c. Most of the students who are former smokers drank.

Interestingly, with predicates like *criticized herself* that have a presupposition that is not entailed by the assertive meaning, the resulting inferences become stronger, but the proposed account explains this as well. Consider the following examples.

(248) Every student who criticized herself was drunk.

- a. **Assertive meaning:** All of *X* were drunk.
- b. **Presupposition:** *X* are students who criticized themselves, and *X* are all female.

(249) No student who criticized herself was drunk.

- a. **Assertive meaning:** None of *X* were drunk.
- b. **Presupposition:** *X* are students who criticized themselves, and *X* are all female.

Intuitively, these sentences presuppose that the relevant students who criticized themselves are all female, which is predicted by the proposed analysis.

5.5.2 More than One Quantifier

The analysis put forward here can also be extended to more complex cases that involve more than one quantifier interacting with the same presupposition. For instance, consider the following example.

- (250) None of the boys introduced exactly one girl to both of the people that he wanted her to meet.

The intended reading is the one where *he* is bound by *none of the boys* and *her* is bound by *exactly one girl*.

Intuitively, the presupposition of this example is paraphrased by (251).

- (251) For all of the boys x , there is at least one girl y such that there are exactly two people that x wanted y to meet.

At first blush, however, the proposed analysis seems to miss the dependency between x and y here, as the predicted presuppositional meaning of (250) is simply (252), which itself does not capture how x and y are related.

- (252) There are exactly two people that x wanted y to meet.

I claim that such cases can be likened to quantificational subordination observed in cross-sentential anaphora, such as the following (Brasoveanu 2007, 2010, van den Berg 1996, Nouwen 2003b, 2007b).

- (253) Three students each wrote exactly two papers. They each sent them to L&P. (Nouwen 2003b:117)

Here, *they* denotes the three students, while *them* denotes the two papers that *each of the three students wrote*, rather than the six papers at the same time. In this sense, the denotation of *them* needs to be dependent on *they*. There are several ways to formally capture this dependency in such a way that is compatible with what is proposed above, but since it takes us too far afield, I will not give a formal analysis here (see the works cited above). However, it is clear that whatever accounts for (253) can be straightforwardly implemented in our analysis to account for the presuppositions of sentences like (250).

5.6 Some Formal Issues

5.6.1 Generalized Quantifiers in Dynamic Semantics

In Section 5.2 above, we only discussed singular indefinites in our formalization based on DPL. Since DPL, as formulated by Groenendijk & Stokhof (1991a) does not contain plural generalized quantifiers, we need to enrich the metalanguage to account for those quantificational determiners we discussed above. The main point of this subsection is primarily technical details of the formalization, and the reader who is not interested in the formal aspect of the analysis can jump to the next subsection without losing the main flow.

Generalized quantifiers have been implemented in dynamic semantics in several ways, but all of them involve non-trivial complications (van Eijck & de Vries 1992, Chierchia 1995, van den Berg 1996, Nouwen 2007a,b, Brasoveanu 2007, 2010).⁷⁷ Correspondingly, our

⁷⁷Unselective generalized quantifiers that are relations between sets of assignment functions rather than sets

metalinguage needs to be more complex than before, but the technical rigorousness is not of our central concern, and I will keep the mathematical aspect of the exposition minimal (see the works cited above). Importantly, the underlying idea stays exactly the same: A quantificational sentence introduces the restrictor and/or the nuclear scope individuals, and the anaphoric element in the presupposition refers back to them.

The core idea behind generalized quantifiers in dynamic semantics is that a determiner refers to two plural individuals in the assertive meaning, namely the individuals who satisfy the restrictor and the individuals who satisfy the nuclear scope. I assume below that plural individuals are simply sets so that the usual static semantics for quantificational determiners, some examples of which are given in (254), can be used without further ado.⁷⁸

- (254) a. **all**(X, Y) : $\Leftrightarrow X \subseteq Y$
 b. **some**(X, Y) : $\Leftrightarrow X \cap Y \neq \emptyset$
 c. **exactly.three**(X, Y) : $\Leftrightarrow |X \cap Y| = 3$

We can add these relations between sets in our metalanguage together with constants and variables for plural individuals. For instance, let us consider (255).

- (255) Exactly three of the students are former smokers.

This sentence can be given the following representation in our metalanguage enriched with plural individuals. Following van den Berg (1996) (see also Brasoveanu 2007, 2010), I will use the maximality operator **max**, which takes a predicate and returns the largest plurality of individuals who satisfy the predicate (cf. Kamp & Reyle's 1993 Σ -operator).

- (256) $\exists X \exists Y \left[\begin{array}{l} \mathbf{max}(\mathbf{students}) = X \\ \wedge (\mathbf{max}(\mathbf{former.smokers}) \cap X) = Y \\ \wedge \mathbf{exactly.three}(X, Y) \end{array} \right]$

This meaning introduces two plural individuals, X and Y with the following conditions. X needs to be the maximal set of students, rather than an arbitrary subset of it, and Y needs to be the intersection of X and the maximal set of former smokers (thus, $Y \subseteq X$, which embodies the conservativity). Then, finally, it is expressed that the intersection $X \cap Y$ —which, due to conservativity, is equivalent to Y —has exactly three members. This captures the reading of the sentence (255). Importantly, in our dynamic setting, X and Y so introduced can be referred back to in a following sentence. Other quantificational determiners can be dealt with in the same manner, by changing the last conjunct of (256), using the classical generalized quantifier meanings in (254).⁷⁹

Now consider the following sentence with a presupposition.

- (257) Exactly three of the students stopped smoking.

of individuals were available in the earlier works of dynamic semantics (Kamp 1981, Heim 1982, Groenendijk & Stokhof 1990, 1991a). However in order to account for cross-sentential anaphora, selective generalized quantification over individuals is necessary (cf. the 'proportion problem' of donkey sentences; see Heim 1990, Chierchia 1995, Brasoveanu 2007, 2010 for discussion).

⁷⁸Link (1983) presents some philosophical arguments for treating plural individuals as non-sets, but as Landman (1989a) claims, the two theories are isomorphic and their difference does not matter much for semantic analyses (see also Schwarzschild 1996, Winter 2001)

⁷⁹Also, for determiners like *all* and *no*, it is possible to analyze the restrictor X as anaphoric in the assertive meaning, as suggested in Section 5.5.1, by removing the existential quantifier $\exists X$.

The assertive meaning of this sentence is the same as (256), but additionally, it involves a presupposition. I assume that in this case, the following two presuppositions are available.

- (258) a. **used.to.smoke**(X)
 b. **used.to.smoke**(Y)

(258a) gives rise to a universal inference, since it is restrictor anaphora, while (258b) gives rise to a weaker inference, as it is nuclear scope anaphora. The variables here can be either X or Y , which I assume is guaranteed by syntax (see below). The update rule is the same as before. First, the initial context C is updated with the assertive meaning (260), yielding C' . Each $\langle f', w' \rangle \in C'$ is such that $f'(X)$ is all the students in w' and $f'(Y)$ is the three students who are former smokers in w' . When the presupposition is (258a), we check whether any such f' in C'^L satisfies the requirement that $f'(X)$ used to smoke in each world w of the original context C , that is, all the students are known to have smoked before, which is a universal inference. When the presupposition is (258b), on the other hand, there needs to be f' in C'^L such that the three particular students $f'(Y)$ are known to have smoked in the past, which amounts to an existential inference.

Let us look at some more examples.

- (259) Fewer than three of the students stopped smoking.

The assertive meaning of this sentence can be analyzed as (260), where **fewer.than.3**(X, Y) : \Leftrightarrow $|X \cap Y| < 3$, which is equivalent to $|Y| < 3$ by conservativity.

$$(260) \quad \exists X \exists Y \left[\begin{array}{l} \text{max}(\text{students}) = X \\ \wedge (\text{max}(\text{former.smokers}) \cap X) = Y \\ \wedge \text{fewer.than.3}(X, Y) \end{array} \right]$$

The presupposition is again the same as before, (258). Notice, however, that in order for the non-universal presupposition (258b) to be true, there needs to be at least students who used to smoke, which is not guaranteed by the assertive meaning. Thus, after the update with the assertive meaning, there might be some $\langle f', w' \rangle \in C'$ such that $f'(Y) = \emptyset$. However, such pairs will not survive after the presupposition (258b) is processed. Thus, the resulting context implies that there are some students who used to smoke. I believe that this is a good prediction of the proposed analysis. That is, with a presupposition, one gets an existential inference more robustly. Compare the following minimal pair, for example.

- (261) a. Fewer than three of the students are former smokers.
 b. Fewer than three of the students stopped smoking.

It appears that one infers that there are some students who were smoking more reliably from (261b) than from (261a), although the judgments are not so robust as both sentences are arguably associated with existential scalar implicature to begin with. See also Section 5.5.1.

It should be mentioned that the semantics presented here is not fine-grained enough to distinguish partitive and non-partitive quantifiers. It is a prediction, therefore, that non-partitive quantifiers like *exactly three students* are also able to give rise to a universal inference. However, at this moment, no convincing evidence is available for or against this prediction, and I would like to leave this issue open.⁸⁰

⁸⁰Given that both *no students* and *none of the students* give rise to universal inferences, it is likely that non-

5.6.2 The Role of Syntax

Up until now, I have not been explicit about how the two dimensional meanings are computed at the subsentential level. Since our metalanguage is based on a dynamic semantics, it is not possible to use the static semantics like Heim & Kratzer (1998) or Karttunen & Peters (1979). There are a number of compositional dynamic semantics, which can be used to make the above analysis compositional, for instance, Heim (1982), Groenendijk & Stokhof (1990), Muskens (1996) and Brasoveanu (2007). Here, I will somewhat informally discuss one way of giving a compositional analysis that derives two formulas in our dynamic semantics as the meaning of a given sentence.

The idea is to map the object language to a formal language, which is an extension of DPL, and which functions as an intermediate language, is in turn given a dynamic interpretation (Muskens 1996). Thus, the intermediate formal language can be thought of as an abbreviation of the model theoretic interpretation that the object language expression ultimately receives.

Since our metalanguage is two dimensional, the meaning of each expression in the object language has three components : (i) assertive meaning, (ii) the presupposition it triggers, and (iii) the inheritance function, specifying how the presupposition of its argument projects. For instance, simple non-presuppositional predicates can be analyzed as involving trivial presuppositions.

$$(262) \quad \begin{array}{l} \text{a. } \llbracket \text{is a former smoker} \rrbracket_A = \lambda\langle x_a, x_p \rangle. \mathbf{former.smoker}(x_a) \\ \text{b. } \llbracket \text{is a former smoker} \rrbracket_P = \lambda\langle x_a, x_p \rangle. \top \end{array}$$

Since the meaning is two dimensional, the argument of the function is a pair $\langle x_a, x_p \rangle$, where x_a represents the assertive meaning of the subject, and x_p is its presuppositional meaning.

Presuppositional predicates are analyzed as follows.

$$(263) \quad \begin{array}{l} \text{a. } \llbracket \text{stopped smoking} \rrbracket_A = \lambda\langle x_a, x_p \rangle. \mathbf{former.smoker}(x_a) \\ \text{b. } \llbracket \text{stopped smoking} \rrbracket_P = \lambda\langle x_a, x_p \rangle. \mathbf{used.to.smoke}(x_a) \wedge x_p \end{array}$$

The presupposition is non-trivial here. The second conjunct of (263b) says that the presuppositions of the argument are simply inherited.

In this setting, the indefinite determiner *a* can be analyzed as follows. It is assumed that the determiner has an index indicating the variable name used in the metalanguage.

$$(264) \quad \begin{array}{l} \text{a. } \llbracket a^x \rrbracket_A = \lambda\langle P_a, P_p \rangle. \lambda\langle Q_a, Q_p \rangle. \exists x [P_a(x) \wedge Q_a(x)] \\ \text{b. } \llbracket a^x \rrbracket_P = \lambda\langle P_a, P_p \rangle. \lambda\langle Q_a, Q_p \rangle. P_p(x) \wedge Q_p(x) \end{array}$$

Crucially, the same variable x is used in the two dimensions of meaning.

Quantificational determiners like *exactly one* are given the following entries. Since it refers to two variables, the index is assumed to refer to both. As mentioned above, it is assumed that the presupposition can be about either of these two variables.

$$(265) \quad \text{a. } \llbracket \text{exactly one}^{X,Y} \rrbracket_A = \lambda\langle P_a, P_p \rangle. \lambda\langle Q_a, Q_p \rangle. \exists X \exists Y [\max(P_a) = X \wedge (\max(Q_a) \cap X) = Y \wedge \mathbf{exactly.three}(X, Y)]$$

partitive quantifiers actually can have a universal inference. However, my naive intuition is that partitive quantifiers are more likely to be associated with a universal inference. This can be due to a matter of saliency of the restrictor set, which I consider a matter of pragmatics that need not be explicitly represented in our semantic theory.

- b. $\llbracket \text{exactly one}^{X,Y} \rrbracket_P = \lambda\langle P_a, P_p \rangle. \lambda\langle Q_a, Q_p \rangle. P_p(Z) \wedge Q_p(Z)$ where $Z = X$ or $Z = Y$

5.7 Summary and Further Prospects

Let us recapitulate. I started out with the observation that the gender inferences of pronouns are presuppositional, and then claimed that they create predicates whose assertive meanings do not entail the gender presupposition, e.g. *criticized herself*, unlike predicates like *stopped using Mac* whose assertive meaning does entail the presupposition. I argued based on this observation that the former type of predicates cause a fundamental problem for existing theories of presuppositions in quantified sentences. In particular, the problem for the localist and trivalent views led us to reject the Frege-Strawson view of presuppositions where presuppositions are modeled as pre-conditions for the sentence to have a truth value. The problem is essentially an undergeneration problem, which illustrates the need for a theory where the truth and falsity of assertive meanings are independently accessible from the truth and falsity of presuppositions. However, Karttunen & Peters's (1979) two-dimensional theory runs into the so-called binding problem in existentially quantified sentences. I proposed a solution to the binding problem where the presuppositions of quantified sentences are anaphoric to their assertive meanings. I showed that under the resulting theory, the projection properties of different quantificational determiners fall out nicely from their anaphoric properties. The major innovation of the proposed account is that the interaction between quantification and presupposition are mediated by the mechanism of anaphora. For the rest of this section, I will address two further issues that the discussion above leads to.

5.7.1 Explanatory Power and Predictability

The theory proposed above is based on Karttunen & Peters's (1979) two dimensional theory of presupposition projection. As mentioned above, it has been criticized for two reasons. On the one hand, it runs into the binding problem of quantified sentences. I have shown above that this problem can be solved with anaphoric presuppositions. The other problem is more conceptual in nature and has to do with the explanatory power of the theory. My theory inherits this problem, and I will not solve it in this dissertation. However, it should be mentioned here, as it is one of the central topics in the current literature on presupposition projection (Fox 2008, 2010, George 2008a,b, Rothschild 2011, Schlenker 2007a, 2008, 2009, 2010a,b; see also Gazdar 1979b, Heim 1983, Soames 1989).

Karttunen & Peters's (1979) theory is primarily descriptive when it comes to the analysis of projection properties of various words (Heim 1983; see Gazdar 1979b, Soames 1979, 1982, 1989 for similar remarks on Karttunen 1973, 1974). Recall that under this framework, an analysis of the meaning of a given lexical item α consists of specifying three components: (i) its assertive meaning $\llbracket \alpha \rrbracket_A$, (ii) the presupposition it triggers, and (iii) its inheritance function $\llbracket \alpha \rrbracket_H$. Essentially, the conceptual problem here is that (iii) can be specified completely independently from the other two aspects of meaning.

Recall that the meaning of conjunction *and*, for example, can be analyzed as follows.

$$(266) \quad \begin{array}{l} \text{a. } \llbracket S_1 \text{ and } S_2 \rrbracket_A^{w,g} \Leftrightarrow \llbracket S_1 \rrbracket_A^{w,g} \wedge \llbracket S_2 \rrbracket_A^{w,g} \\ \text{b. } \llbracket S_1 \text{ and } S_2 \rrbracket_P^{w,g} \Leftrightarrow \llbracket \text{and} \rrbracket_H^{w,g}(\llbracket S_1 \rrbracket^w, \llbracket S_2 \rrbracket^{w,g}) \Leftrightarrow \llbracket S_1 \rrbracket_P^{w,g} \wedge (\llbracket S_1 \rrbracket_A^{w,g} \rightarrow \llbracket S_2 \rrbracket_P^{w,g}) \end{array}$$

According to this analysis, the presupposition of 'S₁ and S₂' is the conjunction of the

presupposition of S_1 and the part of the presupposition of S_2 that is not entailed by S_1 . This correctly captures the projection behavior of *and*, but there is nothing that prevents it from some other projection property. That is, there is no principled reason why lexical items that have the same assertive meaning as (266a) but have one of the following projection properties do not exist.

- (267)
- a. $\llbracket \text{and}' \rrbracket_H^{w,g}(\llbracket S_1 \rrbracket^{w,g}, \llbracket S_2 \rrbracket^{w,g}) \Leftrightarrow \llbracket S_1 \rrbracket_P^{w,g} \wedge \llbracket S_2 \rrbracket_P^{w,g}$
 - b. $\llbracket \text{and}'' \rrbracket_H^{w,g}(\llbracket S_1 \rrbracket^{w,g}, \llbracket S_2 \rrbracket^{w,g}) \Leftrightarrow \llbracket S_2 \rrbracket_P^{w,g} \wedge (\llbracket S_2 \rrbracket_A^{w,g} \rightarrow \llbracket S_1 \rrbracket_P^{w,g})$
 - c. $\llbracket \text{and}''' \rrbracket_H^{w,g}(\llbracket S_1 \rrbracket^{w,g}, \llbracket S_2 \rrbracket^{w,g}) \Leftrightarrow \llbracket S_2 \rrbracket_P^{w,g}$
 - d. $\llbracket \text{and}'''' \rrbracket_H^{w,g}(\llbracket S_1 \rrbracket^{w,g}, \llbracket S_2 \rrbracket^{w,g}) \Leftrightarrow \top$

According to (267a), the presuppositions of both conjuncts simply project out. (267b) is the converse of the actual *and*, and according to it, the following sentence does not have any presuppositions.

(268) Rafael stopped using Mac and'' he used to use a Macbook.

(267c) deletes the presuppositions of S_1 but keeps those of S_2 , and (267d) deletes all the presuppositions. These hypothetical connectives are all coherent and imaginable, but are not found in actual languages, and all the conjunctive connectives that are synonymous with *and* seem to have the same projection properties. This fact suggests that there should be some relation between the assertive meaning and the projection property of a given lexical item, which is completely absent in Karttunen & Peters's (1979) framework.⁸¹

These considerations led Heim (1983) and later researchers to explore alternative approaches. The main goal is to construct a predictive theory where the projection property of a given lexical item can be uniquely determined from its truth conditional meaning. As it turns out, Heim's attempt was not completely satisfactory, but the recent developments have explored several maneuvers, and shown that there are several ways to deal with this issue (Chemla 2009b, Fox 2008, 2010, George 2008a,b, Rothschild 2011, Schlenker 2007a, 2008, 2009, 2010a,b). However, all of them, except for Chemla (2009b), adopt either the localist view or the trivalent view, and run into the undergeneration problem pointed out above. Chemla (2009b), on the other hand, is a two dimensional theory, and due to its restrictiveness, it suffers from the binding problem. Most of these theories are reviewed in Section 6 in some detail.

My treatment of the projection properties of quantificational determiners is restricted and makes clear predictions, as we have seen. However, at this point it is not embedded in a larger framework where the anaphoric presupposition of a quantified sentence follows

⁸¹Soames (1989:581) summarizes the problem lucidly:

Although the resulting system [Karttunen and Peters' theory] is elegant, it suffers from both explanatory and descriptive problems. On the explanatory side, pragmatic presuppositional requirements are reduced to arbitrary linguistic conventions associated with lexical items and constructions. This is plausible for examples like 'even' and clefts; but it is implausible for other cases, particularly the connectives. Surely, there is some connection between the truth conditional content of the connectives and the pragmatic presuppositions of sentences containing them. We are not inclined to think that learning their meanings consists of two separate and unrelated tasks; nor do we expect to find natural languages containing connectives that share the truth conditional contents of their English counterparts while differing arbitrarily from them in their contributions to presupposition inheritance. This suggests some explanatory link between pragmatic presuppositions, truth conditional content, and general principles governing communication — a link that is missing from the Karttunen-Peters account.

from more general principles. My analysis of presupposition projection in quantified sentences, therefore, should be taken as an agenda for constructing a descriptively adequate, explanatory theory of presupposition projection, where it should follow from a more general principle that is yet to be discovered. As far as I know, no attempt has been made to make a two dimensional theory like Karttunen & Peters's (1979) explanatory in the above sense, and this task is entirely left for future research.

5.7.2 Presupposition Projection out of Intensional Contexts

I have discussed the interaction between quantification and presupposition projection looking at quantificational noun phrases. Natural language, however, also allows quantification in the intensional domain, i.e. quantification over time intervals and possible worlds, and it is expected the the analysis put forward above extends to quantification in these non-individual domains as well. However, the extension turns out to be far from trivial, as on the one hand, the semantic analysis of quantification in these domains is less understood than quantification in the individual domain, and on the other hand, some aspects of the empirical status of the relevant judgments are yet to be clarified. Although I leave this topic for future research, I will mention below some major obstacles to a simple extension of the analysis.

Presupposition projection in modal contexts was discussed in the 1970s by Karttunen (1973, 1974) and Gazdar (1979b) among others, and in the 1990s, Heim (1992) and Geurts (1998, 1999) extensively discussed presuppositions triggered in attitude contexts (see also Schlenker 2008, 2009). These authors pointed out that there are several classes of modals with respect to their projection properties.

Presuppositions triggered in the complement of a factive attitude predicate become part of the presuppositions of the entire sentence. For instance, all the sentences in (269) presuppose that John used to smoke, just as much as the embedded sentence does by itself.

- (269)
- a. Mary knows that John stopped smoking.
 - b. Mary discovered that John stopped smoking.
 - c. Mary is aware that John stopped smoking.
 - d. Mary is happy that John stopped smoking.

In addition, these sentences also suggest that Mary *believes/knows* that John used to smoke. Thus, the presupposition gives rise to two inferences here, one about the current common ground, and one about Mary's belief. This is one difference between the two domains of quantification. In the standard possible world semantics, all the predicates in (269) are analyzed as universal quantifiers over possible worlds, and the complement clause denotes a predicate of possible worlds. In this case this predicate has a presupposition, as shown in (270).

- (270) $\llbracket \text{that John stopped smoking} \rrbracket^{w,g}$
- a. **Assertive meaning:** $\lambda w'$. John is a former smoker in w'
 - b. **Presupposition:** $\lambda w'$. John used to smoke in w'

This is parallel to the meaning of *stopped smoking*, which is a predicate of individuals.

- (271) $\llbracket \text{stopped smoking} \rrbracket^{w,g}$
- a. **Assertive meaning:** λx_e . x is a former smoker in w

- b. **Presupposition:** $\lambda x_e. x$ used to smoke in w

However, there seem to be no quantificational noun phrases that exhibit behavior parallel to factive attitude predicates. A factive attitude predicate takes the meaning of (270) and derives two inferences out of (270b): (i) this predicate of possible worlds is true for all the worlds that are compatible with what the attitude holder believes, and (ii) it is also true for the worlds of the context set. On the other hand, it appears that there is no quantificational noun phrase that give rise to two inferences out of (271b). Especially, although the inference (i) can be likened to a universal inference of quantificational noun phrases in the sense that all the entities in the domain of quantification satisfies the presupposition, the inference (ii) does not have a counterpart in the individual domain.

Interestingly, non-factive attitude predicates like *believe*, *doubt*, *hope* and *be certain* also give rise to two kinds of inferences. For example, the following sentences seem to suggest that Mary believes that John was smoking, and also that he actually was.

- (272) a. Mary believes that John stopped smoking.
 b. Mary doubts that John stopped smoking.
 c. Mary hopes that John stopped smoking.
 d. Mary is certain that John stopped smoking.

As observed by Karttunen (1974), Heim (1992) and Geurts (1999), however, the latter inference that John actually was smoking does not always hold, unlike in the case of factive attitude predicates. This is shown by the contrast below.

- (273) Mary wrongly thinks that John was smoking, and
 a. #she knows/is aware that John stopped smoking.
 b. she doubts/hopes that John stopped smoking.

A question immediately arises, therefore, is how to derive the cancelable inference that John actually used to smoke from sentences like (272). Karttunen (1974) and Heim (1992) suggest it is a pragmatic inference that arises from the real presupposition that Mary believes that John used to smoke. However, Geurts (1998, 1999) pointed out an empirical problem of this analysis (cf. the proviso problem; Geurts 1999, Pérez-Carballo 2009, Schlenker 2011a,b, Singh 2007, 2008, van der Sandt 1992, van Rooij 2007). That is, the following sentence has the same presupposition that Mary believes that John was smoking, but it does not suggest that John actually was.

- (274) Bill knows that Mary believes that John was smoking.

Again, an inference parallel to such an inference seems to be not attested in the case of quantification over individuals.

Also, Karttunen (1973, 1974), Gazdar (1979b) and others observe that epistemic possibility modals also give rise to inferences about the common ground. That is, (275a), for instance, seems to suggest that Fred kissed Cecilia before.

- (275) a. It is possible that Fred will kiss Cecilia again. (Karttunen 1973:179)
 b. The courts may force Nixon to stop protecting his aides. (Karttunen 1974:188)
 c. Possibly Boris regrets insulting the king of France. (Gazdar 1979b:111)

Possibility modals give rise to the binding problem in a two-dimensional setting, and it is expected that an anaphoric presupposition proposed above solves it here as well. However, it is a mystery, then, why one obtains an inference that is stronger than an existential inference. Recall that a sentence like (276) only presupposes that there is some student who used to smoke.

(276) A/Some student stopped smoking.

Then by the same token, the following sentence should presuppose that there is some possible world in which John used to smoke, but the inference that it actually has seems to be stronger than that.

(277) It is possible that John stopped smoking.

Importantly, there is again a question of whether this inference is cancelable or not. That the following sentence is coherent suggests at first blush that not all possibility statements give rise to a presupposition about the common ground.

(278) It is possible that John has children and it is possible that his children are away.
(Kadmon 2001:144)

However, what makes the discussion complicated is the possibility of modal subordination (Roberts 1989, Kadmon 2001, Brasoveanu 2007; cf. Section 5.4.3). I will leave this discussion open here. Also besides epistemic modals, there are deontic modals and also quantifiers over temporal intervals that the theory needs to be able to subsume.

Another major question is how to derive these differences among different modals in a principled way. Especially puzzling in this regard is the difference between predicates like *say* and *believe*. Karttunen observes that *say* does not give rise to presuppositional inferences about the common ground or about the subject's belief. For instance, (279) clearly does not suggest that John used to smoke, and also does not necessarily suggest that Mary believes that John was smoking. For instance, if Mary was telling a lie, it is not necessary that she held the belief that John was smoking.

(279) Mary said that John stopped smoking.

Other attitude predicates in this category include the following.

- (280) a. Mary dreamed that John stopped smoking.
b. Mary lied that John stopped smoking.
c. Mary heard that John stopped smoking.

Also, anti-factive predicates such as *pretend*, which presuppose that the complement is *false* (Lakoff 1970), and certain question-embedding predicates seem to belong to this class.

- (281) a. John pretended that he stopped smoking.
b. Mary asked if John stopped smoking.

On the other hand, predicates like *believe* give rise to inferences regarding the attitude holder's belief. It is undeniably desirable to derive the projection properties of these modal predicates from other aspects of their meanings (cf. Gazdar 1979b:109; also see the discussion in the previous subsection), but so far no explicit theory of the classification has been

proposed.

6 Previous Theories of Presuppositions in Quantified Sentences

In this final section of Part I, I will critically examine in detail those previous theories that make explicit predictions for quantified sentences. As pointed out already in Section 4 above, they all run into a problem with predicates whose assertive meanings do not entail their presuppositions.

6.1 Dynamic Semantics

As discussed briefly in Section 3.4.1, localist theories solve the projection problem of presupposition by requiring local satisfaction. I illustrated the idea with Heim's (1983) theory, but there are a class of theories that make similar empirical predictions. We will delve into the details of Heim (1983) and Beaver (1994, 2001) below, and then in the next two subsections, review Schlenker's more recent alternative formulations of this core idea. As I have claimed above, all of these theories undergenerate for predicates like *criticized herself*, which is shown more perspicuously here with with the technical details.

6.1.1 Heim (1983)

As remarked earlier, Heim's (1983) theory can be seen as a partial function approach to presuppositions, where semantic presuppositions of a sentence are conceived of as restrictions on the domain of the function denoted by the sentence. The innovation of Heim's theory is that instead of relating the semantic and pragmatic presuppositions at the global level all at once as in the naive partial function theory presented in Section 3.1, the pragmatic evaluation of the semantic presupposition is calculated at every sentential level. This idea traces back to Robert Stalnaker's (Stalnaker 1973, 1974, 1978) and Lauri Karttunen's (Karttunen 1973, 1974) work, but Heim is the first to apply it to quantificational sentences.

Heim's theory is couched in a version of dynamic semantics (Heim 1982) where sentence meanings are modeled as *Context Change Potentials* (CCPs), rather than as mere propositions, where CCPs are update functions over contexts. For the moment contexts are simply modeled as sets of possible worlds, but as we will see below, in order to deal with quantificational sentences, the definition of contexts needs to be changed to pairs consisting of a possible world and an assignment function.

By assumption, an assertion of a declarative sentence updates the conversational context in which the assertion took place, and yields a new context. The conversational context at a given time is modeled by a set of possible worlds called the context set, i.e. the set of possible worlds that the discourse participants agree to be candidates for the actual world at that moment. For an illustration, consider the following simple sentence which I assume here to carry no presuppositions.

(282) It was raining.

I denote the CCP of a sentence S by $\|S\|$. The CCP of the sentence (282) is given in (283).

(283) For any set of possible worlds c , $\|it\ was\ raining\|(c) = \{w \in c : it\ was\ raining\ in\ w\}$

The underlying idea is that asserting a sentence with respect to a context set c is to eliminate certain possibilities from c . In the present example the resulting context contains only the worlds in c in which it was raining. The resulting context models a state of the conversation where the conversational participants all agree that the sentence is true. In other words, information gain is modeled as shrinkage of the context set.

Now let us consider sentences with non-trivial presuppositions. Heim assumes that such sentences denote CCPs that can only update certain contexts, namely those contexts where the presuppositions are known to be true. For example, *it stopped raining* is given the following partial CCP.

- (284) For any set of possible worlds c , $\| \text{it stopped raining} \| (c)$ is defined only if for all $w \in c$, it was raining in w . If defined, $\| \text{it stopped raining} \| (c) = \{w \in c : \text{it is no longer raining in } w\}$

Thus, the semantic presupposition of a sentence is what makes its CCP partial. The pragmatic presupposition is rather directly connected to this notion of semantic presupposition. The relation between them can be explicitly stated as the Admittance Condition in (285).

- (285) *Admittance Condition for Atomic Sentences*
A context c admits an atomic sentence S just in case $\| S \| (c)$ is defined. Otherwise, S is infelicitous in c .

In general, a context c admits S with a presupposition p only if c entails p , or equivalently, $c \subseteq p$. Since c represents the common ground at a given time in the discourse, what this means that p is part of the common ground, which reflects the underlying idea that the presuppositions must be agreed to be true in the context.

Heim's solution to the projection problem comes from the dynamicity of interpretation. By assumption an atomic sentence within a complex sentence operates on a context and yields a new context that some other parts of the complex sentence can in turn operate on. Consequently, not all parts of the same sentence have to refer to the same context, but rather it dynamically changes within the sentence as the semantic computation proceeds. As an example of a complex sentence, consider a conjunction of two sentences whose CCP is defined as follows.

- (286) For any set of possible worlds c , $\| S_1 \text{ and } S_2 \| (c)$ is defined only if:
a. $\| S_1 \| (c)$ is defined and;
b. $\| S_2 \| (\| S_1 \| (c))$ is defined.
Whenever defined, $\| S_1 \text{ and } S_2 \| (c) = \| S_2 \| (\| S_1 \| (c))$.

According to this meaning, the context set c is first updated with $\| S_1 \|$ yielding a new context $\| S_1 \| (c)$, which in turn is updated with $\| S_2 \|$. Crucially, S_2 is evaluated relative to $\| S_1 \| (c)$, rather than c , which provides a way to solve the projection problem. The key is the admittance extended to complex sentences in the following way.

- (287) *Admittance Condition*
A context c admits a sentence ϕ just in case each of the constituent sentences of ϕ is admitted by the corresponding local context. (Heim 1983: 11)

Let us look at a concrete example. According to (287), a context c admits $\| S_1 \text{ and } S_2 \|$ if c admits S_1 and also $\| S_1 \| (c)$ admits S_2 . Suppose that S_2 here has a presupposition p .

Then what is required is that its local context, $\|S_1\|(c)$ entail p . Notice that when S_1 has a meaning that entails p , then this local context necessarily entails p as well. Therefore in such a case, the update with $\|S_2\|$ is guaranteed to be defined. This is exactly what happens in a conjunctive sentence like (288).

(288) It was raining, and it stopped raining.

The second sentence has a presupposition that it was raining, but the update with the first conjunct guarantees that this presupposition is satisfied no matter what the initial context is. As a consequence, the entire sentence admits any context, capturing the fact that (288) as a whole is not associated with any non-trivial presuppositions. To put it differently, the sentence of the form S_1 and S_2 presupposes what S_1 presupposes and the part of the presuppositions of S_2 that is not entailed by S_1 .

Other connectives can be dealt with in this theory in similar ways. Heim (1983) suggests the following CCPs for *if*-conditionals and negation, where the symbol ‘-’ denotes the set theoretic difference.

- (289) For any context c ,
- a. $\| \text{if } S, \text{ then } T \| (c) = c - (\|S\|(c) - (\|T\|(\|S\|(c))))$
 - b. $\| \text{not } S \| (c) = c - (\|S\|(c))$

I refer the reader to Heim’s original paper for the details (see also Beaver 2001).

Heim (1983) further demonstrates that this theory can be extended to quantificational sentences by defining contexts as sets of pairs $\langle w, g \rangle$ of a possible world w and an assignment function g , rather than merely sets of possible worlds.⁸² For a simple sentence without a free variable, the assignment function plays no role, as shown in (290).

- (290) a. $\| \text{it is raining} \| (c) = \{ \langle w, g \rangle \in c : \text{it is raining in } w \}$
 b. $\| \text{it stopped raining} \| (c)$ is defined just in case for all $\langle w, g \rangle \in c$, it was raining in w . When defined, $\| \text{It stopped raining} \| (c) = \{ w \in c : \text{it is no longer raining in } w \}$

When a sentence contains a free pronoun, on the other hand, a simple atomic sentence imposes a condition on the assignment function too. This is illustrated in (291) (I ignore the inferences associated with the phi features of the third person pronoun *he*).

- (291) $\| \text{He}_9 \text{ is a student} \| (c) = \{ \langle w, g \rangle \in c : g(9) \text{ is a student in } w \}$

Notice that presupposition can be sensitive to assignment functions as well. Here is an example.

- (292) $\| \text{He}_9 \text{ stopped smoking} \| (c)$ is defined just in case for all $\langle w, g \rangle \in c$, $g(9)$ used to smoke in w . If defined, $\| \text{He}_9 \text{ stopped smoking} \| (c) = \{ \langle w, g \rangle \in c : g(9) \text{ is a former smoker in } w \}$

Another crucial assumption is the syntax of quantificational sentences. Heim (1983) assumes the framework of Heim (1982) where they are given a tripartite structure consisting of (i) a quantificational determiner with a numerical index, (ii) a restrictor and (iii) a nuclear

⁸²It is assumed that $g : \mathbb{N} \rightarrow D_e$ is a total function, but this assumption is not technically required. In fact, partial assignment functions would make the definition of fresh variables more perspicuous, and circumvent the problem of ‘downdating’ or loss of information, but I follow Heim’s (1983) here in assuming g to be a total function. See Beaver (1992), van den Berg (1996), Dekker (1996), Krahmer (1998), Beaver (2001), Nouwen (2003b, 2007b) for relevant discussion.

scope. The restrictor and the nuclear scope are assumed to contain a pronoun with the same index as the determiner and treated as ‘sentences’ denoting CCPs. For example, a universally quantified sentence is given the following meaning.

$$(293) \quad \begin{aligned} & \| \text{every}_i R S \| (c) \\ & = \{ \langle w, g \rangle \in c : \forall a \in D_e [\langle w, g[i \mapsto a] \rangle \in \| R \| (c) \Rightarrow \langle w, g[i \mapsto a] \rangle \in \| S \| (\| R \| (c))] \} \\ & \text{(whenever defined)} \end{aligned}$$

$g[i \mapsto a]$ here stands for the function that differs from g at most in that $g[i \mapsto a](i) = a$. R and S are the restrictor and nuclear scope ‘sentences’, respectively.

In a quantificational sentence, it is additionally assumed that i that a quantifier is associated with is a *fresh variable* in c . What this means is the following.

$$(294) \quad \begin{aligned} & \text{Fresh variables} \\ & i \text{ is a } \textit{fresh variable} \text{ in } c \text{ iff for any assignment function } g \text{ and } g' \text{ that differ at most} \\ & \text{for the } i\text{th member, and for any world } w, \langle w, g \rangle \in c \Leftrightarrow \langle w, g' \rangle \in c \text{ (i.e. the value of} \\ & i \text{ does not matter for } c) \end{aligned}$$

To see why this condition is necessary, consider Heim’s (1983) example given in (295).

$$(295) \quad \text{Every nation cherishes its king}$$

The LF of this sentence (under the intended reading) is assumed to be the following.

$$(296) \quad \text{Every}_i (x_i \text{ is a nation}) (x_i \text{ cherishes } x_i\text{'s king})$$

Now consider a context $c = \{ \langle w, g \rangle : g(i) = \text{Thailand and } w \text{ is in the context set} \}$, which violates the condition that i must be a fresh variable. Then for any individual a distinct from Thailand and any g , it is guaranteed that $\langle w, g[i \mapsto a] \rangle \notin \| S \| (c)$ no matter what the sentence S is, because $\| S \| (c)$ is bound to be a subset of c and we know that $\langle w', g[i \mapsto a] \rangle \notin c$ for any w' . Therefore, the antecedent clause of the CCP in (293) is trivially satisfied for $a \neq \text{Thailand}$. For $a = \text{Thailand}$, on the other hand, $\langle w, g[i \mapsto a] \rangle \in \| x_i \text{ is a nation} \| (c)$ for any $\langle w, g \rangle \in c$. Therefore the predicted meaning of (296) is essentially equivalent to that of “Thailand cherishes its king”. However this is obviously not an intuitively available reading of (296).

Next consider a context that satisfies the condition on fresh variables. Then $\| (296) \| (c)$, is a new context $\{ \langle w, g \rangle \in c : \forall a [\langle w, g[i \mapsto a] \rangle \in (\| x_i \text{ is a nation} \| (c)) \Rightarrow \langle w, g[i \mapsto a] \rangle \in \| x_i \text{ cherishes } x_i\text{'s king} \| (\| x_i \text{ is a nation} \| (c))] \}$. In words, what is left is the set of pairs $\langle w, g \rangle$ in c such that if $g(i)$ is a nation, then it cherishes its king. This seems to be an adequate semantics for a universally quantified sentence. Notice also that the nuclear scope of this sentence contains a possessive construction, and hence is presuppositional. The relevant presupposition is that x_i has a king. This presupposition needs to be satisfied at the step $\| x_i \text{ cherishes } x_i\text{'s king} \| (\| x_i \text{ is a nation} \| (c))$. Since the local context for the nuclear scope, i.e. $\| x_i \text{ is a nation} \| (c)$, contains all $\langle w, g \rangle$ in c such that $g(x_i)$ is a nation, what is required is that all nations have a king. In other words, a universal inference is predicted.

Interestingly, the presuppositions of triggered in the nuclear scope are predicted by this theory to universally project in all quantificational sentences. Let us look at the case of *no*. We assign (297) as the CCP for *no*. Again, in order to obtain the correct semantics, it is necessary that i is a fresh variable.

$$(297) \quad \| \text{no}_i R S \| (c) = \{ \langle w, g \rangle \in c : \forall a [\langle w, g[i \mapsto a] \rangle \in (\| R \| (c)) \Rightarrow \langle w, g[i \mapsto a] \rangle \in$$

$$\|R\|(c) - \|S\|(\|R\|(c))\}$$

Let us walk through the meaning of (298) to see how the universal inference is derived.

(298) No student stopped smoking.

The Logical Form is given in (299).

(299) $\text{No}_i (x_i \text{ student}) (x_i \text{ stopped smoking})$

To simplify the discussion, we assume that the restrictor does not have any presuppositions. The admittance condition requires that for each $\langle w, g \rangle \in \|x_i \text{ student}\|(c)$, it is true that $g(i)$ used to smoke in w . Because i is a fresh variable, the local context $\|x_i \text{ student}\|(c)$ contains all the possible value assignments g to i such that $g(i)$ is a student. Therefore the requirement amounts to that all students used to smoke. Fortunately, this is not a problem for (299), because *no* generally gives rise to universal inferences, as we saw in Section 3.3.

However, a problem arises with respect to existential sentences. This theory predicts that they carry universal presuppositions too, for essentially the same reasons as above. More specifically, Heim (1983) assumes that indefinites are not quantificational expressions, but expressions that denote fresh variables (Heim 1982). For example, *A student stopped smoking* has an Logical Form that looks as follows.

(300) $(x_i \text{ student}) (x_i \text{ stopped smoking})$

By assumption i associated with an indefinite is a fresh variable, which means that for every individual a , x_i denotes a . The update with ' x_i is a student' will eliminate those assignment functions g where $g(i)$ is not a student, but still, $\|x_i \text{ student}\|(c)$ admits the nuclear scope just in case, every student used to smoke, which is a universal presupposition. This is evidently empirically problematic (see Section 3.3).

To achieve a weaker presupposition for existential sentences in this theory, Heim (1983) suggests the following strategy. Consider updating c with (300) where not all students used to smoke. Firstly, we update c with $x_i \text{ student}$, yielding a new context c' such that for any $\langle g, w \rangle \in c'$ $g(i)$ is a student in w , which is the local context for the nuclear scope of (300). But c' does not admit it, as not all students used to smoke. Upon realizing this, one performs 'local accommodation' and creates another local context c'' which is $\|x_i \text{ used to smoke}\|(c')$, which admits the nuclear scope.

While this indeed yields the desired weak presupposition for the sentence above, there are two further problems. One has to do with the licensing condition for local accommodation in general, which Heim (1983) herself addresses. The other problem is more substantial and arises with predicates like *criticized herself* that should not entail the presupposition at the level of the predicate.

The mechanism of local accommodation itself is independently motivated by certain empirical facts. For example, the following sentences repeated from Section 2.1 have readings that are not predicted by the analysis above.

- (37) a. Rafael did not stop using Mac, because he never owned one.
 b. If Rafael stopped using Mac, then he must have told us why already. So I think he never owned a Mac computer.

Let us take the matrix sentence of (300a) as an example. I assume the semantics of negation in (301).

(301) $\| \text{not } S \| (c) = c - (\| S \| (c))$

Then (56a) is predicted to have an inference that Rafael used to use Mac, because c needs to admit the sentence, *Rafael stopped using Mac*. However, the *because*-clause would be inconsistent with this. To circumvent this, one could perform local accommodation here to obtain the consistent reading of (56a). That is, c is amended to $\| \text{Rafael used to use Mac} \| (c)$, which will admit *Rafael stopped using Mac*. Consequently, the resulting context will be:

(302) $c - (\| \text{Rafael stopped using Mac} \| (\| \text{Rafael used to use Mac} \| (c)))$

Roughly put, this means, Rafael is not a former Mac user, which is intuitively the meaning of the matrix clause of (56a). (56b) can be dealt with in a similar fashion.

However, this mechanism of local accommodation needs to be constrained somehow, as it is usually felt marked, and not easily available. On the other hand, the existential inference of involved in sentences like *a student stopped smoking* seems to be much easier to access, which is unexpected if the same procedure is involved. In order to explicate this discrepancy, Heim hints at the possibility that local accommodation in quantified sentences with indefinites feels different from and in fact easier than a normal case of local accommodation as it is also ‘global accommodation’ in the sense that the accommodated presupposition will ‘stay in the context for good’, i.e. the resulting context entails the accommodated presupposition.

However, it turns out that it is not trivial to define the relevant notion of globality. As a first shot, let us consider the following definition.

(303) Let S_p be (an occurrence of) an atomic Heimian sentence with a presupposition p , and let $\phi[S_p]$ be a sentence containing it. In uttering $\phi[S_p]$ in c , local accommodation of p in the local context c' of S_p with respect to c , i.e. $\{\langle w, g \rangle \in c' : w \in p\}$ is marked, unless the set of worlds in $\| \phi[S_p] \| (c)$ entails p .

As Soames (1989) points out, however, it is predicted by the notion of globality along the lines of (303) that embedding the relevant sentence in certain contexts would change the judgments. In general, non-veridical contexts deprive an indefinite of a global effect. For example, consider the following sentence from Soames (1989:600), where *a fat man* is read *de dicto*.

(304) If a fat man pushed his bicycle across the flowers, you should have called a cop.

Since local accommodation of the presupposition within the antecedent of this conditional sentence will not result in a context that entails it, (304) is predicted to have a universal presupposition more prominently. However, this seems to be empirically wrong.

To sidestep this issue, one might be tempted to define a non-global version of the constraint, but its definition turns out to be not at all trivial. For instance, consider the following that makes recourse to the minimal clause containing the quantifier and the presupposition trigger.

(305) Let S_p be an atomic sentence with a presupposition p , and let $\phi[S_p]$ be the minimal CP containing S_p which in turn is contained in $\psi[\phi[S_p]]$. In uttering $\psi[\phi[S_p]]$ in context c , local accommodation of p is marked with respect to the local context c' of S_p , unless the set of worlds in $\| \phi[S_p] \| (c')$ entails p for the local context c'' for $\phi[S_p]$.

A problem of this local version of the constraint is that it predicts a contrast between the following sentences with respect to the availability of local accommodation in non-quantificational sentences.

- (306) a. No one met the king of France.
 b. I doubt that the king of France is bald.

For (306b), but not for (306a), there is a minimal CP, namely the embedded clause, where updating update with local accommodation will result in a local context that entails the existence of the king of France. However, this again sounds wrong. As there is a more fundamental problem regarding predicates like *criticized herself*, I will not try to solve this issue here.

The gist of the problem of *criticized herself* is that the gender presupposition is necessarily entailed at the predicate level. Consider the following example.

- (307) Exactly one student criticized herself.

As we have seen already, (307) only has an existential inference, and hence is felicitous as far as there is a female student. What needs to be captured is the assertive meaning that one female student did her homework, and everybody else, regardless of the gender, did not. However, if the gender feature is locally accommodated, a wrong inference is generated. To see this more concretely, let us assume that the CCP of x_i *criticized herself_i* to be the following.

- (308) $\|x_i$ criticized herself_{*i*} $\|(c)$ is defined just in case for all $\langle w, g \rangle \in c$, $g(i)$ is female in w . When defined, $\|x_i$ did her_{*i*} homework $\|(c) = \{\langle w, g \rangle \in c : g(i)$ criticized $g(i)$ in $w\}$

Without local accommodation, a universal inference that every student is female is generated, because i is assumed to be a fresh variable. This is not the reading we are after (if possible at all). With local accommodation, the meaning of (307) would be equivalent to the meaning of (309), which is too weak.

- (309) Exactly one student is female and did her homework.

That is, (309) is semantically weaker than the intuitive reading of (307).

The problem here arises due to the strictly local nature of the computation. In particular, the update by $\|x_i$ criticized herself_{*i*} $\|$, if successful, results in a set of worlds where $g(i)$ is female, but this is not enough to capture the meaning of (307). Incidentally, this problem does not arise with predicates like *stopped using Mac*, as $\|x_i$ stopped using Mac $\|$ should only care about worlds where $g(i)$ used to use Mac. This can be intuitively illustrated by the equivalence of the following two sentences in the assertive dimension.

- (310) a. Exactly one student stopped smoking
 b. Exactly one student used to smoke and stopped smoking

Additionally, as Beaver (2001) points out, presupposition projection out of the restrictor is going to cause a hard problem for this theory. For instance, consider the following sentence.

- (311) A student who stopped smoking drank.

This is analyzed as having the following structure where x_i is a fresh variable.

(312) $(x_i \text{ student who stopped smoking}) (x_i \text{ drank})$

In order for the first sentence to be admitted, it is necessary that all the possible values of x_i satisfies the presupposition that x_i used to smoke. Because x_i is a fresh variable by assumption, it is admitted only if all the individuals used to smoke, which is evidently too strong. Notice also that simple accommodation will not solve this problem, as what is accommodated will be this very strong inference.

6.1.2 Beaver (1994, 2001)

Beaver (1994, 2001) proposes a modification of Heim's (1983) theory where the predicted inferences are all existential for all quantificational sentences regardless of the quantifier. As we saw above, without local accommodation, Heim predicts universal presuppositions for all quantificational sentences because of the fresh variable constraint that requires all the relevant values of the variable in the nuclear scope to satisfy the presupposition. Claiming that there is no empirical evidence for universal presuppositions for any quantifiers (cf. Section 3.3.3), Beaver changes the admittance condition slightly to achieve much weaker presuppositions across the board.

What Beaver (1994, 2001) demonstrates is that one can loosen the admittance condition and derive an existential presupposition instead of a universal presupposition. That is, instead of requiring all pairs $\langle w, g \rangle \in c$ satisfy the presupposition, we can require some of them to do so. Let us look at a concrete example. Recall that in Heim's theory, the sentence is defined only if all pairs satisfy the presupposition.

(313) $\| \text{He}_9 \text{ stopped smoking} \| (c)$ is defined just in case for all $\langle w, g \rangle \in c$, $g(9)$ used to smoke in w . If defined, $\| \text{He}_9 \text{ stopped smoking} \| (c) = \{ \langle w, g \rangle \in c : g(9) \text{ is a former smoker in } w \}$.

Beaver's idea is to relativize the requirement to each value a . First c is divided into pairs $\langle w, g \rangle$ according to the value g gives to 9.

(314) $c_9^a = \{ \langle w, g \rangle : g(9) = a \}$

Then, we require that the presupposition is universally satisfied in c_9^a for at least one a , rather than in c itself:

(315) $\| \text{He}_9 \text{ stopped smoking} \| (c)$ is defined just in case there is some individual a such that for all $\langle w, g \rangle \in c_9^a$, $g(9)$ used to smoke in w .

As a consequence, the sentence is defined as long as there is at least one individual a who satisfies the presupposition. When the sentence is defined, we update with the assertive meaning each of such contexts c_9^a for which the presupposition is satisfied, and amalgamate them to obtain the output context, as illustrated in (316).

(316) Whenever defined, $\| \text{He}_9 \text{ stopped smoking} \| (c)$
 $= \bigcup \left\{ c' : \exists a \left[\begin{array}{l} \text{for all } \langle w, g \rangle \in c_9^a \text{ } g(9) \text{ used to smoke in } w \text{ and} \\ c' = \{ \langle w, g \rangle \in c_9^a : g(9) \text{ is a former smoker in } w \} \end{array} \right] \right\}$

Recall now that the predicative arguments of a quantificational determiner are assumed to have essentially the same structure as *He₉ stopped smoking*. Therefore, quantificational sentences like *Each of the students stopped smoking* only presuppose some student used to

smoke. Similarly for other quantificational determiners.

One might think that it is a problem for Beaver's theory that *each* and *none* only give rise to existential presuppositions, as the experimental data provided by Chemla (2009a) suggest the contrary. However, as Beaver (1994, 2001) notes, one can specify in each lexical item whether the above mechanism or Heim's original notion of definedness is used, which gives a leeway of deriving a universal presupposition. For example, one can specify in the lexicon that *each* and *none* use Heim's notion of definedness, and existential determiners like *some* and *at least three* use Beaver's mechanism to derive existential presuppositions. Furthermore, in order to capture the non-uniform judgments, one can even try assigning two lexical entries for some of the determiners with different notions of definedness. Although it would not explain where the difference between the two classes of determiners comes from, the resulting theory at least achieves a certain degree of descriptive adequacy.

However, being a localist theory, Beaver's account suffers from the same problem as Heim's (1983) with respect to predicates like *did criticize herself*. That is, updating c with $\|x_i \text{ criticized herself}_i\|$ necessary results in a context c such that for each $\langle w, g \rangle \in c$, $g(i)$ is female in w , even under the modified update rule above. Thus, if a quantificational determiner takes such c as its argument, there is no way to arrive at the correct truth conditions for sentences like *Exactly one student criticized herself* that are sensitive to individuals who are not female.

6.2 Schlenker's Localist Theories

In a series of recent papers (Schlenker 2007a, 2008, 2009, 2010a,b), Philippe Schlenker offers two ways of reformalizing the core ideas of the dynamic semantic approach to presupposition projection. In particular, he proposes to dispense with dynamic semantics and partial functions that Heim (1983) and Beaver (1994, 2001) make use of. His main motivation to make this move is the insufficient explanatory power of the dynamic approach to presupposition projection (cf. Section 5.7.1). Under Heim's and Beaver's theories, the projection property of a given item is determined in its lexical entry, and in fact one can define alternative entries that has the same assertive meaning but a different projection property.⁸³ Schlenker's theories are more constrained than dynamic semantics, and the projection property of a given item is made to follow from its assertive meaning. Although this is undoubtedly a welcome result, being localist theories, they face the same problem as Heim (1983) and Beaver (1994, 2001) with respect to predicates like *criticized herself*.

6.2.1 Transparency Theory

Schlenker (2007a, 2008) proposes to consider a presupposition p of a sentence S as a proposition that likes to be expressed explicitly, i.e. as p and S . He postulates the following pragmatic principle that demands this. Anticipating the case of quantified sentences, it is generalized to all expressions rather than just sentences.

- (317) *Be Articulate*
Express the meaning of an expression X_p with a 'presupposition' that p as p and X_p .

⁸³Heim (1983) leveled the same argument against Karttunen & Peters (1979), and presented her own theory as more explanatory, but as Soames (1989) and others pointed out, it is not sufficiently constrained in this respect either. See also Rothschild (2011), Schlenker (2007a, 2008, 2009, 2010a,b).

Of course, in reality, not all presuppositions are explicitly expressed. Thus (317) needs to be a violable constraint, and is assumed to be only satisfied whenever possible. In particular, Schlenker assumes that it can be violated in favor of a constraint that runs counter to it, which he calls *Be Brief*. It requires a redundant conjunct to be not overtly expressed.

- (318) *Be Brief* (Informal)
Do not express unnecessary conjuncts.

It is assumed that satisfaction of *Be Brief* always has a greater importance than satisfaction of *Be Articulate*. Schlenker claims that presupposition projection follows from the interaction between these two pragmatic principles.

Let us take a simple sentence (319) as an example, which presupposes that John used to smoke.

- (319) John stopped smoking_{John used to smoke}.

Be Articulate requires that something like (320) should be used, instead of (319).

- (320) John used to smoke and he stopped smoking_{John used to smoke}.

In a context where it is known that John used to smoke, the first conjunct of (320) is redundant, and *Be Brief* demands that (319) be used. Thus, *Be Articulate* and *Be Brief* put conflicting demands. Since the latter is favored over the former by assumption, in this case (319) needs to be used. On the other hand, if it is not known that John used to smoke, the first conjunct is not redundant and informative. Thus, *Be Brief* does not kick in. Therefore in such a context, (320) is the choice that is favored by the pragmatic principles, and as a consequence, (319) is infelicitous. The net effect is that a sentence with a presupposition like (319) can only be used when the presupposition is already known and would be redundant if overtly expressed. This is the way semantic and pragmatic presuppositions are related in this theory. That is, the semantic presupposition is a proposition that must be expressed overtly unless the context set entails it.

In (321) is a pedantic version of *Be Brief*. According to it, the evaluation of *Be Brief* proceeds incrementally. For instance, in a conjunctive sentence like (320), the first conjunct is checked if it is redundant with respect to the current context, without recourse to the meaning of the second conjunct.

- (321) *Be Brief* (Incremental)
Do not express p in a structure $\alpha [p]$ if for any X and any good final β , the following equivalence holds in all w in the context set C :

$$[[\alpha [p \text{ and } X] \beta]]^w \Leftrightarrow [[\alpha [X] \beta]]^w$$

This incremental version of *Be Brief* captures the asymmetric nature of presupposition projection in conjunction and other operators (see Schlenker 2007a, 2008 for concrete examples of other sentential operators). For instance, the following sentence is not felicitous in any context, unlike (320).

- (322) #John stopped smoking and he used to smoke.

This is captured with the principle of *Be Brief* defined in (321). That is, in order for the first conjunct of (322) to be licensed in the sense of (321), it must be the case that John used

to smoke in all the worlds of the context set C . Then, the second conjunct is guaranteed to be infelicitous. In addition to (321), Schlenker also postulates a non-incremental version of *Be Brief* to explicate symmetric projection properties of certain sentential operators, e.g. disjunction and conditionals, but since sentential cases are not of our primary concern here, I will not discuss it here.

For quantificational sentences, Schlenker assumes that *Be Brief* is evaluated at the level of the predicate. He shows that his theory makes basically the same predictions as Heim's (1983) theory, once the following two assumptions are made.

- (323) a. *Constancy*: The domain of individuals is finite and constant in all the worlds in the context set C , and the restrictor of a quantificational determiner is true of a constant number of individuals in all the worlds in C .
 b. *Non-triviality*: A quantificational sentence has non-trivial truth conditions.

Schlenker (2008:179) remarks as follows:

'Constancy' is a technical hypothesis with no justification; without it, we predict slightly weaker presuppositions than Heim [...]. On the other hand, 'Non-triviality' is entirely natural.

I will not go into the technical details of the proof that Schlenker's theory is equivalent to Heim's when these two assumptions hold (see Schlenker 2007a). Instead, let us look at a concrete example.

- (324) No student λx [x stopped smoking $_{x}$ used to smoke].

Be Articulate prefers (325) to (324).

- (325) No student λx [x used to smoke and x stopped smoking $_{x}$ used to smoke].

According to *Be Brief*, (324) can be used when the first conjunct of (325) is redundant, which is the case when the following equivalence holds for all the worlds w in the context set C , and for all predicates P .

- (326) $[[\text{No student } \lambda x [x \text{ used to smoke and } P]]^w \Leftrightarrow [[\text{No student } P]]^w$

(326) is vacuously true if there is no student, but Non-triviality and Constancy requires that in all worlds there are some students. Then, the presupposition amounts to that all students used to smoke, which is a universal inference.

More generally, as Heim predicts, all quantified sentences will have universal inferences when there is a presupposition trigger in the nuclear scope.⁸⁴ Thus, it is predicted that (327a) also has a universal inference. Specifically, *Be Articulate* demands (327b) to be used instead of (327a).

- (327) a. Exactly one student λx [x criticized herself $_{x}$ is female]
 b. Exactly one student λx [x is female and criticized herself $_{x}$ is female]

Given *Be Brief*, (327a) can be used only if the following equivalent holds for all worlds $x \in C$ and all predicates P .

⁸⁴Moreover, when there is a presupposition trigger in the restrictor, the predicted inference is that all individuals in the universal satisfy the presupposition, as Heim (1983) predicts.

$$(328) \quad \llbracket \text{exactly one student } \lambda x [x \text{ is female and } P] \rrbracket^w \Leftrightarrow \llbracket \text{exactly one student } P \rrbracket^w$$

With Constancy and Non-triviality, in order for this equivalence to hold, all students need to be female, which is a universal inference.

Recall that Heim makes use of the mechanism of local accommodation to arrive at a non-universal inference for sentences with indefinites. Under Schlenker's theory, the same effect as local accommodation can be achieved if *Be Brief* is exceptionally violable in the relevant cases. Let us suppose that *Be Brief* can exceptionally be violated in this case, and (328a) can be used without the equivalence in (328). Then, the sentence just means (327a) without any presuppositions. But does it have correct truth conditions? If the assertive meaning of *criticized herself* does not have any gender inference, and (327a) has no presuppositional inference, then it is predicted to be void of gender inference all together, but this is evidently wrong. that is (327a) suggests that the unique student who criticized herself is female. On the other hand, if the gender inference is part of the assertive meaning, the predicted truth conditions are very weak, as we repeatedly saw above. Notice that in the representation (327a), the presupposition is dissociated from the assertive meaning, and this allows one to formulate a meaning of *exactly one student* that achieves the correct truth conditions, e.g. (329).

$$(329) \quad \llbracket \text{exactly one student} \rrbracket^w(\lambda x.S(x)_{P(x)}) \Leftrightarrow \text{There is one student } x \text{ such that } P(x) \text{ and } S(x), \text{ and for all the other students } y \text{ distinct from } x, \neg S(y) \text{ in } w.$$

However, this runs counter to Schlenker's tenet that presuppositions are those propositions that like to be overtly expressed, and potentially considerably attenuates the explanatory power of his theory. That is, the meaning in (329) manipulates the presuppositional meaning in a semantic way, and once such a mechanism is allowed in a theory, one can define a connective that gives rise to an arbitrary inference from a presuppositional meaning. For instance, one can define an operator like (330).

$$(330) \quad \llbracket \text{not}' \rrbracket^w(S_p) \Leftrightarrow \neg S \text{ and it is desirable that } p$$

However, such an inference never arises from a connective like *not*. In other words, once such a mechanism is available, the resulting theory is as arbitrary as Karttunen and Peter's in that presuppositional meaning can be used to give rise to a variety of inference in an arbitrary manner.

6.2.2 Local Contexts

Schlenker (2009, 2010a) offers another non-dynamic theory of presupposition projection that makes similar predictions as Heim's (1983) and Transparency Theory presented above. The main idea is to reconsider the notion of 'local contexts'. In dynamic semantics, when a context c is updated with a complex sentence, the update is done with the CCPs of the atomic sentences within the complex sentence, and each update yields a new context, or a local context. Each local context, by assumption, represents the common ground at some state of the discourse (potentially a hypothetical state), i.e. the body of knowledge that the discourse participants take for granted at that time. Schlenker makes use of a similar device, but crucially, his local contexts are not representations of the discourse participants' common belief. Rather, for him, the local context of an expression α is defined as the smallest domain of objects needed for evaluating the meaning of α at the current discourse. This allows him to dispense with the dynamic semantics altogether, as we will see now.

As before, let us start with sentential cases and generalize the idea to quantificational sentences. The local context of an atomic sentence S (potentially contained in a bigger sentence) is defined as the smallest domain that does not affect the truth conditions of S with respect to the context set C . As in Transparency Theory, the idea of incrementality is encoded in the notion of (331) so as to account for the effect of the linear order. In the following definition, this is done by quantifying over good finals β' . By abuse of language, I use c in both the object and metalanguage (i.e. $\lambda w. \llbracket c \rrbracket^w = c$).⁸⁵

(331) *Local Context* (Sentential)

The local context of a sentence S occurring in a syntactic context $\alpha S \beta$ is the smallest set of worlds c such that the following equivalence holds for all the worlds w of the context set C and for all good finals β' :

$$\llbracket \alpha [c \text{ and } X] \beta' \rrbracket^w \Leftrightarrow \llbracket \alpha X \beta' \rrbracket^w$$

As in Heim (1983), a sentence S_p with a presupposition p can be felicitously used only if p is entailed by the local context of S_p .

Let us consider a simple conjunctive sentence S and T uttered in a context set C as an example. The local context of S is clearly C , i.e. excluding any world in C can well change the truth of S . For T , on the other hand, one does not need to consider the worlds in C that make S false, because in those worlds the entire conjunction is false anyway. In other words, S and T and S and (S and T) have the same truth conditions. Furthermore, $C \cap \llbracket S \rrbracket$ is the smallest set of worlds that validates the equivalence in (331), i.e. it is the local context for T . This captures that the projection property of *and*. That is, the presuppositions of T do not survive as the presuppositions of the entire conjunction, when S entails them.

Let us now turn to quantificational sentences. In order to deal with presupposition projection in quantified sentences, Schlenker extends the above definition of local contexts to arbitrary expressions. Instead of pondering over the formal definition, let us look at an example.

(332) No students stopped smoking.

We need to ask what the local context of the predicate *stopped smoking* is. Since it is a predicate, its local context is of the predicative type as well. The idea is the same as before, the local context is the strongest predicate that when conjoined with *stopped smoking*, does not change the meaning with respect to the context set C . That is, it is the predicate that entails all the other predicates P that validate the following equivalence.

(333) For all worlds $w \in C$,
 $\llbracket \text{No students } [P \text{ and stopped smoking}] \rrbracket^w$
 $\Leftrightarrow \llbracket \text{No students stopped smoking} \rrbracket^w$

Assume now that Constancy and Non-triviality in (323) hold, too. Then, it turns out that in this case, the local context is $\llbracket P \rrbracket = \lambda x. \lambda w. x$ is a student in w and $w \in C$. The requirement is that this predicate entails the presupposition. Notice that the presupposition is also predicative, i.e. $\lambda x. \lambda w. x$ used to smoke in w . In this case what is required is that the former entails the latter in the sense of generalized entailment, i.e. for all $\langle x, w \rangle$ such that $P(x, w) = 1$, x used to smoke in w . Therefore, the resulting inference is a universal

⁸⁵Schlenker (2009) discusses in an appendix cases where there is no unique smallest set c , but this technical complication does not concern us here.

inference that all the students used to smoke.

The predictions that this theory makes for quantificational sentences are essentially identical to those of Transparency Theory, and hence it runs into the same problems. As Transparency Theory, all the quantificational sentences are predicated to be associated with universal inferences, when Constancy and Non-triviality hold (see Schlenker 2009 for a proof for the equivalence). That is, the local context for the nuclear scope is always the property denoted by the restrictor R restricted to the current context set C , i.e. $\lambda x.\lambda w.R(x, w) \wedge w \in C$. However, this is evidently too strong for certain quantifiers. As already shown above for Transparency Theory, furthermore, local accommodation will not help for sentences like *Exactly one student criticized herself*.

Schlenker (2010a) puts forward yet another technical variant of the above idea, with a slightly different notion of local contexts that is computed based on the notion of R -entailment ('entailment as redundancy'). I do not go into the details of this reformulation, as it makes the same empirical predictions as the theory reviewed here. In particular, for quantified sentences, the local contexts of the restrictor and nuclear scope are required to entail respect presuppositions and hence the theory run into the same undergeneration problem with respect to predicates like *criticized herself*.

6.3 Representational Theory

Another localist theory is put forward by van der Sandt (1992) and Geurts (1999) (also Schlenker 2011a). It is a syntactic theory of presupposition projection, and it deal with the projection problem as a special case of anaphora resolution. However, being a localist theory, it runs into the same undergeneration problem with respect to predicates like *criticized herself*.

This theory is built upon the idea that presuppositions are those propositions that need to be anaphoric to some propositional antecedent available in the discourse, and are likened to pronouns and other anaphoric elements that need to be resolved to some individual antecedent available in the discourse. The formulation of this idea is given in the framework of Discourse Representation Theory (DRT), which was originally formulated as a theory of pronominal anaphora (Kamp 1981, Kamp & Reyle 1993).

6.3.1 Discourse Representation Theory

DRT is a syntactic theory of discourse in the sense that a discourse is explicitly represented in a formal language. DRT models a discourse as a so-called Discourse Representation Structure (DRS), which has two major parts, a set of reference markers that represent the individuals that the discourse is about, and DRS-conditions that represent the content of the discourse. Formally, a DRS S is a pair $\langle U(S), K(S) \rangle$ where $U(S)$ is a set of reference markers, and $K(S)$ is a set of DRS-conditions.

DRS-conditions are defined as (334). The third clause (334c) allows embedding of DRSs within other DRSs.

- (334)
- a. $P(x_1, \dots, x_n)$ is a DRS-condition, where P is an n -place predicate and x_1, \dots, x_n are reference markers.
 - b. If x and y are reference markers, then $x = y$ is a DRS-condition.
 - c. If ϕ and ψ are DRSs, then $\neg\phi, \phi \vee \psi, \phi \Rightarrow \psi$ are DRS-conditions.
 - d. Nothing else is a DRS-condition.

The key concept in DRT is the notion of accessibility, which syntactically delimits the range of possible values that an anaphoric element like a pronoun can pick out as its referent. Accessibility is defined as a reflexive and transitive relation (preorder) between DRSs.

- (335) a. If $\neg\psi \in K(\phi)$, then ϕ is accessible from ψ .
 b. If $\psi \vee \chi \in K(\phi)$, then ϕ is accessible from ψ and from χ .
 c. If $\psi \Rightarrow \chi \in K(\phi)$, then ϕ is accessible from ψ and ψ is accessible from χ .
 d. No other DRSs are accessible from any other DRSs.

The idea is that the reference marker denoted by a pronoun contained in a DRS S needs to find a suitable antecedent reference marker in another DRS T that is accessible from S . Derivatively I will speak of reference markers being accessible from other reference markers.

The above syntax is combined with a model-theoretic interpretation. A DRS ϕ is true, if there is an assignment function f that assigns values to the reference markers of the DRSs accessible from ϕ , and makes all the DRS-conditions of ϕ true. I do not go into the details of the semantics here, as the DRT representations are fairly intuitive. See van der Sandt (1992), Kamp & Reyle (1993) and Geurts (1999) for details.

Both van der Sandt (1992) and Geurts (1999) adopt the version of DRT that allows transformation of a DRS to another DRS before it gets semantically interpreted. Generally, there are two stages in a derivation. First, a sentence is converted into a DRS S , and merged with the current context. Then, in the second step, anaphoric elements in S are resolved, where the anaphora resolution amounts to converting S into another DRS S' .

Here is an example. The sentence in (336a) is assigned the DRS representation in (336b). I use Geurts' notation where a DRS S is represented as $[U(S): K(S)]$.

- (336) a. A linguist is singing.
 b. $[x: \mathbf{linguist}(x), \mathbf{singing}(x)]$

Now consider the sentence in (337a) that contains a pronoun. It is assumed to have the DRS in (337b).

- (337) a. He is loud.
 b. $[\underline{y}: \mathbf{loud}(y)]$

The reference marker here is underlined to indicate that it needs to be resolved. Now (336b) and (337b) are merged to yield (338). The merging operation represents the cumulation of information in a discourse, and defined as taking the unions of the reference markers and DRS-conditions of two DRSs.

- (338) $[x, \underline{y}: \mathbf{linguist}(x), \mathbf{singing}(x), \mathbf{loud}(y)]$

This DRS still contains an underlined material, and is by assumption illicit for semantic interpretation (or 'improper'). The mechanism of anaphora resolution operates on this representation, and transforms it into (339a), which is more compactly written as (339b).

- (339) a. $[x, y: \mathbf{linguist}(x), \mathbf{singing}(x), \mathbf{loud}(y), x = y]$
 b. $[x: \mathbf{linguist}(x), \mathbf{singing}(x), \mathbf{loud}(x)]$

The resulting representation does not contain any underlined material, and can be given a semantic interpretation. As this example illustrates, resolution of a pronoun is essentially identification of an underlined reference marker \underline{y} with another discourse marker x that is

accessible from the DRS that y belongs to, by inserting the DRS-condition $x = y$.

6.3.2 Presupposition Projection in DRT

The idea that van der Sandt (1992) and Geurts (1999) advocate is to generalize the above mechanism of anaphora resolution to presupposition. They assume that presuppositions are DRSs that need to find an antecedent in some accessible DRS (in the sense to be made clear below), just like pronouns need to find an antecedent in some accessible DRS. For technical reasons, DRSs are now defined as triples, $\langle U(S), K(S), A(S) \rangle$, where $A(S)$ is a possibly empty set of DRSs representing presuppositions to be resolved. Following Geurts (1999) I will indicate the contents of $A(S)$ by underlining.

For instance, the sentence in (340a) is given the DRS representation in (340b) (the meaning of proper names are simplified; see Geurts 1999 for discussion).

- (340) a. John's computer is fast.
 b. [\underline{x} : computer(x), own(j, x), fast(x)]

Being definite, the possessive noun phrase *John's computer* is anaphoric, and hence its reference marker x is underlined. Also it carries a presupposition that x is a computer that John owns. Suppose that this is uttered after the following sentence.

- (341) a. John and Bill both have a computer.
 b. [y, z : computer(y), computer(z), own(j, y), own(b, z)]

Then merging the two DRS, we obtain (342).

- (342) $\left[\begin{array}{l} \text{computer}(x), \text{own}(j, x), \text{fast}(x), \\ \underline{x}, y, z: \text{computer}(y), \text{own}(j, y), \\ \text{computer}(z), \text{own}(b, z) \end{array} \right]$

Resolving x to y , we get the DRS in (343a), which can be simplified as (343b).

- (343) a. $\left[\begin{array}{l} \text{computer}(x), \text{own}(j, x), \text{fast}(x), x = y \\ x, y, z: \text{computer}(y), \text{own}(j, y), \\ \text{computer}(z), \text{own}(b, z) \end{array} \right]$
 b. [y, z : computer(y), own(j, y), fast(y), computer(z), own(b, z)]

Technically, the mechanism of presupposition resolution is defined as a transformation operation *Binding* that takes a presuppositional DRS P , an element of the anaphoric structure $A(S)$ and a DRS T accessible from P that is the target of presupposition resolution, and yields a new DRS T' containing P' in place of P in the following manner.

- (344) *Binding*
 a. $U(P') = K(P') = \emptyset$
 b. $U(T') = U(P) \cup U(T)$
 c. $K(T') = K(P) \cup K(T) \cup I$

Here I is the set of identity statements of the form $x = y$ where $x \in U(P)$ and y is a reference marker that is accessible from x . In the above simple example (343a), for instance, $I = \{x = y\}$. As stated in (344a), after resolving a presupposition, P will be converted to a

trivial DRS P' , and the reference markers and conditions of P will be copied to the target DRS T as stated in (344b) and (344c).

Importantly, in not all cases, can a presupposition find a suitable antecedent in an accessible DRS. Consider the sentence in (345a), which is assigned the DRS in (345b).

- (345) a. Either John doesn't have a computer, or his computer is small.
 b. $[\neg[x: \mathbf{computer}(x), \mathbf{own}(j, x)] \vee [y: \mathbf{computer}(y), \mathbf{own}(j, y), \mathbf{small}(y)]]$

Clearly there is no suitable antecedent for the presupposition. In this case, it is assumed that the presupposition is accommodated. Accommodation proceeds just like Binding, except that no identity statements will be added, i.e. $I = \emptyset$. Let us call the relevant operation *Accommodation*. Several constraints are postulated for Accommodation. Firstly, Accommodation targets the least embedded DRS accessible from the presupposition such that the result of the resolution will be coherent and comply with the general pragmatic conditions on the acceptability. One of the conditions is that no variables contained in the DRS-conditions of the resulting DRS can be free, i.e. not linked to any accessible reference markers. This condition will be important for quantificational structures. Also, Binding is assumed to be inherently preferable to Accommodation. In this sense, Accommodation is a last resort operation. In (345b), for example, Binding is not possible, as there is no suitable antecedent, and hence Accommodation is possible, while in (342) Accommodation is blocked, because there is a suitable antecedent. In (345b), furthermore, Accommodation cannot target the topmost DRS, because that would make the first disjunct redundant and unacceptable. Thus, the only possibility is 'local accommodation' which amounts to the following.

- (346) $[\neg[x: \mathbf{computer}(x), \mathbf{own}(j, x)] \vee [y: \mathbf{computer}(y), \mathbf{own}(j, y), \mathbf{small}(y)]]$

Both van der Sandt (1992) and Geurts (1999) provide arguments for this framework over alternatives, especially Heim's (1983) dynamic semantic theory. Geurts (1999), in particular, raises arguments from the treatment of presupposition projection in *if*-conditionals and attitude contexts, but I will not delve into them here and concentrate on the theory's predictions for presuppositions in quantified sentences.

6.3.3 Quantified Sentences in DRT

Both van der Sandt (1992) and Geurts (1999) discuss presupposition projection in quantified sentences. Let us make use of Kamp & Reyle's (1993) duplex conditions to represent quantificational structures.⁸⁶

- (347) a. If ϕ and ψ are DRSs and u is a reference marker, $\phi\langle Qu\rangle\psi$ is a DRS-condition.
 b. If $\psi\langle Qu\rangle\chi \in K(\phi)$, then ϕ is accessible from ψ and ψ is accessible from χ .

Let us look at some examples. A simple quantificational sentence like (348a) will be given the complex DRS in (348b).

⁸⁶It should be mentioned that van der Sandt (1992) only discusses unselective binding, and Geurts (1999) explicitly argues against Kamp & Reyle's (1993) treatment of quantificational structures. Geurts' main objection against it is that it does not allow the domain of quantification to be presupposed. Specifically, given that ϕ in $\phi\langle Qu\rangle\psi$ is a DRS by definition, it is not an appropriate object to be presupposed. Geurts proposes an alternative treatment of quantification, but differences among the theories of quantification in DRT do not matter much for our expository purposes here.

- (348) a. Most of the students are former smokers.
 b. $[: [: \text{student}(x)] \langle \text{most } x \rangle [: \text{former.smoker}(x)]]$

The example in (349a) illustrates that a reference marker introduced in the restrictor is accessible from the nuclear scope. After the resolution of the pronoun, it will have the representation in (349b).

- (349) a. Every student who wrote a paper liked it.
 b. $[: [y : \begin{array}{l} \text{student}(x), \text{paper}(y), \\ \text{wrote}(x, y) \end{array}] \langle \text{every } x \rangle [: \text{liked}(x, y)]]$

Here the reference marker introduced by pronoun *it* is resolved to *y*, which is a paper. This captures the intended reading that every student who wrote a paper liked the paper.

Now let us see what happens when the nuclear scope contains a presupposition.

- (350) a. Most of the students stopped smoking.
 b. $[: [: \text{student}(x)] \langle \text{most } x \rangle [: \text{former.smoker}(x), \underline{\text{used.to.smoke}}(x)]]$

In this case, there is no suitable antecedent for the presupposition $[: \text{used.to.smoke}(x)]$, and hence it needs to be accommodated. There are three possible accommodation sites in this structure. The first option is the topmost DRS, which is preferred if everything else is equal, but this option is unavailable here, because the presupposition contains a variable *x* which would be unbound there. The next option is the restrictor, where *x* will be bound. In this case, the resulting DRS looks as follows.

- (351) $[: [: \text{student}(x), \text{used.to.smoke}(x)] \langle \text{most } x \rangle [: \text{former.smoker}(x)]]$

This DRS represents the proposition that most of the students who used to smoke are former smokers. Beaver (2001) argues that such a reading is actually unavailable and therefore DRT suffers from an overgeneration problem, but Geurts (1999) claims that Beaver's arguments are ill grounded. I will not go into their debate here (it has to do with assumptions about the quantificational structure; cf. fn.86). To be complete, if Accommodation targets the nuclear scope DRS, then the resulting DRS is simply equivalent to (352), since **used.to.smoke**(*x*) is entailed by **former.smoker**(*x*).

- (352) $[: [: \text{student}(x)] \langle \text{most } x \rangle [: \text{former.smoker}(x)]]$

I will not discuss the legitimacy of these readings. Rather I will now demonstrate that this theory runs into the undergeneration problem with the following sentence.

- (353) a. Exactly one of the students criticized herself.
 b. $[: [: \text{student}(x)] \langle \text{exactly.one } x \rangle [: \text{criticized}(x, x), \underline{\text{female}}(x)]]$

Again, just as in the previous case because the presupposition contains *x*, it cannot be globally accommodated. The two syntactically well-formed options for accommodation will look as follows.

- (354) a. $[: [: \text{student}(x), \text{female}(x)] \langle \text{exactly.one } x \rangle [: \text{criticized}(x, x)]]$
 b. $[: [: \text{student}(x)] \langle \text{exactly.one } x \rangle [: \text{criticized}(x, x)]]$

The readings that they generated are paraphrased by (355).

- (355) a. Exactly one of the female students criticized herself.
 b. Exactly one of the students is female and criticized herself.

Both of these readings are weaker than the intended reading of (353a).

To sum up, what makes this theory localist is the constraint demanding that the variable x in the presupposition be bound. If a presupposition contains a variable bound by a quantifier, it needs to be resolved within the restrictor or the nuclear scope, but this will not generate the relevant reading of (353a). Although it is more flexible than dynamic semantics, as accommodation in the restrictor is available, it is still a localist theory and faces the undergeneration problem.

6.4 Three Valued Theories

Theories of presupposition projection that deploy three truth values, rather than two, have their roots in philosophy and logic (Bochvar 1981, Kleene 1952). Peters (1979) showed the adequacy of the idea as a linguistic theory (see also van Fraassen 1969), which was subsequently developed by Krahmer (1998), Beaver & Krahmer (2001), George (2008a,b) and Fox (2008, 2010) (see also Cooper 1983, who uses four truth values but achieves essentially the same theory as trivalent theory; cf. fn.62). As I have pointed out already, three valued approaches of presupposition projection are inherently incapable of the problem caused by predicates like *criticized herself*, since the presupposition is necessarily entailed by the assertive meaning of the predicate.

6.4.1 Three Truth Values and the Felicity Condition

Trivalent theory of presupposition projection represents a presupposition failure as a distinct truth value, denoted here by $\#$. In other words, presuppositions are encoded in the truth conditions as the conditions where $\#$ is returned. For instance, *John stopped smoking* is given the following meaning.

$$(356) \quad \llbracket \text{John stopped smoking} \rrbracket^w = \begin{cases} 1 & \text{John used to smoke and stopped in } w \\ 0 & \text{John used to smoke and still does in } w \\ \# & \text{otherwise} \end{cases}$$

These complex truth conditions yield pragmatic presupposition via the following Felicity Condition (cf. Stalnaker 1978).

- (357) *Felicity Condition*
 An assertion of sentence S is felicitous only if for all w in the context set, $\llbracket S \rrbracket^w \neq \#$.

Thus, for instance, an assertion of *John stopped smoking* requires that it be known already that John used to smoke.⁸⁷

Aiming at constructing an explanatory theory of presupposition projection, Fox (2008, 2010) claims that the correct projection properties of sentential operators are accounted for in this framework by incorporating the idea of incremental evaluation (George 2008a,b pursues a very similar approach, which is also reviewed below). I do not go into the details of this algorithm, as our main concern is quantified sentences. However, it should be clear that

⁸⁷Soames (1989) questions the validity of this Felicity Condition based on vague predicates (he illustrates it with a hypothetical predicate *smidget*).

it is expressive enough to correctly describe the projection properties of various sentential connectives. For instance, the meaning of *and* can be analyzed as follows (repeated from Section 3.4.2).

$$(358) \quad \llbracket \text{and} \rrbracket^w(q)(p) = \begin{cases} 1 & \text{if } p = q = 1 \\ 0 & \text{if } p = 0 \text{ or } (p = 1 \text{ and } q = 0) \\ \# & \text{otherwise} \end{cases}$$

This will yield the correct presupposition of a conjunctive sentence.

What about quantified sentences? The theory makes clear predictions, based on the meanings of the quantifier and the predicate. For instance, *stopped smoking* should have the following denotation.

$$(359) \quad \llbracket \text{stopped smoking} \rrbracket^w = \lambda x_e. \begin{cases} 1 & \text{if } x \text{ used to smoke and stopped in } w \\ 0 & \text{if } x \text{ used to smoke and still does in } w \\ \# & \text{otherwise} \end{cases}$$

This predicate can combine with normal generalized quantifiers, such as (360) (I disregard the presuppositions of the quantifiers).

$$(360) \quad \begin{aligned} \text{a. } & \llbracket \text{none of the students} \rrbracket^w \\ & = \lambda P_{\langle e,t \rangle}. \begin{cases} 1 & \text{if for all of the students } x, P(x) = 0 \\ 0 & \text{if for at least one of the students } x, P(x) = 1 \\ \# & \text{otherwise} \end{cases} \\ \text{b. } & \llbracket \text{some of the students} \rrbracket^w \\ & = \lambda P_{\langle e,t \rangle}. \begin{cases} 1 & \text{if for at least one of the students } x, P(x) = 1 \\ 0 & \text{if for all of the students } x, P(x) = 0 \\ \# & \text{otherwise} \end{cases} \end{aligned}$$

The underlying idea is that the sentence *None of the students P* is true just in case *P* returns 0 for all students, while we can be sure that it is false as soon as *P* returns 1 for some student. Similarly for *some of the students*.

Given these meanings, we can compute the presuppositions of the sentences in (361).

- (361) a. None of the students stopped smoking.
b. Some of the students stopped smoking.

Let us first discuss (361a). Its truth conditions are given in (362).

$$(362) \quad \llbracket \text{None of the students stopped smoking} \rrbracket^w \\ = \begin{cases} 1 & \text{if all the students used to smoke, and did not stop in } w \\ 0 & \text{if at least one student used to smoke and stopped in } w \\ \# & \text{otherwise} \end{cases}$$

According to the Felicity Condition given above, this sentence can be uttered when it denotes 1 or 0 in all of the worlds in the context set. Thus, what needs to be satisfied by the context set is the disjunction of the conditions for 1 and 0, i.e. all students used to smoke and continued smoking, or at least one student is a former smoker. This is equivalent to the proposition that all of the students used to smoke, or at least one student is a former smoker.

Notice that (362b) is predicted to have the same disjunctive presupposition, because the only truth conditional difference between the two sentences is that the conditions for 1 and 0 are swapped.

$$(363) \quad \llbracket \text{Some of the students stopped smoking} \rrbracket^w \\ = \begin{cases} 1 & \text{if at least one student used to smoke and stopped in } w \\ 0 & \text{if all the students used to smoke and did not stop in } w \\ \# & \text{otherwise} \end{cases}$$

The disjunctive presupposition so derived is weaker than a universal inference, and fails to straightforwardly account for the empirical evidence presented in Chemla (2009a) suggesting that *none of the students* triggers a universal inference. Furthermore, the experimental results of Chemla (2009a) and Sudo, Romoli, Hackl & Fox (2011) indicate that the projection properties of *none of the students* and *some of the students* are different, which is not captured either. Fox (2010) suggests some ways to derive other inferences in this general setup, to which we now turn.

6.4.2 Fox's Two Repair Strategies

Fox (2010) suggests that a disjunctive presupposition like the one we saw above is pragmatically marked and triggers one of two operations: (i) pragmatic strengthening, and (ii) insertion of the \mathcal{A} -operator (see also Sudo, Romoli, Hackl & Fox 2011). Pragmatic strengthening is a pragmatic inference that applies to a disjunctive presupposition $[\forall x \in R[P(x)]] \vee [\exists x \in R[P(x) \wedge S(x)]]$, derived from a quantificational sentence of the form $Q(R)(\lambda x.S(x)_{P(x)})$, and strengthens it to a universal inference $\forall x \in R[P(x)]$. The rationale behind this is that it is unnatural to hold a belief that either everybody satisfies the presupposition, or someone satisfies the presupposition and assertion, without being committed to one of these.⁸⁸ In the above case, for example, the derived presupposition is that either all the students were smoking, or some student is a former smoker. It is pragmatically marked to hold this belief in a neutral context, and this proposition is strengthened to simply that all the students were smoking. Thus, when pragmatic strengthening is applied, both sentences above are predicted to have a universal inference.

The \mathcal{A} -operator, on the other hand, accounts for the difference between *none of the NP* and *some of the NP* (see also Krahmer 1998, Beaver & Krahmer 2001). The \mathcal{A} -operator is a general mechanism that achieves (local) accommodation. Its function is to turn a presuppositional meaning into part of the assertive meaning, by collapsing the conditions for 0 and #.

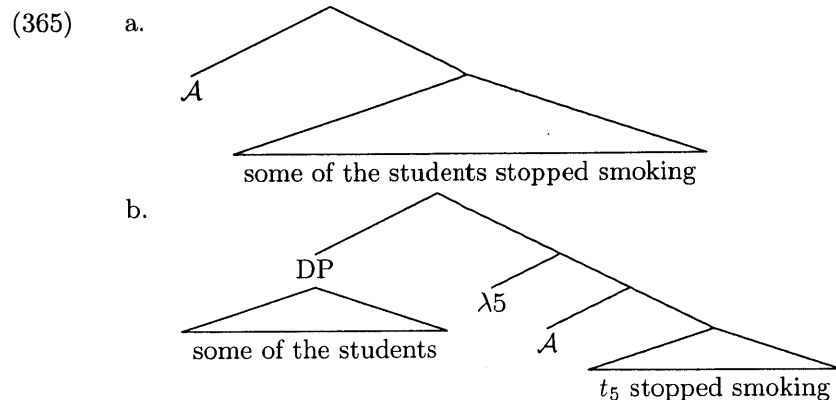
$$(364) \quad \llbracket \mathcal{A} \rrbracket^w(p) = \begin{cases} 1 & \text{if } p = 1 \\ 0 & \text{otherwise} \end{cases}$$

⁸⁸This strengthening mechanism is likened to the kind of inference postulated for conditional sentences, which derives a presupposition q from a weaker conditional presupposition $\neg p \vee q$ (cf. Karttunen & Peters 1979, van Rooij 2007, von Stechow 2008, Pérez-Carballo 2009). However, this is famously questioned by Geurts (1999), and one can construct a parallel argument against Fox's pragmatic strengthening, too. That is, (i) has a disjunctive presupposition due to the factive predicate *know*, but does not suggest that all of the students used to smoke.

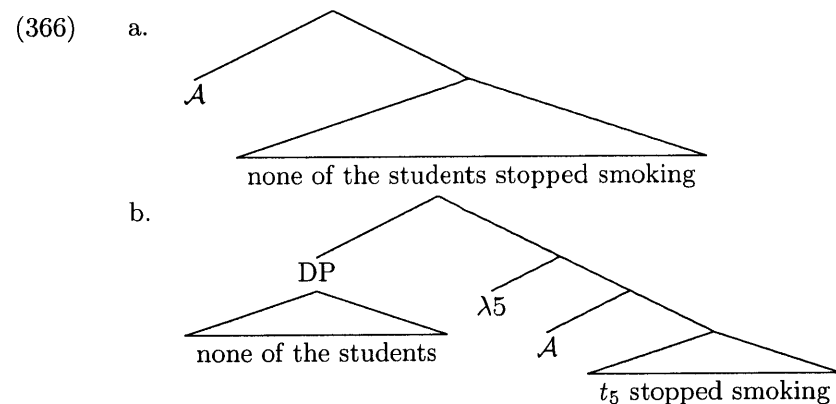
(i) John knows that either all of the students used to smoke, or some of them are former smokers.

Thus, once \mathcal{A} applies, the sentence will lose its presuppositions, and all the presuppositional content will be asserted.

Fox (2010) assumes that the \mathcal{A} -operator can apply above or below the quantifier. Let us consider the following two possibilities first.



Both of these structures denote 1 with respect to a possible world w if at least one of the students is a former smoker and 0 otherwise. Thus, the resulting inference is only existential. On the other hand, for *none of the students*, it will make a difference. Consider the following representations.



Firstly, (366a) is predicted to denote 1 if all of the students were smoking and continued smoking, and 0 otherwise. This entails the universal inference that all of the students used to smoke. In other words, the universal inference is derived as an entailment of the assertive meaning. (366b) yields a marked reading that all of the students are still smoking or never smoked, which is not even associated with an existential inference.

To wrap up, according to Fox (2010), there are three types of presuppositions that each of (361) has. (361) is repeated here for convenience.

- (361) a. None of the students stopped smoking.
 b. Some of the students stopped smoking.

Both of these sentences have the disjunctive presupposition that either every student was smoking, or some of them are former smokers, which can be strengthened to a universal inference. With the \mathcal{A} -operator, the existentially quantified sentence (361b) is bound to lack

a universal inference, while (361a) still can have a universal inference when the \mathcal{A} -operator is applied above the quantifier. This difference between *none of the NP* and *some of the NP* can be capitalized on to account for their difference in the robustness of a universal inference.

However, this theory is not expressive enough to accommodate the presuppositions of predicates like *criticized herself*. As explained in Section 4.3, the predicate necessarily entails the gender presupposition in a theory with three truth values.

$$(367) \quad \llbracket \text{criticized herself} \rrbracket^w = \lambda x_e. \begin{cases} 1 & \text{if } x \text{ is female and } x \text{ criticized } x \text{ in } w \\ 0 & \text{if } x \text{ is female and } x \text{ did not criticize } x \text{ in } w \\ \# & \text{otherwise} \end{cases}$$

As a consequence, it is not possible to account for the correct truth conditions of sentences like (368).

(368) Exactly one of the students criticized herself.

To make the matter worse, it is not easy to account for the non-universal inference of (368) in the first place. Under this theory it is given the following truth conditions that entail the universal inference that all the students are female.

$$(369) \quad \llbracket \text{Exactly one of the students criticized herself} \rrbracket^w = \begin{cases} 1 & \text{if one of the students is female and criticized herself,} \\ & \text{and all the other students are female and did not criticize themselves} \\ 0 & \text{if either at least two of the students are female and criticized themselves,} \\ & \text{or all of them are female and none of them criticized themselves} \\ \# & \text{otherwise} \end{cases}$$

Clearly, the sentence (368) does not have an entailment that all the students are female.

Generally, all non-upward monotonic quantifiers are predicted to have a universal inference just like *none of the NP* above. That is, for the truth conditions of such a sentence, all the individuals in the restrictor are relevant, and the predicate denotation needs to return either 1 or 0 to all of them. However, as experimentally shown by Chemla's (2009a), not all non-upward monotonic quantifiers are associated with a universal inference.⁸⁹

Although this account is already incorrect, let us consider what readings are predicted for (369) for the sake of completeness. Without Fox's repair strategies, the disjunction of the following three propositions is predicted.

- (370) a. All the students are female, and exactly one of them criticized herself.
 b. Two or more of the students are female, and criticized themselves.
 c. All of the students are female, and none of them criticized themselves.

It is reasonable to assume that this disjunctive presupposition is pragmatically marked and can be strengthened to a universal inference that all of the students are female. Alternatively, one can apply the \mathcal{A} -operator. If it is applied above the quantifier, the resulting reading will be (371).

⁸⁹ As suggested to me by Danny Fox (p.c.), this problem might be solvable by devising an alternative semantics for non-upward monotonic quantifiers. However, at this moment, a concrete implementation of this idea is not available.

(371) All of the students are female and exactly one of them criticized herself.

If the operator is applied below the quantifier, the resulting reading is (372).

(372) Exactly one of the students is female and criticized herself.

None of these correspond to the reading we are after, which is paraphrased as follows.

(373) Exactly one of the student is female and criticized herself, and all the others did not criticized themselves.

6.4.3 George (2008a,b)

George (2008a,b) presents a version of trivalent theory that makes different predictions for quantified sentences from Fox's (2010). Especially, it does not predict that *exactly one of the NP* gives rise to a universal entailment.

The notion of *functional deployment* is the key building block of George's theory. It determines the projection property of a given function f by specifying when it should denote $\#$ in the following manner.

(374) *Function Deployment*

Let f be an n -ary function. If there is b such that $f(\vec{y}) = f(\vec{z}) = b$ for any \vec{y} and \vec{z} that are acceptable repairs for \vec{x} , then $f[\vec{x}]$ (read ' f deployed on \vec{x} ') is equal to b . Otherwise $\#$.

Function deployment is an extension of the usual function-argument combination that takes into account presuppositional arguments, and it is built on the notion of *acceptable repairs*. For truth functional operators, acceptable repairs are simple. By assumption, the only repair of 0 is 0, the only repair of 1 is 1 and the repairs of $\#$ are both 0 and 1.

With this setting, what is predicted is identical to the so-called strong Kleene trivalent logic (Kleene 1952). Consider the case of negation \neg , as an example, which is a unary function over truth values. When 1 is its argument, since the only repair of 1 is 1, and since $\neg(1) = 0$ by definition, $\neg[1] = 1$. Similarly, since the only repair of 0 is 0 and $\neg(0) = 1$, $\neg[0] = 1$. However, for $\#$, there are two repairs 0 and 1, and because $\neg(1) \neq \neg(0)$, the result is $\#$.

Now let us consider the case of conjunction, which is a binary operator over truth values. When the argument is $\langle 1, 1 \rangle$, its possible repair is $\langle 1, 1 \rangle$ and since $\wedge(1, 1) = 1$, it follows that $\wedge[1, 1] = 1$. Similarly for other combinations of 0 and 1. Essentially, function deployment coincides the usual notion of function application with respect to the classical truth values 0 and 1, but it becomes more interesting when $\#$ is involved. Consider $\wedge[1, \#]$. There are two possible repairs, $\langle 1, 0 \rangle$ and $\langle 1, 1 \rangle$. Since $\wedge(1, 0) \neq \wedge(1, 1)$, $\wedge[1, \#] = \#$. Similarly, $\wedge[\#, 1] = \#$. For $\langle 0, \# \rangle$, on the other hand, since $\wedge(0, 0) = \wedge(0, 1) = 0$, $\wedge[0, \#] = 0$. For the same reason, $\wedge[\#, 0] = 0$. Therefore, there are cases where part of a sentence denotes $\#$, but the whole sentence still has a classical truth value, 0 or 1. George makes use of this to solve the projection problem. Since sentential connectives are not the main interest for us, I refer the reader to George's original works for further details and his treatment of other connectives.

The definitions of repairs are rather simple for truth values, but for quantificational sentences, more complex definitions are necessary. The arguments of a quantificational determiner are predicates, and hence we have to think about repairs of predicates. Natural

candidates for repairs of a predicate P of type $\langle e, t \rangle$ are the following.

$$(375) \quad \begin{array}{l} \text{a. } P^{0/\#} = \lambda x_e. \begin{cases} 1 & \text{if } P(x) = 1 \\ 0 & \text{otherwise} \end{cases} \\ \text{b. } P^{1/\#} = \lambda x_e. \begin{cases} 0 & \text{if } P(x) = 0 \\ 1 & \text{otherwise} \end{cases} \end{array}$$

In words, $P^{0/\#}$ treats presupposition failure as 0, and $P^{1/\#}$ treats it as 1. However, this causes an empirical problem for non-upward monotonic quantifiers like *exactly three students* (George 2008a also discusses universal quantifiers with presuppositions in the restrictor as another problem). Consider for instance, (376).

(376) Exactly three students stopped smoking.

In order to deploy the generalized quantifier *exactly three students* on the presuppositional predicate *stopped smoking*, we need to check if the following two propositions have the same truth value, where (377a) is derived with the repair $\llbracket \text{stopped smoking} \rrbracket^{0/\#}$ and (377b) is derived with the repair $\llbracket \text{stopped smoking} \rrbracket^{1/\#}$.

- (377) a. Exactly three students are former smokers.
b. Exactly three students are not smoking now.

The prediction, therefore, is that the sentence (376) is true just in case both sentences in (377) are true, false when they are false, and is presupposition failure otherwise. However, these truth conditions seem to be too strong. That is, the sentence is judged true even if there are many non-smokers now, as far as exactly three of them are former smokers. In other words, (377b) need not be true, for (376) to be true.

In order to circumvent the problem George introduces the notion of *relevant sets*. The idea is to treat both $P^{0/\#}$ and $P^{1/\#}$ as repairs in some cases, and only $P^{0/\#}$ in others. In the above case, for instance, we want to ignore (377b). George defines the notion of relevant sets in a general way,⁹⁰ but in the case of quantified sentences, the relevant set at the evaluation of the quantificational determiner and its restrictor is the entire set of individuals, while at the point when the nuclear scope is evaluated the relevant set have shrunk to the individuals satisfying the restrictor. With the notion of relevant sets, we can force function deployment to ignore the repair $g^{0/\#}$ unless no individual in the relevant set satisfies g .

(378) *Available Repairs*

Let X be the relevant set of a function f with arguments \vec{a} and g in this order.
 $g^{0/\#}$ is the only repair for g if for some $x \in X$, $g(x) = 1$, while both $g^{0/\#}$ and $g^{1/\#}$

⁹⁰The general definition of relevant sets is given below, where functions b and b' agree on a set X iff for all $x \in X$, $b(x) = b'(x)$.

(i) *Relevant Sets*

A set X is a relevant set for a function f and a list of arguments \vec{a} iff for every pair of arguments b and b' such that b and b' agree on X and every list of non-presuppositional arguments \vec{c} , $f(\vec{a}, b, \vec{c}) = f(\vec{a}, b', \vec{c})$

As George observes, there is generally more than one relevant set, but we generally speak of the smallest relevant set. He also remarks that there are cases where there is no smallest relevant set, but for them, we can restate everything in terms of every relevant set.

are the available repairs for g if for no $x \in X$, $g(x) = 1$.

Coming back to (376), what the resulting theory predicts is the following. When there is at least one student who used to smoke and stopped, then the available repair is only $\llbracket \text{stopped smoking} \rrbracket^{0/\#} = \llbracket \text{is a former smoker} \rrbracket$. Then, the sentence is predicted to be true just in case there are exactly three former smokers, and false if there are more or less former smokers. On the other hand, when there is no student who used to smoke, then both of $\llbracket \text{stopped smoking} \rrbracket^{0/\#}$ and $\llbracket \text{stopped smoking} \rrbracket^{1/\#}$ are possible repairs. Because there is no student who used to smoke, the former repair is bound to be false. Thus, the sentence is predicted to be false, when the latter repair also results in falsity. That is, there are more than three or less than three students who are not smoking now. In all the other cases, i.e. none of the students are former smokers, and there are exactly three who are not smoking now, presupposition failure is predicted.

For considerations that have to do with universally quantified sentences, and the asymmetric nature of conjunction, George introduces further complications that do not concern us much here, although it changes the presuppositions slightly for (376). However, importantly, this system is again unable to capture the correct truth conditions for sentences like the following.

(379) Exactly one of the students criticized herself.

The two repairs will be synonymous with the following sentences.

- (380) a. Exactly one of the students is female and criticized herself.
 b. Exactly one of the students is male or criticized themselves.

When there is at least one female student, (380a) is the only available repair, and hence the sentence is predicted to be true if there is exactly one student who is female and criticized herself, and false otherwise. However, these truth conditions are too weak, as the sentence is predicted to be true even if some male students criticized themselves in addition to the female student. The gist of the problem is the same as before. The presupposition needs to be entailed at the predicate level under this theory, which is not appropriate here.

6.5 Chemla's Similarity Theory

Chemla (2009b) puts forward a recent version of two dimensional theory of presuppositions. Chemla's theory is motivated by unification of scalar implicatures and presuppositions, but I evaluate his theory as a theory of presupposition projection. Chemla's (2009b) theory makes concrete and interesting predictions about presupposition projection out of quantified sentences. As I will show, however, being a two dimensional theory, it suffers from the binding problem.

The central idea of Chemla's theory is that presupposition triggers have lexically specified scales that contain extreme elements. For an illustration, let us take *stopped smoking*, which I treat here as an atomic lexical item for the sake of simplicity.

(381) $\llbracket \text{stopped smoking} \rrbracket = \lambda x_e. x$ is a former smoker

By assumption, it is associated with the following ordered set of alternatives, where \perp and \top denote contradiction and tautology respectively.

$$(382) \quad \left\langle \begin{array}{ll} \lambda x_e. \perp, & \lambda x_e. \neg x \text{ used to smoke,} \\ \lambda x_e. x \text{ is a former smoker,} & \\ \lambda x_e. x \text{ used to smoke,} & \lambda x_e. \top \end{array} \right\rangle$$

In general, it is assumed that a predicate $\lambda x_e. P(x)$ with a presupposition $\lambda x_e. Q(x)$ is associated with the scale of the following form.

$$(383) \quad \langle \lambda x_e. \perp, \lambda x_e. \neg Q(x), \lambda x_e. P(x), \lambda x_e. Q(x), \lambda x_e. \top \rangle$$

Now consider a simple sentence in (384).

$$(384) \quad \text{John stopped smoking.}$$

It is assumed that the alternative propositions of (384) are constructed with the other members of the scale associated with *stopped smoking*. Thus, in this case, the following four propositions are the alternatives of (384).

$$(385) \quad \begin{array}{l} \text{a. } \perp \\ \text{b. } \neg \text{John used to smoke} \\ \text{c. } \text{John used to smoke} \\ \text{d. } \top \end{array}$$

By assumption, these alternatives are grouped according to which side of the scale the members used in them belong to, relative to the assertive meaning of *stopped smoking*. Because *stopped smoking* is in the middle of the scale, there are two groups. In fact all presupposition triggers are assumed to be in the middle of a scale, and hence there are always two groups to consider. Let us call them negative and positive alternatives.

$$(386) \quad \begin{array}{l} \text{a. Negative alternatives: } \{\perp, \neg \text{John used to smoke}\} \\ \text{b. Positive alternatives: } \{\text{John used to smoke}, \top\} \end{array}$$

These alternatives give rise to inferences with the help of the following principle, where *CG* stands for ‘it is common ground that’.⁹¹

$$(387) \quad \begin{array}{l} \textit{Epistemic Similarity Principle} \\ \text{Let } S \text{ be a set of alternatives. Then for all } p, q \in S, CG(p) \Leftrightarrow CG(q) \end{array}$$

Applying to this principle to the alternative sets in (386), we obtain the following inferences.

$$(388) \quad \begin{array}{l} \text{a. } CG(\perp) \Leftrightarrow CG(\neg \text{John used to smoke}) \\ \text{b. } CG(\text{John used to smoke}) \Leftrightarrow CG(\top) \end{array}$$

It is natural to assume that the discourse is coherent, and hence that $\neg CG(\perp)$ and $CG(\top)$ always hold. As a consequence, we infer from (388) that $\neg CG(\neg \text{John used to smoke})$ and that $CG(\text{John used to smoke})$. The latter means that it is known among the discourse participants that John used to smoke. In addition, $\neg CG(\neg \text{John used to smoke})$ is also generated under this theory, but this is a very weak inference and essentially harmless here. But as demonstrated below, the inference from the negative alternatives becomes non-trivial in certain quantified sentences and creates a problem.

⁹¹Chemla (2009b) uses B_s which stands for ‘the speaker believes that’ in order to keep the uniformity with scalar implicatures, but as scalar implicatures are not relevant here, we use *CG*.

In addition to this basic mechanism Chemla maintains that when certain conditions are met, one can strengthen the inferences in (388) to the following. He calls the inferential step from (388) to (389) an *epistemic step* (cf. Sauerland 2008a).

- (389) a. $CG(\perp) \Leftrightarrow \neg\text{John used to smoke}$
 b. $CG(\text{John used to smoke}) \Leftrightarrow \top$

Given the assumption that it is never the case that $CG(\perp)$ and it is always the case that $CG(\top)$, both of these entail that $CG(\text{John used to smoke})$. This mechanism does not yield anything new in simple sentences like this, but gives the system a certain degree of flexibility for presuppositions of quantified sentences.

6.5.1 Sentential Connectives

Here is how presupposition projection is dealt with under Chemla's theory. Let us consider first the case of negation.

- (390) John did not stop smoking.

The alternatives are the following, which are derived from (386) above by prefixing the negation to each alternative.

- (391) a. Negative alternatives: $\{\neg\perp, \neg\neg\text{John used to smoke}\}$
 b. Positive alternatives: $\{\neg\text{John used to smoke}, \neg\top\}$

Then, by the Epistemic Similarity Principle, the following inferences are derived.

- (392) a. $CG(\neg\perp) \Leftrightarrow CG(\neg\neg\text{John used to smoke})$
 b. $CG(\neg\text{John used to smoke}) \Leftrightarrow CG(\neg\top)$

These inferences are the same as in the simple positive case above, and hence the predicted inference is that it is common ground that John used to smoke. This captures the projection property of negation.

Now consider the case of conjunction.

- (393) John used to smoke and he stopped smoking.

The alternatives of (393) are the following.

- (394) a. Negative alternatives:
 $\left\{ \begin{array}{l} \text{John used to smoke and } \perp, \\ \text{John used to smoke and } \neg\text{John used to smoke} \end{array} \right\}$
 $= \{\perp, \perp\}$
 b. Positive alternatives:
 $\left\{ \begin{array}{l} \text{John used to smoke and John used to smoke,} \\ \text{John used to smoke and } \top \end{array} \right\}$
 $= \{\text{John used to smoke, John used to smoke}\}$

The inferences derived via the Epistemic Similarity Principle are the following.

- (395) a. $CG(\perp) \Leftrightarrow CG(\perp)$
 b. $CG(\text{John used to smoke}) \Leftrightarrow CG(\text{John used to smoke})$

Both of these are tautological, and hence no non-trivial inference is drawn. This captures the fact that the sentence above does not carry any presupposition.

I will omit the discussion of other sentential connectives, and jump into the case of quantified sentences.

6.5.2 Quantified Sentences

Chemla's theory makes varying predictions for quantified sentences. Let us consider several concrete examples.

A universally quantified sentence is predicted to have a universal inference. The sentence in (396), for example, generates the inferences in (397).

- (396) Every student stopped smoking.
 (397) a. $CG(\forall x \in \mathbf{student}[\perp]) \Leftrightarrow CG(\forall x \in \mathbf{student}[\neg x \text{ used to smoke}])$
 b. $CG(\forall x \in \mathbf{student}[x \text{ used to smoke}]) \Leftrightarrow CG(\forall x \in \mathbf{student}[\top])$

In a coherent discourse, it must be the case that $\neg CG(\forall x \in \mathbf{student}[\perp])$ and also that $CG(\forall x \in \mathbf{student}[\top])$. Therefore, the following inferences follow.

- (398) a. $\neg CG(\forall x \in \mathbf{student}[\neg x \text{ used to smoke}])$
 b. $CG(\forall x \in \mathbf{student}[x \text{ used to smoke}])$

(398b) is the presupposition that every student used to smoke, as desired. (398a) is very weak inference and is harmless here. With an epistemic step, (398a) gets strengthened to $CG(\neg \forall x \in \mathbf{student}[\neg x \text{ used to smoke}])$, which is an existential presupposition, while (398b) stays the same. All in all, what is predicted is the universal inference with or without an epistemic step.

For an existentially quantified sentence, the predicted inference is weaker than a universal inference. This is a welcome result, but the general mechanism here predicts an inference that is stronger than desired. Let us consider the following example.

- (399) Some student stopped smoking

This sentence has the following two inferences.

- (400) a. $CG(\exists x \in \mathbf{student}[\perp]) \Leftrightarrow CG(\exists x \in \mathbf{student}[\neg x \text{ used to smoke}])$
 b. $CG(\exists x \in \mathbf{student}[x \text{ used to smoke}]) \Leftrightarrow CG(\exists x \in \mathbf{student}[\top])$

Again, in a coherent discourse, $\neg CG(\exists x \in \mathbf{student}[\perp])$ and $CG(\exists x \in \mathbf{student}[\top])$ hold, from which the inferences in (401) are derived.

- (401) a. $\neg CG(\exists x \in \mathbf{student}[\neg x \text{ used to smoke}])$
 b. $CG(\exists x \in \mathbf{student}[x \text{ used to smoke}])$

The inference in (401b) is an existential inference that some student used to smoke. (401a), on the other hand, says that it is not common ground that there is some student who did not smoke. This inference seems to be empirically problematic. Suppose that it is commonly known that some of the students smoke and some other students have never smoked. Then the inference (401a) is in conflict with this situation. But intuitively, the sentence *Some student stopped smoking* can be perfectly felicitously uttered in this scenario. As I will show immediately below, an independent and more fundamental problem, i.e. the binding

problem, arises with predicates like *criticized herself*, and so I will not attempt to give a remedy of this problem here.

Now, for the sake of completeness, let us consider applying an epistemic stem to the inferences in (400). The resulting inferences are the following.

- (402) a. $CG(\neg\exists x \in \mathbf{student}[\neg x \text{ used to smoke}])$
 b. $CG(\exists x \in \mathbf{student}[x \text{ used to smoke}])$

The former is a universal inference that every student used to smoke. Therefore in this case a universal inference is predicted. As discussed in Section 3.3, (partitive) existential sentences may have universal inferences as one of their readings. Thus, it is a desirable feature of Chemla's theory that both existential and universal sentences are predicted for existentially quantified sentences.

6.5.3 The Binding Problem

However, being a two dimensional theory, Chemla's theory runs into the binding problem. Under this account, the predicate *did her homework* receives the following denotation and has the alternatives in (404).

(403) $\llbracket \lambda 5 \text{ did her}_5 \text{ homework} \rrbracket = \lambda x_e. x \text{ did } x\text{'s homework}$

(404) $\left\langle \begin{array}{l} \lambda x_e. \perp \quad \lambda x_e. x \text{ is not female} \\ \lambda x_e. x \text{ did } x\text{'s homework} \\ \lambda x_e. x \text{ is female} \quad \lambda x_e. \top \end{array} \right\rangle$

With a universal quantifier, this does not cause a problem. Consider the sentence in (405).

- (405) Every student did her homework.

The predicted inferences are the following.

- (406) a. $CG(\forall x \in \mathbf{student}[\perp]) \Leftrightarrow CG(\forall x \in \mathbf{student}[x \text{ is not female}])$
 b. $CG(\forall x \in \mathbf{student}[x \text{ is female}]) \Leftrightarrow CG(\forall x \in \mathbf{student}[\top])$

Because there are students, $CG(\forall x \in \mathbf{student}[\perp])$ should be false, from which we obtain (407a). Also since $CG(\forall x \in \mathbf{student}[\top])$ should be true, (407b) is derived.

- (407) a. $\neg CG(\forall x \in \mathbf{student}[x \text{ is not female}])$
 b. $CG(\forall x \in \mathbf{student}[x \text{ is female}])$

Notice that (407b) amounts to a universal inference that every student is female, and that (407a) is an innocuous weak inference that it is not commonly assumed that every student is male. As before, taking an epistemic step does not change the picture here.

By contrast, an existentially quantified sentence is predicted to have an intuitively incorrect inference. Consider the following sentence.

- (408) Some student did her homework.

The inferences predicted by the Epistemic Similarity Principle are the following.

- (409) a. $CG(\exists x \in \mathbf{student}[\perp]) \Leftrightarrow CG(\exists x \in \mathbf{student}[x \text{ is not female}])$

$$\text{b. } CG(\exists x \in \mathbf{student}[x \text{ is female}]) \Leftrightarrow CG(\exists x \in \mathbf{student}[\top])$$

With the assumptions about CG , we obtain the following inferences.

- (410) a. $\neg CG(\exists x \in \mathbf{student}[x \text{ is not female}])$
 b. $CG(\exists x \in \mathbf{student}[x \text{ is female}])$

(410b) is an existential inference, which is satisfied as far as there is at least one female student. However, this does not capture the inference of the sentence *Some student did her homework*, namely, that there is a female student who did her homework.

To make the matter worse, the same problem that we saw with *stopped smoking* arises here, namely, the inference (410a) is too strong, as it requires that the existence of a male student should not be known. Thus it is predicted that the sentence becomes infelicitous if it is known that there are male students, but this is evidently wrong.

Part II

Person and Number Features on Bound Pronouns and Complex Indices

Synopsis: In the present part, I will discuss the issue of phi features on bound pronouns, mainly focusing on the person and number features and their interaction. I start with discussing how the semantics of person features should be modeled. I take up two major approaches found in the literature, which I call the indexical semantics and variable semantics. The indexical semantics treats first and second person pronouns as constants, while the variable semantics treats them as variables, just like third person pronouns. At first sight, the variable semantics seems to be favorable, as it assigns the uniform semantics to pronouns of all persons, but I will point out two empirical problems. The indexical semantics, on the other hand, does not suffer from these problem, but instead needs an extra assumption about the bound uses of first and second person pronouns. I will review three approaches to the issue of bound first and second person pronouns, and then put forward a new analysis coupled with a novel semantics for first and second person pronouns that treats them as variables with special indices. The core of the proposal is that indices are enriched so as to encode the person information. In the second half of the present part, I will discuss number features on bound pronouns, which interact with person features in an interesting way. I will extend my account of person features on bound pronouns to subsume number features and their interaction, by encoding more information in the indices. I offer both empirical and conceptual arguments for my analysis over previous analyses.

Organization: Section 7 contains an introduction to the semantics of first and second person pronouns, where I will review the indexical semantics and variable semantics. The issue of bound first and second person pronouns is introduced in Section 8, and three previous approaches to this issue are critically reviewed in Section 9. A new account is offered in Section 10. From Section 11, I will discuss number features on bound pronouns, and how they interact with person features. Two previous approaches to the issue of number features on bound pronouns are discussed in Section 12, and my analysis of bound first and second person pronouns are extended to cover number features in Section 13.

7 The Semantics of First and Second Person Pronouns

Just like third person pronouns, first and second person pronouns do not have lexically specified fixed referents, as one can easily verify. For example, the first person pronoun *I* can be used to refer to different individuals in different occasions, as it just refers to whoever is the speaker of the sentence containing that occurrence of *I*.⁹² Thus, when Sam and Natasha utter *I am hungry*, they are talking about different individuals with *I*. Similarly *you* refers to whoever is the hearer when the sentence is uttered and does not have a fixed referent.⁹³ In this sense, first and second person pronouns are similar to third person pronouns. However, unlike third person pronouns, their denotations are highly restricted, and basically determined by the conversational context in which the utterance is taking place (Kaplan 1977). That is, first person pronouns refer to whoever is speaking, and

⁹²This is an oversimplification. For example, *I* in a direct quote does not need to refer to the speaker of the utterance containing that quote. Also, as we will see in Part III, certain types of complex sentences in certain languages ‘shift’ the interpretation of first and second person pronouns systematically. But these complications do not arise in simple sentences.

⁹³Or some group of people including the hearer. For the sake of simplicity, I will ignore plural pronouns until Section 12. Also, I will not discuss the generic, or *impersonal* use of *you* in this dissertation, which is available in several but not all languages (see Gruber 2011, Malamud 2006, Siewierska 2004 and references therein).

second person pronouns refer to whoever is spoken to.⁹⁴

Let us formalize this idea in our semantics. Following Kaplan's (1977) pioneering work, I postulate possible contexts in our metalanguage, which are entities of type k . Possible contexts, by assumption, consist of two individuals and a possible world, e.g. $c = \langle a_c, h_c, w_c \rangle$.⁹⁵ The intended interpretation of this is as follows: a_c is the speaker of the context c , and h_c is the hearer of the context c , and w_c is the world in which the conversation between a_c and h_c is taking place.⁹⁶ From now on, the interpretation function $\llbracket \]$ is relativized to a context c as well, in addition to a possible world w and an assignment function g . Throughout Part II, c is simply assumed to correspond to the context of utterance that the expression in question is used. I will discuss this more precisely in Part III.

For expressions we have encountered so far, the context index is simply irrelevant. Therefore, their denotations stay the same as before, as in (411). Here I ignore the presuppositional dimension.

- (411) a. $\llbracket \text{John} \rrbracket^{c,w,g} = \text{the individual John}$
 b. $\llbracket \text{left} \rrbracket^{c,w,g} = \lambda x_e. x \text{ left in } w$
 c. $\llbracket \text{he}_i \rrbracket^{c,w,g} = g(i)$

These semantic values are not dependent on the value of c at all, which captures the fact that their meanings do not depend on who is talking to whom.

First and second person pronouns, on the other hand, should be sensitive to the context index somehow, but in what way? Two ways of formalizing the semantics of first and second person pronouns can be found in the literature.

7.1 Two Analyses of First and Second Person Pronouns

The simplest semantics for first and second person pronouns that one can think of is one where they simply refer to one of the coordinates of the context c . In other words, under this view, first and second person pronouns are analyzed as constants referring to a_c and h_c , as in (412).

- (412) a. $\llbracket \text{me} \rrbracket^{c,w,g} = a_c$
 b. $\llbracket \text{you} \rrbracket^{c,w,g} = h_c$

Lexical entries along these lines can be found in Kaplan (1977), Kratzer (1998a, 2009), Anand & Nevins (2004), and Anand (2006), for example. I call (412) the *indexical semantics* of first and second person pronouns.

Another approach treats first and second person pronouns as variables and the person features as presupposition triggers on a par with gender features (Büring 2005, Heim 2008a,b, Heim & Kratzer 1998, Jacobson to appear, Sauerland 2003, 2008b, Sauerland, Anderssen & Yatsushiro 2005, Schlenker 1999, 2003a,b, von Stechow 2003; see also Ka-

⁹⁴Second person pronouns allow a deictic use, just like demonstratives, where those occurring in the same sentence may denote different individuals, from which I will abstract away in this dissertation, and confine my attention to contexts where there is a unique addressee.

⁹⁵Kaplan (1977) contends that contexts should be treated as unanalyzable primitives, rather than tuples, but his philosophical considerations are essentially orthogonal to the formal treatment of contexts, as Schlenker (to appear) discusses. Nothing in the present dissertation hinges on the choice I make here, and everything can be recast in terms of Kaplanian primitive contexts. See also Lewis (1980) for relevant discussion.

⁹⁶In Part III, I will argue that these interpretations are not quite right, but for the moment I will stick to this conventional view.

plan 1989). In the first part of the present dissertation, I presented empirical evidence for Cooper’s (1983) analysis of gender features where *her* presupposes that its referent is female, as in (413).

- (413) a. $\llbracket \text{her}_i \rrbracket_A^{c,w,g} = g(i)$
 b. $\llbracket \text{her}_i \rrbracket_P^{c,w,g} \Leftrightarrow g(i) \text{ is female in } w$

This idea can be straightforwardly extended to other phi features, including person features: first person pronouns presuppose that their referent is the speaker of the current context, and second person pronouns presuppose that their referent is the hearer of the current context.

- (414) a. $\llbracket \text{me}_i \rrbracket_A^{c,w,g} = g(i)$
 b. $\llbracket \text{me}_i \rrbracket_P^{c,w,g} \Leftrightarrow g(i) = a_c$
- (415) a. $\llbracket \text{you}_i \rrbracket_A^{c,w,g} = g(i)$
 b. $\llbracket \text{you}_i \rrbracket_P^{c,w,g} \Leftrightarrow g(i) = h_c$

Unlike under the indexical semantics, first and second pronouns under this view bear numerical indices and denote variables that are interpreted via the assignment function g , just like third person pronouns. I call this semantics of first and second person pronouns the *variable semantics*.

The variable semantics looks more attractive at first sight, as different phi features—gender and person features here—are assigned uniform interpretive functions, i.e. they introduce presuppositions. Also, according to the variable semantics, all pronouns are uniformly interpreted as variables, unlike in the indexical semantics where first and second person pronouns are constants, while third person pronouns are variables. However, there are empirical concerns for the variable semantics with presuppositional restrictions.

7.2 Two Problems for the Variable Semantics

7.2.1 Failure of Semantic Binding

As extensively discussed in Part I, sentences like (416) below under bound pronoun readings have a gender inference that is essentially existential. Thus, it is felicitous even if Mary is the only female student (see Part I for a way to arrive at this existential inference).

- (416) Exactly one student did her homework, namely Mary.

Now suppose a first person pronoun is a variable, and the first person feature is a presupposition trigger, as the variable semantics contends. Then by the same token, (417), is expected to have an existential presupposition that one student is the speaker, under its bound pronoun reading. However, this prediction is not borne out.

- (417) #Exactly one student did my homework (, namely me).

This sentence does not have the intended bound pronoun reading to begin with, and its only available reading is the one where the possessive first person pronoun *my* is read as a free pronoun, i.e. “I did my homework, but no other student did *my* homework.” Notice importantly that the predicted presupposition of the bound pronoun reading should not be a problem, as it only requires that at least one of the students, namely the one who did his homework, is the speaker.

To further strengthen the point, if the bound interpretation of a first person pronoun is forced, the sentence either becomes ungrammatical or infelicitous. For instance, (418) shows that a first person reflexive pronoun is simply ungrammatical with a quantificational subject like *exactly one student*.

- (418) a. Exactly one student criticized herself, namely Mary.
 b. *Exactly one student criticized myself, namely me.

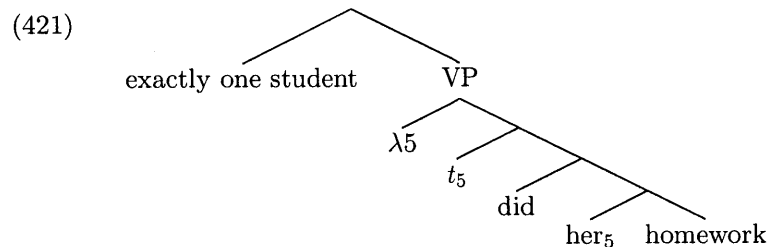
Similarly, (419b) with a first person pronoun is simply odd, as this construction forces the bound pronoun reading of *me*.

- (419) a. Exactly one student bought lunch with her today, namely Mary.
 b. #Exactly one student bought lunch with me today, namely me.

One might wonder if the lack of the bound pronoun reading with the first person pronouns in the above examples is due to an extra factor, e.g. quantifiers like *exactly one student* cannot be used to talk about the speaker.⁹⁷ However, such a constraint is not realistic, given that the following sentence is perfectly fine under a bound variable reading, provided that the speaker is female.

- (420) Exactly one student did her homework, namely me.

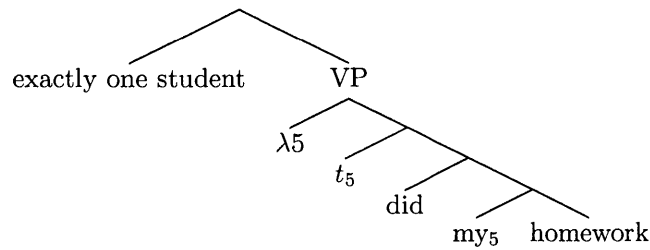
To state the problem of the variable semantics more precisely, it overgenerates the non-existing bound pronoun reading of (417), due to the same mechanism that derives the available bound pronoun reading of (416). That is, in the case of (416), the following LF derives the bound pronoun reading.



As explained in the first part of the present dissertation, the VP denotation has the gender presupposition that the subject is female, which existentially projects up through *exactly one student*, and the bound pronoun reading with the presupposition that that unique student who did her homework is female is derived. Now let us consider (417). Under the variable semantics, the following LF, which is isomorphic to (421), should be available for this sentence.

⁹⁷Heim (2008b:40) suggests that the ungrammaticality of a sentence like *Mary likes myself* when the speaker is Mary is due to the prohibition against using a third person expression to refer to the speaker (see also Jacobson to appear for a similar remark). However, as she notes, this cannot be the whole story, as in contexts such as dissertation writing, it is possible to refer to the writer by *the present author*, but the sentence *The present author likes myself* is still ungrammatical. In any event, the constraint that Heim hints at does not apply to quantificational expressions such as *exactly one student*, as (420) shows.

(422)



As the semantics of my_5 and her_5 are completely identical except for the content of the presupposition, the VP denotation has the same assertive meaning as in (421), while the presupposition is that the subject is the speaker. This presupposition should project up through *exactly one student*, giving rise to the bound pronoun reading with the presupposition that the unique student who did his or her homework is the speaker. This presupposition could well be true and felicitous. As a consequence, the bound pronoun reading is overgenerated.

The exact same overgeneration problem arises with second person pronouns, as shown in (423).

- (423)
- a. Exactly one student did your homework, namely you.
 - b. *Exactly one student likes yourself.
 - c. #Exactly one student bought lunch with you today.

The upshot of the above observations is that first and second person pronouns cannot be bound by quantificational noun phrases like *exactly one student*. This state of affairs does not directly follow under the simple variable semantics view given above, and some constraint needs to be stated independently of the semantics. Such a morphosyntactic constraint is indeed suggested by authors such as Heim (2008b), Kratzer (1998a, 2009) and Schlenker (1999, 2003b) in connection with the issue of bound pronoun readings of first and second person pronouns. We will review this in Section 9.1 in great detail

On the other hand, under the indexical semantics, the non-existent bound pronoun reading of (417) above is correctly ruled out. More specifically, since first and second person pronouns are semantically constants, just like proper names, the mechanism of Predicate Abstraction simply cannot manipulate their denotations. Therefore, they cannot be bound at all. However, the indexical semantics faces a problem when it comes to the bound uses of first and second person pronouns, as we will see in Section 8.

7.2.2 Failure to Fail the Presupposition

There is another, potentially more serious, problem for the variable semantics regarding the point that the first and second person features are presuppositional on a par with gender features. As pointed out in Part I, when the gender information of a third person pronoun does not match the referent's gender, what results is a feeling of squeamishness, a hallmark of presupposition failure, but importantly, the assertive meaning is unaffected and still can be judged true or false. The following example illustrates this.

- (424) CONTEXT: A baby, who is a boy, is sleeping. Mary thought he was a girl, and said the following.
She is sleeping.

Suppose the baby is actually sleeping. Then what Mary said is true, although she is wrong about the gender of the baby. If the baby is not sleeping, on the other hand, the sentence is false. The point is that in this case the truth of the sentence can be assessed independently of the truth of the gender presupposition.

If the first and second person features are presuppositional, we should be able to construct a similar case. The relevant context should be one where the speaker refers to somebody wrongly thinking that that person is he himself. In such a situation, the use of a first person pronoun should give rise to the true-but-something-is-wrong feeling we just witnessed with (424). However, this prediction is not borne out, as Stokke (2010) already pointed out. Here are two examples due to Stokke, modeled after examples in Barwise & Perry (1983) and Kaplan (1977) respectively.

(425) CONTEXT: André has gone mad and thinks he is Napoleon. When the doctors try to calm him down, he retorts:
I won the Battle of Austerlitz! (Stokke 2010:98)

(426) CONTEXT: David is looking at a shop window. On the other side of the glass, there is a man who looks just like him, and David therefore mistakes the window for a mirror. Suddenly, he notices that the person's pants are on fire and exclaims:
My pants are on fire! (Stokke 2010:98)

In both of these contexts, the speaker thinks somebody else is he himself. According to the variable semantics, this should trigger a presupposition failure, but what is said should not be affected by this and remain true, just as for (424). However, this is not the judgment we obtain for these examples. More specifically, the sentence in (425) cannot be taken as about Napoleon, although that is what the speaker intends to mean, and has to be about the speaker. If such an interpretation were available, the sentence should be judged true, albeit it should also be associated with a feeling of presupposition failure. Similarly, the sentence in (426) cannot be about the man on the other side of the glass, but needs to be about David himself. Thus, the sentence is unambiguously judged false. This again illustrates that a first person pronoun has to refer to the speaker and cannot refer to the individual the speaker intends to refer to.

Stokke (2010) also provides examples with second person pronouns that show the same point: second person pronouns necessarily refer to the current addressee, and cannot induce a presupposition failure. This is illustrated by the following example due to Stokke.

(427) CONTEXT: Saul and David are sitting on a sofa. In front of the sofa is a glass pane. Opposite is another sofa. The sofas look exactly the same and two men dressed like David and Saul are sitting in the seats opposite to them. So, from where David and Saul are sitting, the pane looks like mirror. Suddenly, David realizes that the pants of the person sitting opposite Saul are on fire. So he turns to Saul and warns him:
Your pants are on fire! (Stokke 2010:99)

As Stokke remarks, the sentence here sounds plainly false, rather than true with a feeling of presupposition failure.

These data suggest that person features are not presupposition triggers, unlike gender features, contrary to the assumptions of the variable semantics.⁹⁸ How does the indexical semantics fare in this regard? According to it, first and second person pronouns do not involve any presuppositions and just blindly pick out the speaker and hearer. This captures the intuition that the only possible referents of the first person pronouns in (425) and (426) are *Andrès* and *David* respectively, and similarly that of the second person pronoun in (427) is *Saul*. In other words, they directly contribute to the truth conditions of the sentence, and these examples are correctly predicted to be plainly false.

7.3 Section Summary and Outlook

We saw above that the variable semantics for first and second person pronouns with presuppositional person restrictions wrongly predicts that semantic binding by quantifiers like *exactly one student* be possible, unless supplemented with some constraint. It also predicts that they can be used to refer to individuals other than the speaker/hearer in contexts where the speaker makes wrong assumptions. On the other hand, the indexical semantics does not run into these overgeneration problems. Thus, between the two, the indexical semantics fares better. However, it is important to notice that the arguments leveled against the variable semantics here are not against the idea that first and second person pronouns denote variables. In fact, in Section 10, I will propose a new semantics for first and second person pronouns where they are treated as variables in such a way that the above problems do not arise.

On the other hand, the indexical semantics runs into the problem of bound first and second person pronouns. We saw above that they cannot be bound by quantifiers like *exactly one student*, which follows from the indexical semantics where they are constants. However, it is known that they actually *can* be bound, although not by *exactly one student*.

8 The Issue of Bound First and Second Person Pronouns

As we saw above, quantifiers like *exactly one student* cannot bind first and second person pronouns at all. This is shown again in (428).

- (428) a. Exactly one student brought lunch with her today.
 b. #Exactly one student brought lunch with me today.
 c. #Exactly one student brought lunch with you today.

Only (428a) has a bound pronoun interpretation, and (428b) and (428c) do not. This fact favors the indexical semantics for first and second person pronouns over the variable semantics, as the latter predicts that binding in (428b) and (428c) should be possible with a coherent presupposition.

To repeat, according to the indexical semantics, first and second person pronouns directly refer to the speaker and hearer of a given context, respectively, without the mediation of the assignment function *g*.

- (429) *Indexical Semantics*

⁹⁸As mentioned in fn.17, Stokke (2010) also concludes that the presuppositional semantics of gender features is also wrong. However, as I argued extensively in the previous part of this dissertation, the Frege-Strawson view of presuppositions, which he crucially assumes in rejecting the presuppositional analysis of gender features, is questionable.

- a. $\llbracket \text{me} \rrbracket^{c,w,g} = a_c$
- b. $\llbracket \text{you} \rrbracket^{c,w,g} = h_c$

Since semantic binding is only possible with variables that are interpreted via g , it follows that (428b) and (428c) lack bound pronoun readings.

As discussed by Heim (2008a,b), Kratzer (1998a, 2009), and Partee (1989) among others, however, there are cases where first and second person pronouns behave as bound pronouns (see also Cable 2005, Jacobson to appear, Maier 2009a,b, Rullmann 2004, von Stechow 2003).⁹⁹ An example of bound first person pronouns is given in (430) (which is originally due to Irene Heim's unpublished notes).

(430) Only I did **my** homework.

This sentence has two interpretations, paraphrased by (431a) and (431b).

- (431) a. I did my homework, but John didn't do **his** homework, Mary didn't do **her** homework, etc.
- b. I did my homework, but John didn't do **my** homework, Mary didn't do **my** homework, etc.

The denotation of *my* under the bound pronoun reading is not fixed, and co-varies with the subject, while it is fixed to the current speaker in the free pronoun reading. Here, for extra linguistic reasons, the bound pronoun reading is more salient. The same ambiguity obtains with a second person pronoun, as shown by (432).

- (432) Only you did **your** homework.
 - a. You did your homework, but I didn't do **my** homework, John didn't do **his** homework, etc.
 - b. You did your homework, but I didn't do **your** homework, John didn't do **your** homework, etc.

How do we account for the two readings of first and second person pronouns, given the indexical semantics in (429)? As one can guess, the free pronoun reading is rather straightforward to derive, while the bound variable reading does not easily follow. In order to see this problem more concretely, let us make some assumptions about the semantics of *only*.

8.1 Semantics of *Only*

Following the widely held view pioneered by Rooth (1985, 1992a), I assume that *only* is a focus sensitive sentential operator that takes a set C of alternative propositions, and a

⁹⁹Partee's (1989) main concern is not bound first and second person pronouns, and she only raises the relevant example in an endnote (note 3). Also she remarks that a bound use of first person pronouns is not found in quantified sentences, but in a relative clause like the following:

- (i) I'm the only one around here who will admit that I could be wrong.

Subsequent work by the authors cited above uncovered instances of bound first and second person pronouns in quantified sentences. For reasons that are not quite well understood, the judgments for quantified sentences are more stable and crisp across speakers than cases involving relative clauses like (i) (see discussions in Cable 2005 and Kratzer 2009). For this reason, I will confine my attention to the former in bulk of the present part of the dissertation, and only discuss relative clause cases in Section 13.7.3.

propositional argument, and universally quantifies over the alternative propositions in the following way.¹⁰⁰

$$(433) \quad \llbracket \text{only} \rrbracket^{c,w,g} = \lambda C. \lambda p. p(w) = 1 \wedge \forall q \in C [q(w) \rightarrow p \subseteq q]$$

The alternative set C is assumed to be essentially pragmatically determined, but its possible values are constrained by the focus structure of the sentence. It is assumed that a sentence containing *only* also contains a constituent carrying an F -feature.¹⁰¹ A constituent with an F -feature is marked by a subscript F below. It is also assumed that every constituent is associated with two kinds of meanings, an ordinary meaning and a focus alternative meaning. For any interpretable expression α , these meanings are denoted by $\llbracket \alpha \rrbracket^{c,w,g}$ and $\|\alpha\|^{c,w,g}$, respectively. The focus alternative meaning is defined in terms of the ordinary meaning in the following manner. If α carries an F -feature and $\llbracket \alpha \rrbracket^{c,w,g} \in D_\tau$, then the focus alternative meaning of α will be the domain of τ , i.e. $\|\alpha_F\|^{c,w,g} = D_\tau$. If α does not carry an F -feature, the focus alternatives are going to be as in (434).

$$(434) \quad \begin{array}{l} \text{a. If } \alpha \text{ is a terminal node, } \|\alpha\|^{c,w,g} = \{\llbracket \alpha \rrbracket^{c,w,g}\}. \\ \text{b. If } \alpha \text{ is not a terminal node and has } \beta \text{ and } \gamma \text{ as its daughters where } \llbracket \beta \rrbracket^{c,w,g} \in D_{\langle \sigma, \tau \rangle} \text{ and } \llbracket \gamma \rrbracket^{c,w,g} \in D_\sigma, \\ \quad \left\| \begin{array}{c} \alpha \\ \beta \quad \gamma \end{array} \right\|^{c,w,g} = \{f(x) : f \in \|\beta\|^{c,w,g} \wedge x \in \|\gamma\|^{c,w,g}\}. \end{array}$$

The set C of alternative propositions is assumed to be introduced by the \sim -operator that takes a focus alternative meaning and imposes the following presuppositional restrictions on C . I assume that $\llbracket c \rrbracket^{c,w,g} = C$.

$$(435) \quad \left\| \begin{array}{c} \sim \\ c \quad \alpha \end{array} \right\|^{c,w,g} \text{ presupposes:}$$

- a. $C \subseteq \|\alpha\|^{c,w,g}$
- b. $|C| > 1$
- c. $\llbracket \alpha \rrbracket^{c,w,g} \in C$

The idea is that C is a set of alternatives to $\llbracket \alpha \rrbracket^{c,w,g}$ including $\llbracket \alpha \rrbracket^{c,w,g}$ itself and at least one more member. The precise value of C is assumed to be determined contextually. From now on, I will use C in the object language, instead of c , to simplify the exposition.

Here is a simple example illustrating how this account works.

$$(436) \quad \text{Only John}_F \text{ left.}$$

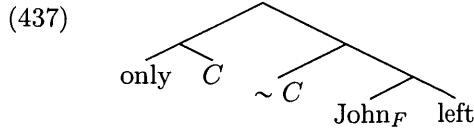
I assume that this sentences has the following structure.

¹⁰⁰ Alternatively *only* can be analyzed as a function that takes an individual and yields a generalized quantifier (Heim 2008b):

$$(i) \quad \llbracket \text{only} \rrbracket^{c,w,g} = \lambda C. \lambda x_e. \lambda P_{\langle e, t \rangle}. \{y \in C : P(y) = 1\} = \{x\}$$

As it turns out that this choice yields exactly the same results as the sentential operator analysis that I adopt here. Also it is immaterial for our purposes whether $p(w) = 1$ is part of the truth-conditional or presuppositional meaning.

¹⁰¹ Arguably an F -feature has a consequence in the prosodic structure of the sentence. I will not delve into this aspect in this dissertation. See Selkirk (1995) and Schwarzschild (1999) among others for discussion.



Since $John_F$ has an F-feature, it is interpreted as follows.

- (438) a. $\llbracket John_F \rrbracket^{c,w,g} = \text{John}$
 b. $\llbracket John_F \rrbracket^{c,w,g} = D_e$

On the other hand, $left$ does not have an F-feature and is a terminal node, so its focus alternative meaning is the singleton set consisting of its ordinary meaning, as in (439).

- (439) a. $\llbracket left \rrbracket^{c,w,g} = \lambda x_e. x \text{ left in } w$
 b. $\llbracket left \rrbracket^{c,w,g} = \{ \lambda x_e. x \text{ left in } w \}$

Combining these, the constituent $John_F left$ has the following semantics.

- (440) a. $\llbracket John_F left \rrbracket^{c,w,g} \Leftrightarrow \text{John left in } w$
 b. $\llbracket John left \rrbracket^{c,w,g} = \{ x \text{ left in } w : x \in D_e \}$

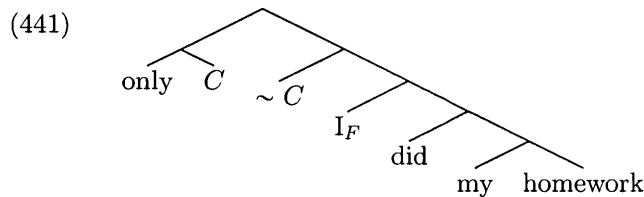
The \sim -operator requires that C be a contextually salient non-singleton subset of (440b) containing (440a) as one of its members. Now, $only$ operates on C and (440a), yielding the truth-conditions that the sentence is true if and only if John left and nobody else left. This captures the truth conditions of the sentence (436).

8.2 The Issue of Bound First and Second Person Pronouns

With the assumptions above at hand, let us analyze the sentence in (430), which is repeated here.

- (430) Only I did my homework.

It is a general fact about English that with $only$ immediately preceding the subject what is focused must be the subject (or a subpart of the subject when it is complex). In this case, therefore, I is focused and carries the F-feature. Then the LF structure of the sentence looks as follows.



Since the ordinary semantic value of the pronoun I is of type e , its focus alternatives are the members of D_e . The focus value of the sentence (430) then is the set $\{ \llbracket \text{did my homework} \rrbracket^{c,w,g}(x) : x \in D_e \}$. What is the denotation of the predicate $\llbracket \text{did my homework} \rrbracket^{c,w,g}$? Given the indexical semantics of first and second person pronouns, it is the function $\lambda x_e. x \text{ did } a_c \text{'s homework}$. Then the alternative set C is required to be a subset of the set of propositions $\{ x \text{ did } a_c \text{'s homework in } w : x \in D_e \}$. $Only$ operates on C and yields the truth conditions that a_c did a_c 's homework but no other person did a_c 's homework. Thus we obtained the free pronoun reading of (430).

What about the bound pronoun reading of (430)? Notice that in the derivation of the free pronoun reading above, the predicate *did my homework* denotes the function $\lambda x_e. x$ did a_c 's homework, where the denotation of the object is fixed to a_c 's homework and does not vary with x . In order to derive the bound pronoun reading, however, the predicate denotation needs to be $\lambda x_e. x$ did x 's homework, where the object x 's homework does co-vary with the subject x . Thus the problem here is how to obtain the bound pronoun interpretation of *my*, given the indexical semantics of first person pronouns in (429a). Importantly, the mechanism that achieves the bound pronoun reading of third person pronouns, namely a binder index and the assignment function g , is not available for first and second person pronouns, because according to the indexical semantics, their denotations are insensitive to g .

This is the issue of bound first and second person pronouns. Previous studies explored three different solutions to the present issue.¹⁰² One idea entertained most widely in the current semantic literature is that bound first/second person pronouns are interpreted in different ways from free first/second person pronouns, but they happen to look alike due to a morphosyntactic mechanism (Kratzer 1998a, 2009, Heim 2008a,b, von Stechow 2003). A second approach is to blame the focus sensitive operator *only* for the bound interpretation, while keeping the uniform semantics for the free and bound uses of first and second person pronouns (Jacobson to appear; Schlenker 2003b, Heim 2008a, Spathas 2010 for a similar idea).¹⁰³ Yet another approach postulates a mechanism that achieves semantic binding of first and second person pronouns that is separate from the binding mechanism for third person pronouns. This idea is explored by Cable (2005) and adopted by Kratzer (2009).¹⁰⁴

It should be mentioned at this point that some of these ideas are fleshed out with the variable semantics, and as I will point out in the next section, the second approach crucially hinges on it. However, such an analysis faces the overgeneration problems discussed in the previous section, although these issues are not explicitly mentioned by previous studies.

8.3 Other Focus Constructions

Before moving on, I would like to add some more empirical observations pertinent to the present discussion. I illustrated above the issue of bound first and second person pronouns with a focus construction with *only*. This is because without an operator like *only*, the interpretive difference between the free and bound pronoun readings is unobservable. For example, the following sentence should in principle be ambiguous between the two readings.

(442) I did my homework.

However, the truth conditions of the two readings here are identical. The same logic applies to third person pronouns, and for instance, the following sentence should be ambiguous in the same way (cf. Buring 2005).

(443) John did his homework.

¹⁰²Maier (2009a,b) puts forward a pragmatic account of the problem of bound first and second person pronouns, but the predictions of his theory are not entirely clear to me. I will leave examination of his theory for a different occasion.

¹⁰³Spathas (2010) focuses on gender features, but ideally the same mechanism should account for the case of person features. I will discuss the case of gender features in Section 13.7.1.

¹⁰⁴Kratzer (2009) is an eclectic account where she postulates distinct semantics for free and bound first second person pronouns, and also a binding mechanism that binds both types of first second person pronouns.

In the case of third person pronouns, various quantifiers allow us to differentiate the truth conditions of the two readings. For instance, the bound and free pronoun readings of (444) are truth-conditionally independent.

(444) Every student did his homework.

On the other hand, bound readings of first and second person pronouns are rarer, as quantifiers like *every student* and *exactly one student* cannot bind them, as observed in the previous section.¹⁰⁵ Rather, potential binders of first and second person pronouns are strictly limited to other occurrences of first and second person pronouns, a fact that needs to be explained. Let us state this generalization as follows (we will see from Section 11 that plural bound pronouns do not necessarily abide by this constraint).

(445) A singular bound pronoun needs to have the same person feature as the noun phrase that binds it.

Given this restriction, focus constructions where the binder is focused are typical contexts where the bound pronoun readings of first/second person pronouns are clearly distinguished from the free readings.

Thus, the interpretive difference between bound and free readings of first/second person pronouns manifests itself in other kinds of focus constructions than sentences with *only*. For instance, the following sentences have bound pronoun readings of *my* that are different from the free pronoun readings (although not truth-conditionally).

(446) a. Even I_F did my homework.
b. I_F did **my** homework too.

Both of these sentences are associated with an additive inference about somebody else other than the speaker (cf. Rooth 1985, Karttunen & Peters 1979, Beaver & Clark 2008). Importantly, this inference can be about somebody else having done the speaker's homework, which is the free pronoun reading, or about somebody else having done his or her own homework, which is the bound pronoun reading. Although I do not go into the details here,

¹⁰⁵It is sometimes considered under the variable semantics approach, e.g. in Heim (2008b), that the rarity of bound first and second person pronouns is due to the implausibility of the predicted reading. For example, consider (i).

(i) Every student did my homework.

The variable semantics predicts that (i) presupposes that every student is the speaker (cf. Part I), which is impossible given that there is only one speaker in a given context. However, the issue is more profound than this. That is, we can construct a sentence whose predicted presuppositions are pragmatically plausible. For example, consider the second person version of (i).

(ii) Every student did your homework.

The predicted inference here is that every student is one of the hearers. This is possible, say, when a professor is talking to a group of students. Also we saw earlier that *exactly one student* should give rise to a pragmatically natural inference for (iii).

(iii) Exactly one student did my homework.

However none of these sentences have a bound pronoun reading. Rather, first and second person pronouns simply cannot be bound by quantifiers like *every student* and *exactly one student*, unlike third person pronouns.

the bound pronoun reading does not straightforwardly follow from the indexical semantics in (429), for the same reason as in the case of *only* discussed above.

Bound pronoun readings are also considered to be available under ellipsis as well, which arguably also involves focus (Heim 1997, Merchant 2001, Rooth 1992b, Tancredi 1992), but the judgments of such sentences containing a person or gender mismatch are known to be degraded at least for some speakers (Büring 2005, Heim 1997, Rooth 1992b, Spathas 2010). In (447) are two examples involving VP-ellipsis with a person mismatch.

- (447) a. I did my homework, Bill_F did ~~do his homework~~ too.
 b. Bill did his homework, I_F did ~~do my homework~~ too.

Ultimately, the marked status of phi-feature mismatch should be given a theoretical account (see Spathas 2010 for an attempt), but I will not discuss this in this dissertation.

9 Previous Approaches to the Issue of Bound First and Second Person Pronouns

9.1 Minimal Pronouns

9.1.1 Different Semantics for Free and Bound Pronouns

One approach to the problem of bound first and second pronouns postulates a special morphosyntactic mechanism (Kratzer 1998a, 2009, Percus 2006, Heim 2008a,b, von Stechow 2003). The underlying idea is that free and bound first and second person pronouns are semantically distinct, despite their appearance. Percus (2006), Heim (2008b) and von Stechow (2003) assume the variable semantics, but it can be cashed out using the indexical semantics, as in Kratzer (2009). Importantly, even though the first overgeneration problem with quantifiers like *exactly one student* can be overcome with the morphosyntactic mechanism assumed in this approach, the second problem regarding presupposition failure remains to be explained. For this reason, I will use the indexical semantics in presenting the idea here.

According to the indexical semantics, free first and second person pronouns are real indexical pronouns with the meanings in (429). As we have seen above, they cannot be bound by the mechanism used for binding third person pronouns, i.e. the assignment function g and Predicate Abstraction. The reason is simply because they are constants. The minimal pronoun approach claims that bound occurrences of first/second person pronouns are not interpreted as (429), but rather, they are in fact third person pronouns with an index and do get interpreted via the assignment function g . Thus semantically, they are third person pronouns, but morphologically, they look like first and second person pronouns, due to the morphosyntactic requirements that will be spelled out shortly. The two versions of first and second person pronouns according to this idea look as follows. For the moment, I differentiate the two entries by the presence or absence of an index subscript.

- (448) a. $\llbracket \text{me} \rrbracket^{c,w,g} = a_c$
 b. $\llbracket \text{me}_i \rrbracket^{c,w,g} = g(i)$
 (449) a. $\llbracket \text{you} \rrbracket^{c,w,g} = h_c$
 b. $\llbracket \text{you}_i \rrbracket^{c,w,g} = g(i)$

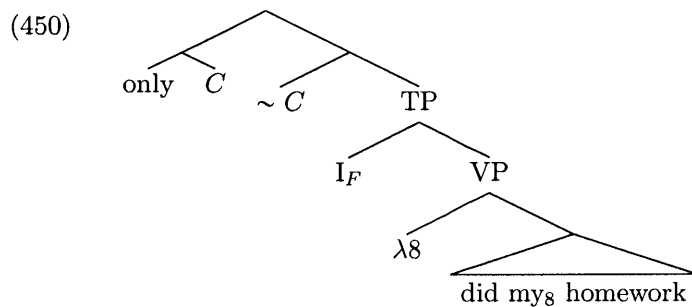
Because bound first and second person pronouns have the same semantics as third person

pronouns, they can be semantically bound by a binder index λi via the rule of Predicate Abstraction.

Let us analyze the bound pronoun reading of the sentence (430), repeated below, with the above machinery.

(430) Only I did my homework.

Assume the following LF representation for this sentence.



The constituent labeled as VP denotes the following function.

(451) $\llbracket \lambda 8 \text{ did my}_8 \text{ homework} \rrbracket^{c,w,g} = \lambda x. x \text{ did } x\text{'s homework in } w$

Importantly, the denotation of the object, i.e. x 's homework, co-varies with the subject x . As desired, this correctly gives rise to the bound pronoun reading of (430). More specifically, the focus alternative meaning of the constituent marked TP in (451) is $\{x \text{ did } x\text{'s homework in } w : x \in D_e\}$, of which C is a subset. Therefore, the sentence is true if and only if the speaker a_c did a_c 's homework but no other relevant person x did x 's homework.

9.1.2 Feature Transmission

It is conspicuous that the distribution of the bound first and second person pronouns me_i and you_i needs to be somehow constrained, or this account will massively overgenerate. Firstly they should not be allowed to be free, or they will pick out just an arbitrary individual like *he* can. Secondly, since they have the same semantics as each other, they are predicted to be interchangeable, if they are freely available. This is clearly wrong, too. For example, the following sentences do not have bound pronoun readings.

- (452) a. Only I did your homework.
 b. Only you did my homework.

By the same token, *John* and *every student* should be able to bind first and second person pronouns, which, as we saw above, is not correct.

- (453) a. Only John did my homework.
 b. Only John did your homework.
 c. Every student did my homework.
 d. Every student did your homework.

More generally, there needs to be a way to capture the generalization that the bindee and the binder need to have the same person feature.

To this end, Kratzer (1998a) proposes that bound first and second person pronouns are actually born featureless, and only acquire their morphological outlook in the PF branch of the syntax. Following Kratzer’s later work, I call such featureless pronouns *minimal pronouns* and denote them by \emptyset . Minimal pronouns are assumed to have the following semantics.

$$(454) \quad \llbracket \emptyset_i \rrbracket^{c,w,g} = g(i)$$

The crucial assumption here is that the morphological content of a minimal pronoun is inherited from its semantic binder via the rule of *Feature Transmission* in such a way that their semantics is not affected. More concretely, Feature Transmission is formulated as follows.¹⁰⁶

(455) *Feature Transmission under Semantic Binding*

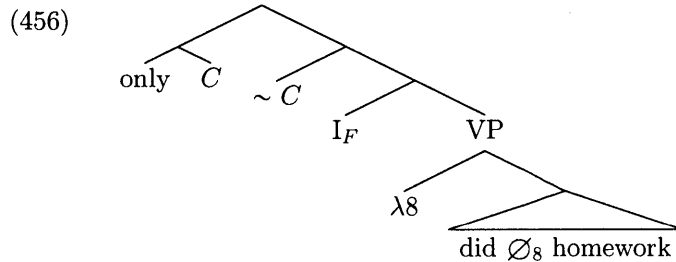
In the derivation of PF, the phi features of a DP must be copied onto pronouns that it binds.

Although we are only interested at this moment in person features, (455) is formulated generally, anticipating the extension to other phi features.

Here is an illustration of this idea with a concrete example. Let us take the now familiar sentence (430) again.

(430) Only I did my homework.

According to the present analysis, the LF representation of this sentence involves \emptyset in place of *my*.



As a consequence, the VP here denotes the function $\lambda x. x$ did x ’s homework in w which gives rise to a bound pronoun reading. At the PF branch the operation in (455) transmits the phi features of the binder I to the bindee \emptyset , and the latter gets pronounced as *my*.

What happens if the minimal pronoun in (456) bears a different index than the one introduced by the movement of its semantic binder? In this case, the minimal pronoun will be free and its denotation will be assignment dependent. Also since Feature Transmission does not take place, and it will not inherit any feature from anything. In such a case, Kratzer (1998a) and Heim (2008b) suggest that the derivation is ruled out as illegitimate at the PF branch, as a pronoun without phi features cannot be pronounced. In other words, minimal

¹⁰⁶Kratzer (2009) formulates the relevant rule in terms of *Feature Unification* (Barlow 1988), and gives some conceptual arguments for regarding this operation as unification rather than transmission, but as far as I can see, there is no empirical motivation for one over the other. Also Kratzer’s (2009) theory of minimal pronouns involves local binding relations, and technically differs from what is assumed here. Part of the reason why she made this move is because of another set of environments where first and second person pronouns can be bound, which will be discussed in Section 13.7.3.

pronouns are required to be semantically bound. It is also a possibility, as Kratzer (1998a) suggests, that this prohibition against free minimal pronouns is morphological in nature and language dependent, and those languages with radical argument drop, such as Chinese and Japanese, tolerate free minimal pronouns, which get pronounced as null pronouns. Either way, crucially, they never surface as first or second person pronouns.

At this point, it is worthwhile discussing the following sentence (Heim 2008b).

(457) Only I did her homework.

This sentence does not have a bound pronoun reading, and the theory correctly predicts that it does not. The reason is the following. If the possessive pronoun were a minimal pronoun, it would be unable to surface as a third person pronoun *her*, because its binder is not third person. Thus, it has to be a non-minimal pronoun equipped with phi features from the beginning of the derivation. Importantly, Feature Transmission is assumed to obligatorily apply to all instances of bound pronouns, minimal or not, and therefore, in (457), *her* must inherit the first person feature of its binder *I*. This results in one of two conceivable situations. One is that such a pronoun with both first and third person features is morphologically inexpressible and the derivation is ruled out at PF. Another possibility is that third person is not a real feature, as sometimes suggested (Heim 2008b, Percus 2006, Sauerland 2008a), and the pronoun is simply expressed as *my*.¹⁰⁷ In either case, the theory predicts that the relevant bound pronoun reading is never expressed by (457).

It is therefore crucial that Feature Transmission is an obligatory rule that applies to all bound pronouns. The flip side of this is the prediction that on the surface first person pronouns can only be bound by first person pronouns, and similarly second person pronouns can only be bound by second person pronouns, which captures the descriptive generalization mentioned in Section 8.3. Thus, quantifiers like *exactly one student* and *every student* are unable to bind first or second person pronouns, because when they bind minimal pronouns, the minimal pronouns are not going to be realized as first or second person pronouns.¹⁰⁸ As we will see, however, the obligatoriness of Feature Transmission leads to some complications once number features are brought into the picture (Heim 2008b, Kratzer 2009), which will be discussed in Section 12.2.

9.1.3 Digression: von Stechow's Alternative Formulation

An alternative formulation of the idea presented above is put forward by von Stechow (2003). He notes that the theory of minimal pronouns commits itself to a view that Quantifier Raising (QR) takes place before operations at PF, and hence it needs to be treated as an overt movement. Recall that the minimal pronoun approach crucially assumes that Feature Transmission is a PF operation that only affects the pronunciation of minimal pronouns and never their interpretation. However there are cases where QR feeds Feature Transmission. For example, in the following sentence a bound pronoun reading of *my* is available.¹⁰⁹

(458) Only my_F mother is going to pick me up.

¹⁰⁷As Irene Heim (p.c.) pointed out, this implies that *my* in this case has the feminine gender feature is not morphologically expressed.

¹⁰⁸This solves the first problem of the variable semantics, the unbindability by *exactly one student*, but the second problem, failure to fail the person presupposition, remains problematic.

¹⁰⁹I thank Irene Heim (p.c.) for this example.

In order to analyze this sentence within the minimal pronoun account, *my* needs to QR out of the subject to a position where it c-commands *me*, which is a minimal pronoun. Then, Feature Transmission applies to the minimal pronoun, and it gets realized as *me* at PF. However, under the view of syntax where all covert movements including QR happen only at LF and never feed PF operations like Feature Transmission, this will be impossible.

I would like to point out that this is essentially a conceptual point and not necessarily a problem for the minimal pronoun approach, given a view of QR advocated by Fox & Nissenbaum (1999). According to them, QR is indeed an instance of ‘overt movement’ in the sense that it applies before PF operations, but it so happens that a DP that has undergone QR is pronounced in the base generated position, rather than in the raised position, and as a result the movement looks ‘covert’. The reader is referred to Fox and Nissenbaum’s work for empirical motivation.

Based on these considerations, von Stechow himself pursues a different formulation of the idea of minimal pronouns. However, his alternative formulation suffers from a different problem. In order to see the problem concretely, let us examine his theory in some detail.

His idea is exactly the opposite of the minimal pronoun account. The minimal pronoun approach contends that bound first/second person pronouns are not first/second person when they are born, and become first/second person only at PF. Under von Stechow’s account, on the other hand, bound first/second person pronouns are born as first/second person pronouns, but cease to be first/second person and become minimal pronouns at LF, when they are interpreted. The relevant rule is called Feature Deletion, which is stated as follows.¹¹⁰

(459) *Feature Deletion under Semantic Binding*

At LF, delete the phi features of a bound pronoun that are shared by its binder.

Notice, however, that in order for this idea to work, a semantic binding relation must be established before the application of Feature Deletion. Thus, for (430), for instance, the subject *I* needs to semantically bind *my* when (459) applies. This is easy to achieve under the variable semantics of first and second person pronouns, but we have seen that it has an empirical problem that has to do with presuppositions. If, on the other hand, the indexical semantics is assumed, it is not clear how the relevant notion of semantic binding can be defined, as first and second person pronouns do not bear indices and are semantically constants.¹¹¹ Therefore, I conclude here that von Stechow’s formulation in terms of Feature Deletion introduces additional complications to the theory, especially regarding the definition of semantic binding. For this reason, I will not discuss this alternative rendition any further.

¹¹⁰The original formulation says, “Delete the features of all variables that are semantically bound.” However, this is too strong. For example, *Exactly one student did her homework* would fail to generate the inference about the gender of the relevant student, as the gender feature would be deleted.

¹¹¹I will propose in the next section a semantics of first and second person pronouns where they are treated as variables and do come with indices, but I will also show that in this approach neither Feature Deletion nor Feature Transmission is necessary in the first place. Also, as suggested to me by Irene Heim (p.c.), it might be possible to define a purely syntactic notion of binding, instead of semantic binding, that (459) can refer to. Such an account, however, would be purely syntactic, and the connection with semantic binding would be indirect at best. Since such an analysis has not been spelled out, I will leave it as a mere possibility here.

9.2 Multi-dimensional Approach

A second approach to the issue of bound first and second person pronouns attributes the availability of the bound interpretation to the properties of focus constructions. As we saw in Section 8.3, the interpretive differences of bound first and second person pronouns come to light in focus constructions involving operators like *only* and *even*. This suggests a possibility that focus environments are somehow responsible for creating contexts where effects of phi features can be partially ignored. Spathas (2010), and Jacobson (to appear) among others pursue this idea to account for the issue of bound first and second person pronouns without postulating minimal pronouns or an additional morphological rule like Feature Transmission (see also Heim 2008a and Schlenker 2003b).¹¹² However, as I will claim below, this account crucially relies on the variable semantics of first and second person pronouns, and therefore suffer from the overgeneration problems pointed out in Section 7.

9.2.1 Rethinking Focus Alternatives in Multi-dimensional Semantics

The central tenet of this approach is that phi features always have semantic effects, even when the pronoun is bound, but only in the dimension of ordinary semantic values. What is assumed here is the two dimensional focus semantics introduced in Section 8.1 above, where focus alternatives are computed in a separate dimension of meaning, denoted by $\| \|$. The proposal is that $\| \|$ ignores the semantic contribution of phi features altogether, so that in the dimension of focus alternatives bound pronouns behave as pure variables with no restrictions on their values. This will lead to the desired bound reading of a sentence like (430).

(430) Only I did my homework.

Let us delve into the details now.

Heim (2008a) and Spathas (2010) implement the core idea above using a two dimensional theory of presuppositions, where presuppositional and assertive meanings are represented in separate dimensions (cf. Karttunen & Peters 1979 among others; see Part I). Thus, we have a third dimension of meaning for presuppositions in addition to the assertive and focus alternative dimensions. Assuming the variable semantics of first and second person pronouns, which all of the three authors adopt, the meaning of the predicate in (430) can be analyzed as follows. As in Part I, I use $\llbracket \ \rrbracket_P$ to denote the presuppositional meaning.

- (460) a. $\llbracket \lambda 2 t_2 \text{ did my}_2 \text{ homework} \rrbracket^{c,w,g} = \lambda x. x \text{ did } x\text{'s homework in } w$
 b. $\llbracket \lambda 2 t_2 \text{ did my}_2 \text{ homework} \rrbracket^{c,w,g} = \{ \lambda x. x \text{ did } x\text{'s homework in } w \}$
 c. $\llbracket \lambda 2 t_2 \text{ did my}_2 \text{ homework} \rrbracket_P^{c,w,g} = \lambda x. x = a_c$

Since the subject *I* in (430) is focused, the following meaning is derived for the part of (430) excluding *only*.

- (461) a. $\llbracket [I_5]_F \lambda 2 t_2 \text{ did my}_2 \text{ homework} \rrbracket^{c,w,g} \Leftrightarrow g(5) \text{ did } g(5)\text{'s homework in } w$

¹¹²Both Spathas and Jacobson refer to Heim's (2005) handout, which Heim (2008a) is a more recent version of. Although Spathas (2010) only discusses gender features, it is desirable that the account explains both gender and person features, as the phenomena seem to be essentially of the same nature, which is tacitly assumed by Heim and Jacobson. Also Jacobson (to appear:fn.1) notes that this type of account does not straightforwardly cover bound first and second person pronouns in relative clauses, and what is called 'partial binding' with plural pronouns. I will briefly discuss the former in Section 13.7.3. The latter is taken up in great detail in Section 11.

- b. $\llbracket [I_5]_F \lambda_2 t_2 \text{ did my}_2 \text{ homework} \rrbracket^{c,w,g} = \{x \text{ did } x\text{'s homework in } w : x \in D_e\}$
c. $\llbracket [I_5]_F \lambda_2 t_2 \text{ did my}_2 \text{ homework} \rrbracket_P^{c,w,g} \Leftrightarrow g(5) = a_c$

In this setting, the semantics of *only* can be defined so that the presuppositional meaning does not have to be satisfied by focus alternatives.

- (462) a. $\llbracket \text{only}_C \text{ TP} \rrbracket^{c,w,g} = \forall q \in C [q \neq \lambda w'. \llbracket \text{TP} \rrbracket^{c,w',g} \Rightarrow q(w) = 0]$
b. $\llbracket \text{only}_C \text{ TP} \rrbracket^{c,w,g} = \{(462a)\}$
c. $\llbracket \text{only}_C \text{ TP} \rrbracket_P^{c,w,g} = \llbracket \text{TP} \rrbracket^{c,w,g} \wedge \llbracket \text{TP} \rrbracket_P^{c,w,g}$

The assertive meaning (462a) states that all the propositional alternatives in C are false, and the focus alternative meaning (462b) is a singleton set containing it. What is important here is the presupposition (462c). It requires that the assertive meaning and presupposition of TP be true. For (430), the alternative propositions are that x did x 's homework for relevant individuals x , and the presupposition is, $g(5)$ did $g(5)$'s homework in w and $g(5)$ is identical to a_c . This captures the bound pronoun interpretation.

Jacobson's (to appear) version of this account is couched in the framework of variable free semantics (Jacobson 1999, 2000, 2002, 2008; see also Barker & Shan 2008), and also deploys the partial function approach of presuppositions (which I independently criticized in Part I), and consequently the technical details are considerably different from what is presented above. However, as far as empirical predictions are concerned, it can be seen as a technical variant of the analysis above, although Jacobson spells out conceptual arguments for her framework, and also offers analyses of related phenomena under her account. Importantly, the criticism raised below applies to her rendition as well as to the version presented above.

9.2.2 Problem: Reliance on the Variable Semantics

Recall from Section 7 that the variable semantics of first and second person pronouns gives rise to two overgeneration problems. I will replicate the first one within the approach here. Let us assume the following entry for the assertive meaning of *exactly one*. I ignore the focus alternative meaning.

- (463) $\llbracket \text{exactly one NP VP} \rrbracket^{c,w,g}$
 $= \exists x \in \llbracket \text{NP} \rrbracket^{c,w,g} [\llbracket \text{VP} \rrbracket^{c,w,g}(x) \wedge \forall y \in \llbracket \text{NP} \rrbracket^{c,w,g} [(y \neq x) \Rightarrow \neg \llbracket \text{VP} \rrbracket^{c,w,g}(y)]]$

Also recall from Part I that a sentence of the form *exactly one NP VP* where the VP denotation has a presupposition is associated with an existential inference that at least one individual in the NP satisfies the presupposition. Importantly, according to this semantics, nothing prevents *exactly one student* from combining with the predicate *did my homework* whose meaning is given in (460). This would yield the truth conditions in (464).

- (464) $\llbracket \text{exactly one student did my homework} \rrbracket^{c,w,g}$
 $\Leftrightarrow \text{there is exactly one student } x \text{ who did } x\text{'s homework in } w.$

Although I do not go into the details here (see Part I), the predicted presupposition of this sentence is only existential, i.e. one student (namely the one who did his homework) is the speaker, and hence should not give rise to any inconsistency. However, such a reading is not available. Thus, the variable semantics overgenerates. This is the same problem that we already saw in Section 7. Notice that this approach does not postulate Feature Transmission, and hence this overgeneration problem is not circumvented.

How crucial is the variable semantics for this account of bound first and second person pronouns? To see that it is indeed indispensable, let us consider the following unsuccessful attempt to use the indexical semantics while keeping the core ideas of this account that focus alternative meanings are insensitive to the person information.

- (465) a. $\llbracket \lambda 2 t_2 \text{ did my homework} \rrbracket^{c,w,g} = \lambda x. x \text{ did } a_c \text{'s homework}$
 b. $\llbracket \lambda 2 t_2 \text{ did my homework} \rrbracket^{c,w,g} = \{\lambda x. x \text{ did } x \text{'s homework}\}$
 c. $\llbracket \lambda 2 t_2 \text{ did my homework} \rrbracket_P^{c,w,g} = \lambda x. \top$

It is already not clear how this meaning can be compositionally arrived at, but let us bear with it, as it would cause an independent problem even if it were derivable in a compositional fashion. Here, the predicate does not carry any non-trivial presupposition (I ignore the presuppositions of the possessive construction). Instead, the first person pronoun denotes the speaker a_c in the assertive dimension, instead of the presuppositional dimension. With the semantics of *only* given above, this derives the desired bound pronoun meaning of the sentence *Only I did my homework*, as the reader can easily verify. Notice that the object a_c is not bound at all, but its focus alternative x is bound.

However this analysis suffers from another overgeneration problem. It predicts that the sentence in (466) should have focus alternatives with a bound pronoun interpretation.

- (466) Only John did my homework.

The predicted bound pronoun reading is true if and only if John did my homework, but nobody else did his or her homework. Such a reading is unavailable for (466). More broadly, the present problem stems from the fact that we now have lost a way to account for the generalization that the binder and bindee need to share person features. Under the analysis above, the first person pronoun above is never bound by anything in the first place, and the binding in the focus dimension is completely blind to the person information.

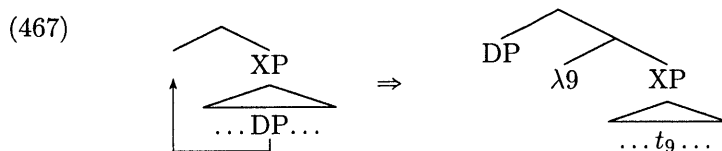
Notice that we have tried putting the meaning of the person feature in the presupposition and in the assertive meaning, but both attempts failed. Of course it should not be in the focus alternative meaning either, since the idea this account started with is to ignore phi features in the focus alternatives, to begin with. I conclude, therefore, that for this approach the variable semantics is indispensable but the two overgeneration problems associated with it are not accounted for.

9.3 Monstrous Approach

Cable (2005) takes yet another maneuver for solving the issue of bound first and second person pronouns (see also Kratzer 2009). As remarked above, under the indexical semantics of first and second person pronouns in (429), the mechanism of semantic binding that is used to establish bound pronoun readings of third person pronouns, i.e. binder indices λi and the rule of Predicate Abstraction, does not achieve bound pronoun readings of first and second person pronouns. The reason simply is that the denotations of first and second person pronouns are not dependent on the assignment function g , and Predicate Abstraction can only affect g . Cable's idea is to introduce special versions of Predicate Abstraction that affect the denotations of first and second person pronouns.

9.3.1 Predicate Abstraction for First and Second Person Pronouns

It is worth reviewing how the standard Predicate Abstraction works first. It is assumed that in the syntactic component, movement creates a binder index λ_i , leaving a traces with the same index. This is illustrated in (467).



An index node so created triggers the rule of Predicate Abstraction that modifies the assignment function.

(468) *Predicate Abstraction*

$$\llbracket \widehat{\lambda_i \text{ XP}} \rrbracket^{c,w,g} = \lambda x_e. \llbracket \text{XP} \rrbracket^{c,w,g[i \rightarrow x]}$$

Cable's trick is to introduce new rules that modify a_c and h_c , rather than g , so that the interpretations of first and second person pronouns will be affected. In order to achieve this, he postulates new binder indices λ_s and λ_h , which are used to trigger these special rules rather than Predicate Abstraction, together with the following syntactic constraints.

- (469)
- a. Movement of a first person pronoun creates either λ_s or λ_1 .
 - b. Movement of a second person pronoun creates either λ_h or λ_2 .
 - c. Nothing else can create these four binder indices.

The indices λ_s and λ_h trigger special rules used to derive bound first and second person pronouns, respectively. On the other hand, the numerical binders λ_1 and λ_2 are used to interpret traces of moved first and second person pronouns that do not semantically bind any other occurrences of pronouns of the same person. They are assumed to trigger Predicate Abstraction in (468), although they are still distinguished from indices on third person pronouns to prevent first and second person from binding third person pronouns. This will be illustrated with concrete examples immediately below.

The core of the proposal is the rules λ_s and λ_h trigger, which are given in (470). I call them *Monstrous Predicate Abstraction* (cf. the monster in Part III).

(470) *Monstrous Predicate Abstraction*

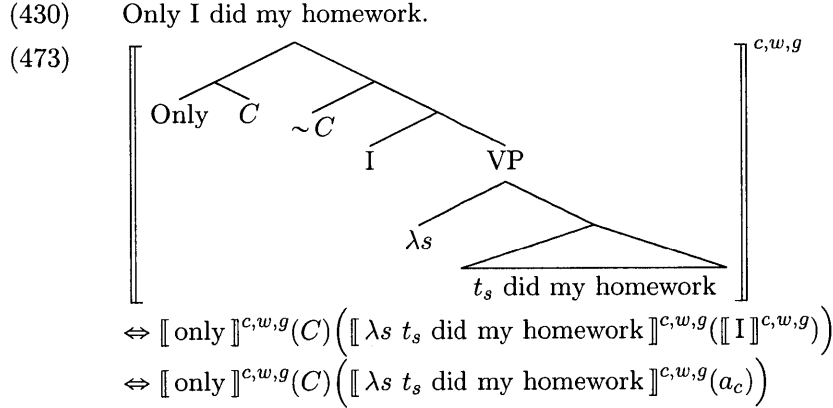
- a. $\llbracket \widehat{\lambda_s \text{ XP}} \rrbracket^{c,w,g} = \lambda x_e. \llbracket \text{XP} \rrbracket^{\langle x, h_c, w_c \rangle, w, g}$
- b. $\llbracket \widehat{\lambda_h \text{ XP}} \rrbracket^{c,w,g} = \lambda x_e. \llbracket \text{XP} \rrbracket^{\langle a_c, x, w_c \rangle, w, g}$

The function of these rules is to introduce a lambda term λx and replace a_c and h_c with the variable x . In the constituent XP in (470a), the original value of a_c is lost, and first person pronouns will refer to x instead. Similarly for (470b). This mechanism will create a predicate with bound variables, as will be demonstrated shortly.

Finally, the interpretation of traces needs to be mentioned as well. Cable assumes that the traces t_1 and t_2 are interpreted via g , but t_s and t_h are interpreted just like first and second person pronouns.

- (471) a. $\llbracket t_1 \rrbracket^{c,w,g} = g(1)$
 b. $\llbracket t_2 \rrbracket^{c,w,g} = g(2)$
 (472) a. $\llbracket t_s \rrbracket^{c,w,g} = a_c = \llbracket I \rrbracket^{c,w,g}$
 b. $\llbracket t_h \rrbracket^{c,w,g} = h_c = \llbracket \text{you} \rrbracket^{c,w,g}$

Let us see more concretely how this account captures the phenomenon of bound first and second person pronouns. I only show this with first person pronouns, but second person cases are captured by the exact same mechanism, except that the binder indices are λh and $\lambda 2$. Firstly, the bound pronoun reading of (430) is captured by the LF in (474).

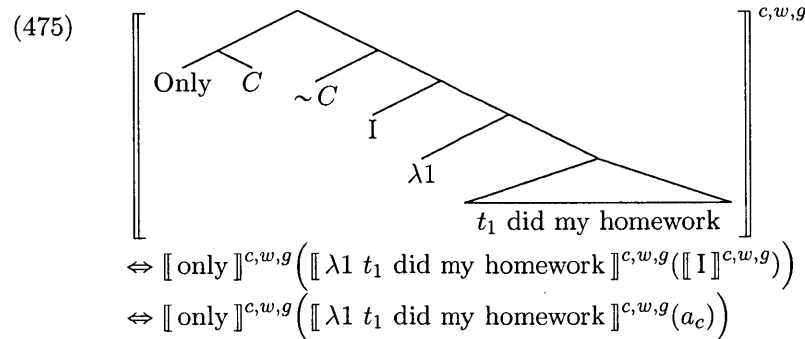


Importantly, the constituent labeled VP here denotes the function, $\lambda x. x$ did x 's homework, due to the index λs . The derivation of this VP denotation is given in (474).

- (474) $\llbracket \lambda s t_s \text{ did my homework} \rrbracket^{c,w,g}$
 $= \lambda x. \llbracket t_s \text{ did my homework} \rrbracket^{\langle x, h_c, w_c \rangle, w, g}$
 $= \lambda x. x$ did x 's homework

Thus, (473) is true just in case a_c did a_c 's homework but for all the other relevant individuals x , x did not do x 's homework. This is the desired bound pronoun reading.

The free pronoun reading (430) is accounted for using the numerical binder index $\lambda 1$, instead of λs . The following LF is isomorphic to (473) except that the indices are 1 rather than s .



The crucial part is the predicate, which denotes the function $\lambda x. x$ did a_c 's homework, as shown in (476).

- (476) $\llbracket \lambda 1 t_1 \text{ did my homework} \rrbracket^{c,w,g}$
 $= \lambda x. \llbracket t_1 \text{ did my homework} \rrbracket^{c,w,g[1 \rightarrow x]}$
 $= \lambda x. x \text{ did } a_c \text{'s homework}$

Thus, the sentence is true if and only if a_c did a_c 's homework but no other relevant individual did a_c 's homework, which is the free pronoun reading.

Notice that the mechanism of Monstrous Predicate Abstraction is very powerful, and changes the denotation of the first and second person pronouns in the scope of λs and λh once and for all. In the next subsection, I will point out an undergeneration problem, which suggests that this mechanism is in fact too coarse-grained.

9.3.2 An Undergeneration Problem

Cable's account undergenerates certain readings for sentences containing more than one first or second person pronoun under the scope of another first or second person pronoun.¹¹³ For instance, consider the sentence in (477).

- (477) Only I believe that my advisor read my dissertation.

This sentence says that I believe my advisor read my dissertation, and in addition, all the other people do not believe the same thing. What do they not believe? It can be read as one of the following four.

- (478) a. Nobody else believes that **my** advisor **my** dissertation.
 b. Nobody else believes that **his** advisor read **his** dissertation.
 c. Nobody else believes that **his** advisor read **my** dissertation.
 d. Nobody else believes that **my** advisor read **his** dissertation.

The problem posed by this observation is that the special binders only generate the first two readings (478a) and (478b), where the lower two first person pronouns are both bound or both free. They are derived by the following simplified LFs.

- (479) a. Only I $\lambda 1$ believe that my advisor read my dissertation.
 b. Only I λs believe that my advisor read my dissertation.

In (479a), the binder $\lambda 1$ does not change the speaker coordinate of the context, and as a consequence, the two occurrences of *my* both denote the current speaker in focus alternatives too, yielding the free pronoun reading (478a). On the other hand in (479b), λs substitutes x for the speaker coordinate of the context, and since both occurrences of *my* are in its scope, they both end up denoting x . This captures the bound pronoun reading (478b). However, there is no other LF possible under this theory that would matter for the interpretation of the first person pronouns in the embedded clause, and the other two readings cannot be described. Notice also that both of the first person pronouns belong to a different clause from the binder index, and under the standard conception of scope taking, neither of them can outscope the binder index. I take this problem to be a serious challenge for Cable's account. To phrase it differently, the binder index λs is not selective and it has to target all the first person pronouns in its scope.

¹¹³In an unpublished manuscript, Sergei Minor independently points out the same problem. I thank him for very helpful discussions. See also Kratzer (2009) for relevant remarks.

This problem naturally leads to a remedy of this analysis, namely to make λs selective (cf. Cable’s 2005 treatment of gender features). This is exactly what I will propose in the next section. Interestingly, the resulting system resembles the minimal pronoun approach in certain respects.

10 Variable Semantics with Complex Indices

We have reviewed three previous approaches to the issue of bound first and second person pronouns, among which two were shown to suffer from empirical problems. To repeat, the multi-dimensional approach is crucially dependent on the variable semantics where the person features ensure the correct denotations as presuppositions, which leads to independent problems pointed out in Section 7, and Cable’s monstrous approach has an undergeneration problem. As mentioned at the end of the last section, the crux of the problem of Cable’s (2005) approach is that Monstrous Predicate Abstraction is not fine-grained enough and shifts the speaker (or hearer) coordinate of the context index once and for all. As a consequence all occurrences of first (or second) person pronouns need to bound.

In this section, I propose an alternative account. The account is similar to Cable’s (2005) in some respects.¹¹⁴ In particular, I will postulate more fine-grained versions of λs and λh , by enriching the information that indices carry. Interestingly, the resulting account resembles the minimal pronoun approach as well in certain respects. I will also propose to abandon the indexical semantics, and instead put forward a novel semantics of first and second person pronouns that treats them as variables just like third person pronouns. This allows us to achieve semantic binding without recourse to a morphological operation like Feature Transmission. Importantly, this analysis does not run into the problems of the variable semantics we saw in Section 7. Also I will claim in the second half of the present part that it allows for a better theory of the interaction between person and number features on bound pronouns.

10.1 Indices with Person Features

Let us start with the new semantics for first and second person pronouns. Recall that one of the problems of the variable semantics of first and second person pronouns discussed in Section 7 is that it fails to capture the generalization that the binder and bindee need to have the same person feature. For example, a third person quantifier like *exactly one student* should not be able to bind a first person pronoun. The idea I propose here is to directly build this requirement into the system of semantic binding by encoding the person information in them.¹¹⁵

Here are the technical details. Indices are assumed to be members of $\mathbb{N} \times \text{TYPE} \times \{1, 2, 3\}$, rather than just numbers or numbers with type information and always carry the person information. For readability’s sake, I will write $i_e[\textcircled{1}]$, $i_e[\textcircled{2}]$ and $i_e[\textcircled{3}]$ instead of $\langle i, e, 1 \rangle$ and so on, and also often omit the type information when no confusion arises. In order to ensure the correct denotations, I assume that the assignment function is subject to the following admissibility condition that is assumed to apply to an utterance (cf. Schlenker 2003b, Stokke 2010).

¹¹⁴I found on January 6th, 2012 that Sergei Minor at the University of Tromsø is independently developing essentially the same analysis as what is presented here. I thank him for highly helpful discussion.

¹¹⁵See Heim & Kratzer (1998) for an idea that indices encode the semantic type information of the referent. See also Heim (2008b) and Rullmann (2003) for related ideas, which we will review in Section 12.

(480) *Admissibility Condition for Assignment Functions*

An utterance of a sentence is felicitously evaluated with respect to context c , possible world w and assignment function g , only if g satisfies the following three conditions: for all $i \in \mathbb{N}$,

- a. $g(i[\textcircled{1}]) = a_c$
- b. $g(i[\textcircled{2}]) = h_c$
- c. $g(i[\textcircled{3}]) \neq a_c$ and $g(i[\textcircled{3}]) \neq h_c$.

It ensures that under the free pronoun readings, first person pronouns can only denote a_c , second person pronouns can only denote h_c , and third person pronouns cannot denote either of them.^{116,117} Since (480) applies only at the topmost/utterance level, and when it is modified within a sentence via Predicate Abstraction, the modified assignment function does not have to comply with (480), which is the key to achieve semantic binding. This will be shown with concrete examples shortly.

With the enriched indices, we can abandon the indexical semantics, and treat pronouns of all persons uniformly as variables, as shown in (481). Notice that the context parameter c is no longer necessary for interpreting pronouns.

- (481)
- a. $\llbracket \text{me}_{i[\textcircled{1}]} \rrbracket^{w,g} = g(i[\textcircled{1}])$
 - b. $\llbracket \text{you}_{i[\textcircled{2}]} \rrbracket^{w,g} = g(i[\textcircled{2}])$
 - c. $\llbracket \text{him}_{i[\textcircled{3}]} \rrbracket^{w,g} = g(i[\textcircled{3}])$

Notice importantly that under this account, person features are not presupposition triggers, unlike gender features, and hence the second problem of the variable semantics mentioned in Section 7 simply does not arise.

I assume that traces are interpreted in the same way as overt pronouns.

- (482)
- a. $\llbracket t_{i[\textcircled{1}]} \rrbracket^{w,g} = g(i[\textcircled{1}])$
 - b. $\llbracket t_{i[\textcircled{2}]} \rrbracket^{w,g} = g(i[\textcircled{2}])$
 - c. $\llbracket t_{i[\textcircled{3}]} \rrbracket^{w,g} = g(i[\textcircled{3}])$

The final ingredient we need to achieve semantic binding is binder indices. I assume that movement of a noun phrase creates a binder index with the corresponding person feature. If a first person pronoun moves, a binder index $\lambda i[\textcircled{1}]$ is created, for example. It follows from this assumption that noun phrases can bind pronouns just in case they have the same person feature, which captures the key generalization that the variable semantics fails to account for. Thus, the first overgeneration problem for the variable semantics of first and second person pronouns does not arise here, as quantifiers like *exactly one student* are third person expressions and can only introduce $\lambda i[\textcircled{3}]$ and never binds a first or second person pronoun.

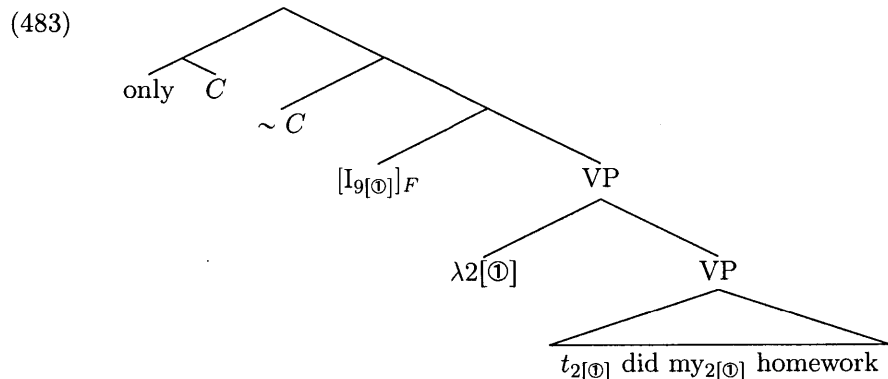
¹¹⁶Notice that the admissibility condition states that a free third person pronoun may refer to neither the speaker nor the hearer. Some authors propose that this effect is achieved via the pragmatic principle of *Maximize Presupposition!* (cf. Percus 2006, Sauerland 2008a), but such an account is committed to a presuppositional semantics for person features and needs to solve the problem of presupposition failure pointed out in Section 7.

¹¹⁷One caveat that should be mentioned in this connection is that it is known that in certain contexts third person pronouns can refer to the speaker or the hearer, but these are typically the contexts where the speaker does not have a *de se* belief about the referent. I will argue in Part III that a_c and h_c should be regarded as *de se* and *de te* individuals, rather than merely the speaker and the hearer, and with this assumption, such cases are not problematic for the condition proposed here.

It is easy to see that the proposed semantics of first and second person pronouns dissolves the issue of bound first and second person pronouns without any extra assumptions. Let us see this with (430) again, repeated here.

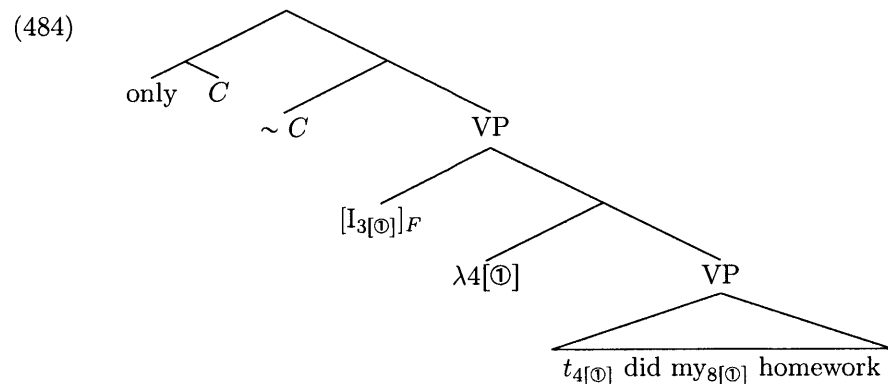
(430) Only I did my homework.

Consider the following LF where the possessive pronoun *my* bears the same index that the movement of *I* creates, i.e. 2[①].



Crucially, the VP denotes the function $\lambda x. x$ did x 's homework, which is necessary to derive the bound pronoun reading.

What about the free pronoun reading of the same sentence (430)? It is generated with an LF where *my* bears an index distinct from the binder index, as in (484).



The VP in this case denotes the function $\lambda x. x$ did a_c 's homework, which as we have repeatedly seen, will end up with the free pronoun interpretation.

Moreover, the problem of multiple pronouns that is problematic for Cable's approach does not arise in this theory, for the same reasons as the problem does not arise for third person pronouns. That is, all and only those occurrences of pronouns that have the same index as the binder index are interpreted as bound pronouns. In other words, the binder index is selective under this analysis, unlike under Cable's account.

It is important to notice that in this account, the meaning of *my* is the same in both bound and free pronoun readings (modulo the admissibility condition on assignment functions), unlike in the minimal pronoun approach, but like Cable's (2005) approach. Also unlike Cable's approach but like the minimal pronoun approach, first and second person

pronouns can be directly bound by binder indices using exactly the same mechanism that is used for semantic binding of third person pronouns. The resulting account is nonetheless similar to the minimal pronoun account in that the person feature is necessarily shared between the binder and bindee, but crucially this is part of the syntactic mechanism of binding, and a separate operation like Feature Transmission is not required to achieve it. To put it differently, all the burden put on Feature Transmission in the minimal pronoun approach is shifted to the syntactic assumptions about indices: They carry person information.

10.2 Summary

In this section, I proposed a new semantics for person features which gives a straightforward account of the issue of bound first and second person pronouns. There are several important points that should be repeated here. According to the proposed analysis, first and second person pronouns denote variables that are assigned values via an assignment function, just like third person pronouns. This has a number of welcome consequences. One is that semantic binding can be done using the same mechanism that is used for third person pronouns, and we do not need an additional PF operation like Feature Transmission or special versions of Predicate Abstraction. Yet, it is similar to the minimal pronoun approach in that it requires the binder and the bindee to share a person feature. In the proposed account this requirement is directly built into the syntactic mechanism responsible for semantic binding, rather than imposed as a morphological condition.¹¹⁸

Among the three previous approaches to the issue of bound first and second person pronouns that we discussed above, only the minimal pronoun approach remains as a contender to the analysis proposed here. From the next section, we will look at number features on bound pronouns, which interact with person features in an interesting way, and discuss how the minimal pronoun approach and my novel approach with complex indices can be extended to cover them.

11 Number Features on Bound Pronouns

We will now expand our data set by including plural features on bound pronouns. I will in particular look at two phenomena: (i) semantically singular plural pronouns (which are sometimes also called dependent pronouns) and (ii) partial binding (or split bound pronouns). Number features and person features interact here, and their interaction poses some theoretical challenges. I will offer an account based on the proposal made in the previous section that makes use of complex indices, and compare it with two previous analyses by Rullmann (2003, 2004) and Heim (2008b). The rest of this present section gives a brief background on the semantics of plurality and introduces the two empirical phenomena that we will focus on.

11.1 A Brief Introduction to the Semantics of Plurality

Let us begin with theoretical assumptions about the meanings of plural noun phrases in natural language. In many languages, number features can be found on pronouns as well as on noun phrases. The semantics of plurality has attracted formal semanticists' attention

¹¹⁸Indices on first and second person pronouns might be independently useful to explain syntactic phenomena, e.g. Binding Theory, Weak Cross Over (see Ruys 2000, Büring 2005 and references therein) and the copy theory of movement. I leave these topics for future research.

for decades, and many competing views have been offered (Bennett 1974, Link 1983, 1987, Landman 1989a,b, 2000, Lasersohn 1995, Schwarzschild 1992, 1996, Winter 2001, 2002, among many others), but for our purposes, nothing beyond what is standardly assumed is necessary.

What do plural noun phrases like *John and Bill* refer to? Following previous studies, I assume that plural noun phrases refer to sets of individuals.¹¹⁹ For example, *John* denotes the individual John, while *John and Bill* denotes the set consisting of the individuals John and Bill, $\{j, b\}$. I will refer to non-set individuals as atomic or singular individuals, and set individuals as plural individuals, or simply pluralities.

Correspondingly, there are predicates that take plural individuals, rather than atomic individuals, as their arguments. Standardly, three types of predicates are recognized: distributive, collective and mixed predicates (see Winter 2001, 2002 for a different view). Distributive predicates only combine with atomic individuals, e.g. *be smart*, while collective predicates only combine with plural individuals, e.g. *formed a team*. Mixed predicates can take either kinds of individuals, e.g. *wrote a love song*.

What is puzzling is the fact that, on the surface, distributive predicates can take plural subjects. For instance, *be smart* is a distributive predicate, since it describes a property of one single individual, but *John and Bill are smart* is as grammatical as *John and Bill formed a team* or *John and Bill wrote a love song*. What differentiates distributive predicates from the other two types of predicates is the following inference pattern.

(485) A predicate *P* is distributive if *John and Bill P* implies *John P* and *Bill P*.

This inference is attributed to the distributivity operator (Link 1983, 1987, Roberts 1987, Lasersohn 1998, Winter 2001), which will play an important role in my theory of number features on bound pronouns. We will see how the distributivity operator works in concrete terms in the following sections.

Collective predicates, on the other hand, are only true of plural subjects, and resist singular subjects, like *John*.¹²⁰ For example, *formed a team* is classified as a collective predicate according to this criterion.

(486) a. *John formed a team.
b. John and Bill formed a team.

The rest are mixed predicates, which include *wrote a love song*, *weigh 120kg*, *lifted a piano*, and so on. These predicates do not necessarily support the inference pattern (485) and also do not resist singular subjects.

(487) a. John and Bill wrote a love song \Rightarrow John wrote a love song and Bill wrote a love song.
b. John wrote a love song.

¹¹⁹Link (1983) insists that plural individuals should not be regarded as sets, but his arguments are mainly philosophical and do not directly concern us here (Landman 1989a,b, Schwarzschild 1992, 1996). The reason why I am adopting the set view is primarily expository. That is, given the isomorphism between the set of sets of individuals and Link's semi-lattice, the set view is properly stronger than the non-set view, e.g. an atomic individual *a* can be distinguished from a singleton set individual $\{a\}$. Since Rullmann (2003, 2004) makes crucial use of this difference between atomic individuals and singleton set individuals, I will use sets as plural individuals. As we will see below, however, neither Heim (2008b) nor my account hinges on the set view, and can be formulated with Link's view.

¹²⁰There are two well known exceptions: (i) group denoting nouns like *the committee* and *the team*, and (ii) the 'involvement' readings (Landman 1989a). They are ignored here, for the sake of simplicity.

The classification of predicates is a matter of the lexical semantics. Thus, distributive predicates are specified as selecting for atomic individuals, while collective predicates obligatorily select for sets of individuals as their arguments. Mixed predicates, on the other hand, do not have such restrictions.

This much is what we need to know about the semantics of plurality to follow the discussion below, and the assumptions we are making here are, I believe, fairly uncontroversial. Following general notational convention, I will mostly use lower case letters, e.g. *x*, *a*, etc., for atomic individuals, and upper case letters, e.g. *X*, *A*, etc., for plural individuals in our metalanguage. Also I omit the selectional restrictions of distributive and collective predicates in the metalanguage to simplify the exposition.

11.2 Plural Features on Pronouns

Let us now come back to number features on pronouns. Up until now, we have only looked at singular pronouns. How are plural pronouns interpreted? When a plural pronoun is used referentially, it refers to a collection of individuals, and cannot refer to a single individual.¹²¹ For instance, the referent of *they* in (488) cannot be construed as one individual or entity.

- (488) a. They are smart.
b. They are expensive.

As the anomaly of (489) shows, furthermore, this plurality inference associated with *they* is an obligatory inference.

- (489) a. #They are the smartest student.
b. #They are the most expensive book in this store.

In English, unlike gender and person features, plural features appear rather freely on ordinary (countable) noun phrases as well, e.g. *these students* and *these books*. An example analogous to (489) shows that the plurality inference is obligatory here too.

- (490) a. #These students are the smartest one.
b. #These books are the most expensive one.

Arguably, it is desirable to assign the same semantics to number features on pronouns and those appearing on other kinds of noun phrases. However, there is a controversy in the recent literature as to the nature of plurality inferences (Sauerland 2003, 2008b, Sauerland, Anderssen & Yatsushiro 2005, Pearson, Khan & Snedeker 2010, Spector 2007, Farkas & de Swart 2010). In particular, those associated with non-definite noun phrases are known to pose a theoretical challenge. As this would take us too far afield, I will remain agnostic in this dissertation as to exactly how number features are interpreted. Instead, I will exclusively focus on the nature of number features on bound pronouns.

Rullmann (2003, 2004) discusses two interesting phenomena surrounding plural features on bound pronouns: (i) semantically singular plural pronouns, and (ii) partial binding. I will illustrate them with some concrete examples now.

¹²¹Here I disregard the so-called singular *they*, which refers to an atomic individual, although its morphology is plural. This seems to be a peculiar feature of English *they*. One can eliminate this confound by looking at other languages like German and French or inanimate referents as in (488b). See Section 12.1.5 for some discussion on singular *they* in connection with Rullmann's (2003) theory. See also Sauerland (2008b).

Semantically singular plural pronouns occur in sentences like (491) (cf. Heim, Lasnik & May 1991, Sauerland 2003).

(491) These boys (all) think that they are the smartest student.

Notice that the embedded clause here is identical to (489a), but the sentence is felicitous. An intuitive paraphrase of this sentence is that each of these boys thinks that *he* is the smartest student. What is striking here is that *they* is used to denote a single individual, unlike in (489a).

Sauerland (2003) among others takes this phenomenon to be evidence for a minimal pronoun approach where the plural feature on a bound pronoun is semantically inert and just copied from its binder (see also Heim, Lasnik & May 1991, Heim 2008b). Rullmann (2003), on the other hand, pursues a semantic explanation of this phenomenon.¹²² Notice that the explanation under the minimal pronoun approach is rather straightforward. In (491), there is a plural binder, *these boys*, and its plural feature is transmitted to the minimal pronoun in the embedded clause, which gets pronounced as *they*. On the other hand, a semantic approach like Rullmann's must explain the difference between (489a) and (491) in a semantic way.

Unlike semantically singular plural pronouns, the second phenomenon, partial binding, *prima facie* favors a semantic explanation over a minimal pronoun account. Consider the following sentence.

(492) Each of the students told each of the professors that their meeting was fun.

This sentence has a reading where the pronoun *their* is read as simultaneously bound by both of the universal quantifiers, which is paraphrased as (493).

(493) Each student x told each professor y that x and y 's meeting was fun.

If each quantifier introduces one index, the pronoun has to have two indices to be read as co-varying with both of them. Such a mechanism of multiple indexing seems to be inevitable here, and in fact all of the previous accounts of this phenomenon assume that *their* in (493) has two indices, each bound by a different quantifier (Rullmann 2003, 2004, Heim 2008b, Kratzer 2009; cf. Higginbotham 1983, Sportiche 1985, Buring 2005 for Binding Theoretic motivation for the same mechanism). Notice importantly that the plural pronoun in (493) is bound by two *singular* quantifiers. If the pronoun needs to inherit the features of its binder or binders, as the minimal pronoun approach contends, where does the plural feature come from? It seems that at least the plural feature has to be inherent in the bound pronoun *their* here, but this runs counter to the central tenet of the minimal pronoun approach. On the other hand, this phenomenon can be given a natural semantic account, given a mechanism of multiple indexing. That is, the denotation of *their* in (493) is a plurality consisting of two individuals, so the pronoun is plural.

Furthermore, quite interestingly, the above two phenomena can co-occur within a single pronoun. Consider (494).

¹²² Although pursuing a minimal pronoun approach, Kratzer (2009) concludes based on partial binding that number features on bound pronouns are always interpreted. Thus, her account is eclectic in several respects. It postulates minimal pronouns, but assumes that number features are exempt from Feature Transmission/Unification. Also it adopts Cable's Monstrous Predicate Abstraction to account for long distance binding of person pronouns. I will not offer a detailed review of her account in this dissertation.

(494) These students thought that no professor remembered their first meeting.

Their here can be interpreted as ranging over pairs of a professor and a student. A paraphrase of this reading is given in (495).

(495) Each of these students *x* thought that there is no professor *y* such that *y* remembered *x* and *y*'s first meeting.

Here *x* is singular in the sense that it denotes one of the relevant students, despite the fact that in (495) *the students* is plural. Thus, the mechanism that is responsible for semantically singular plural pronouns seems to be at work here, interacting with multiple indexing.

Moreover, person features add a twist to all of the above. Generally, both semantically singular plural pronouns and partial binding are possible with pronouns of any person. For example, *we* in the embedded clause in the following sentence denotes a singular individual, just as in the case of *they* in (491) above.

(496) We all think that we are the smartest student.

Similarly, partial binding is possible, as exemplified by (497).

(497) Each professor told me that we should have a meeting this week.

We here can be read as ranging over a pair of individuals consisting of the speaker and one of the professors. Finally, (498) shows that the two phenomena can happen at the same time.

(498) We each thought that no professor remembered our first meeting.

These can be replicated with a second person pronoun, but since English second person pronouns are number neutral (except in a dialect that has *y'all*), I will use first person pronouns rather than second person pronouns in most of the examples. As Rullmann (2004) himself points out, his semantic account cannot adequately explain the interaction between person and number features. Heim (2008b) offers a Feature Transmission analysis that covers more data than Rullmann's account that relies heavily on morpho-phonological rules.

Lastly, there is a set of examples that are harder to account for in existing theories. Dimitriadis (2000) points out that semantically singular plural pronouns do not require a c-commanding antecedent. Consider the following examples. (499a-d) are taken from Dimitriadis (2000:70-71), and (499e) is from Dimitriadis (2000:91).

- (499)
- a. The students John and Mary taught think they will win \$100.
 - b. The guys who saw John and Mary think they are taller than each other.
 - c. The coaches that trained them think they will win.
 - d. The lawyers that represent John and Mary think they will refuse to settle.
 - e. The people who voted for Street and Weinberg thought that they would win the election.

In all of these examples, *they* in the embedded clause can be read as denoting an atomic individual. Dimitriadis (2000) himself does not discuss the issue of phi features in this connection, but importantly, the person features of non-c-commanding antecedents and pronouns bound by them must match. For instance, the following sentences allow singular

readings of *we*.

- (500) a. The people who voted for me and John thought that we would win the election.
b. The girls who dated me and John all said that we were the most insensitive man in the world.

Also, partial binding is possible in a similar configuration. Consider the following examples.

- (501) a. The students John and Bill taught asked Mary if they were married.
b. The people who voted for Mary and Sue thought we were married.

These sentences have readings that are paraphrased as (502).

- (502) a. The students John taught asked Mary if John and Mary were married, and the students Bill taught asked Mary if Bill and Mary were married.
b. The people who voted for Mary thought Mary and I were married, and the people who voted for Sue thought Sue and I were married.

Thus, only subparts of the plural pronouns in (501) vary according to the subject.

As we will see, these sentences where the binder and the bindee do not stand in a c-command relation are not subsumed under Rullmann's (2003) and Heim's (2008b) theories. I will offer an account by extending the theory of person features introduced in Section 10.

12 Previous Approaches

12.1 Rullmann's Semantic Approach

As remarked above, partial binding at first blush seems to pose a challenge for the minimal pronoun approach. For this reason, Rullmann (2003) pursues a semantic account that does not make use of morphosyntactic operations like Feature Transmission. For such an account, semantically singular plural pronouns are going to be non-trivial, and Rullmann (2003) puts forward a solution based on Winter's (2001) theory of plural quantification. As Rullmann (2003, 2004) himself remarks, however, his account suffers from some empirical problems.

12.1.1 Winter's Plural Quantification

Focusing on third person pronouns, Rullmann (2003) claims that semantically singular plural pronouns can be given a purely semantic account using the theory of plural quantification proposed by Winter (2001, 2002). Especially important for Rullmann's purposes is the ontological distinction between singularities and pluralities: singular DPs denote atomic individuals, while plural DPs denote (non-empty) sets of individuals, including singleton sets. In order to avoid unnecessary proliferation of semantic types, type e objects are sorted into singularities and pluralities. The set of singular individuals is denoted by SG and the set of plural individuals by PL. The latter is defined as $\wp(\text{SG}) \setminus \{\emptyset\}$, which is abbreviated as $\wp^+(\text{SG})$. Thus D_e in this setting is the union of these two sets, $\text{SG} \cup \text{PL}$.

- (503) a. $\text{SG} = \{a, b, c, \dots\}$
b. $\text{PL} = \{\{a\}, \{b\}, \{c\}, \{a, b\}, \{b, c\}, \dots\}$

Correspondingly, the extensions of singular predicates are sets of singular entities, while the extensions of plural predicates are sets of plural entities, i.e. sets of sets of singular entities. As an illustration, assume that there are three students, a , b and c . Then the denotation of the singular predicate *student* is $\{a, b, c\}$, while that of the plural predicate *students* is the following set of sets.

$$\left\{ \begin{array}{ccc} & \{a, b, c\}, & \\ \{a, b\}, & \{a, c\} & \{b, c\}, \\ \{a\}, & \{b\}, & \{c\} \end{array} \right\}$$

Notice that this set includes singleton sets $\{a\}$, $\{b\}$ and $\{c\}$. Winter gives empirical motivation for drawing a distinction between atomic, singular individuals like a and singleton pluralities like $\{a\}$. Specifically, many languages have determiners that combine with singular NPs, and determiners that combine with plural NPs. For example, in English, *each* selects for a singular NP, while *all* selects for a plural NP. Importantly the resulting truth conditions are the same for distributive predicates, as shown in (504).

- (504) a. Each student is smart.
b. All the students are smart.

For collective predicates like *meet*, which do not combine with a singular denoting noun phrase like *John*, on the other hand, only the plural selecting determiners are acceptable, as in (505).

- (505) a. *Each student met.
b. All the students met.

Winter capitalizes on the difference between atomic individuals like a and singleton individuals like $\{a\}$ to account for the commonalities like (504) and also the differences like (505) between *each* and *all*. Specifically, he proposes that determiners that select for plural NPs stand in the following relation with determiners that select for singular NPs.

$$(506) \quad \text{Det}_{pl}(A, B) \Leftrightarrow \text{Det}_{sg}(\cup A, \cup(A \cap B))$$

For instance, in the case of *all* and *each*:

$$(507) \quad \llbracket \text{all} \rrbracket(A, B) \Leftrightarrow \llbracket \text{each} \rrbracket(\cup A, \cup(A \cap B))$$

To see concretely how the contrast (505) is accounted for, let us consider the following toy situation. There are three students a, b, c . Suppose furthermore that there were two meeting events, one among the students a, b, c and one among one student and two other individuals c, d, e . Thus, the extension of the predicate *met* is the set $\{\{a, b, c\}, \{c, d, e\}\}$. The unacceptability of (505a) is accounted for as follows. Since *each* quantifies over singular individuals, while the predicate is only true of sets of individuals, it is always false. On the other hand, (505b) is predicted to be contingent and hence felicitous. That is, assuming (507), the predicted truth conditions of (505b) are that it is true iff $\{a, b, c\} \subseteq \{\{a, b, c\}, \{c, d, e\}\}$. Therefore the sentence is correctly predicted to be true in the given scenario.

The case of distributive predicates in (504) are captured in a similar way. Suppose again that there are three students a, b, c , and there are 5 smart people, a, b, c, d, e . Then the singular and plural predicates are assigned the following extensions.

- (508) a. Singular *is smart*: $\{a, b, c, d, e\}$
 b. Plural *are smart*: $\wp^+(\{a, b, c, d, e\})$

The example (504a) is simply analyzed as $\llbracket \text{each} \rrbracket(\{a, b, c\}, \{a, b, c, d, e\})$, where $\llbracket \text{each} \rrbracket$ is the subset relation. Since the first argument is a subset of the second, it is predicted to be true. The plural example (504b) is predicted to be true just in case

$$\llbracket \text{all} \rrbracket(\wp^+(\{a, b, c\}), \wp^+(\{a, b, c, d, e\}))$$

This is equivalent to the following according to (507).

$$\begin{aligned} & \llbracket \text{each} \rrbracket(\cup(\wp^+(\{a, b, c\})), \cup(\wp^+(\{a, b, c\}) \cap \wp^+(\{a, b, c, d, e\}))) \\ \Leftrightarrow & \llbracket \text{each} \rrbracket(\{a, b, c\}, \{a, b, c\}) \end{aligned}$$

Therefore, the plural sentence (504b) is predicted to be true in the same situation.

12.1.2 Rullmann on Semantically Singular Plural Pronouns

Using Winter's analysis, Rullmann provides an account of semantically singular plural pronouns. Consider the following sentence.

- (509) All students thought they would win.

Here again, *they* can be read singular, and the sentence can be felicitously used even if it's assumed that only one person wins. Rullmann's idea is to analyze the pronoun *they* here as denoting a singleton plurality like $\{a\}$, rather than an atomic individual like a . More specifically, the extension of the predicate *thought they would win* is analyzed as the set $\{X \in \text{PL} : X \text{ thought } X \text{ would win}\}$ (intensionality is ignored for the sake of simplicity). It is assumed that *would win* here is a plural predicate that is true only of singleton individuals.

Here is a concrete situation that illustrates this. Assume as before that $\llbracket \text{student} \rrbracket = \{a, b, c\}$, $\llbracket \text{students} \rrbracket = \wp^+(\{a, b, c\})$. Now suppose that a thought a would win, b thought b would win, and c thought c would win, so $\{a\}, \{b\}, \{c\} \in \{X \in \text{PL} : X \text{ thought } X \text{ would win}\}$. Because of the semantics of this predicate, a non-singleton plurality like $\{a, b\}$ is never in the extension of this predicate. In this context, (509) is analyzed as follows, again assuming Winter's equivalence in (507).

$$\begin{aligned} (510) \quad & \llbracket (509) \rrbracket \Leftrightarrow \llbracket \text{all} \rrbracket(\llbracket \text{students} \rrbracket, \{X \in \text{PL} : X \text{ thought } X \text{ would win}\}) \\ & \Leftrightarrow \llbracket \text{each} \rrbracket(\cup(\llbracket \text{students} \rrbracket), \cup(\llbracket \text{students} \rrbracket \cap \{X \in \text{PL} : X \text{ thought } X \text{ would win}\})) \\ & \Leftrightarrow \llbracket \text{each} \rrbracket \left(\begin{array}{l} \cup(\wp^+(\llbracket \text{student} \rrbracket)), \\ \cup(\wp^+(\llbracket \text{student} \rrbracket) \cap \{X \in \text{PL} : X \text{ thought } X \text{ would win}\}) \end{array} \right) \\ & \Leftrightarrow \llbracket \text{each} \rrbracket(\{a, b, c\}, \cup(\{\{a\}, \{b\}, \{c\}\})) \\ & \Leftrightarrow \llbracket \text{each} \rrbracket(\{a, b, c\}, \{a, b, c\}) \end{aligned}$$

Therefore, as desired, the sentence is predicted to be true in the given scenario.

What is important here is the assumption that plural pronouns such as *they* range over singleton individuals, which are distinct from atomic individuals. The reason why a plural pronoun is used is because the quantifier ranges over plural individuals.

Thus, Rullmann accounts for semantically singular plural pronouns bound by plural quantifiers, but what about cases like (491), where the relevant noun phrase is not quan-

tificational?

(491) These boys think that they are the smartest student.

In this case, the predicate *think that they are the smartest student* is a set of singleton individuals, under Rullmann's account, e.g. $\{\{a\}, \{b\}, \{c\}\}$. On the other hand, *these boys* denotes a non-singleton set of individuals, e.g. $\{a, b, c\}$. Therefore, at first sight, Rullmann's account seem to predict (510) to be always false. To circumvent this problem, Rullmann claims that in such cases there is a hidden distributivity operator \mathcal{D} , which in fact can be overtly realized as *each* or *all* without changing the meaning.

(511) These boys {each, all, \mathcal{D} } thought that they are the smartest student.

The distributivity operator creates a plural predicate that can apply to a non-singleton set denoted by *these boys*. Specifically, Rullmann proposes the following semantics for the distributivity operator, where * designates closure under union.

(512) $\llbracket \text{each/all}/\mathcal{D} \text{ VP} \rrbracket = *(\llbracket \text{VP} \rrbracket \cap \{\{x\} \mid x \in \text{SG}\})$

In words, the distributivity operator takes a VP, first collects the singleton extensions in it, creating a predicate that is only true of singleton pluralities, and then it closes its extension with union. More concretely, assume that each of the three boys a, b and c thinks that he is the smartest student. Then the extension of *thought that they are the smartest student* is $\{X \in \text{PL} : X \text{ thought } X \text{ is the smartest student}\}$, i.e. $\{\{a\}, \{b\}, \{c\}\}$. The intersection with singleton sets is vacuous here, but the closure under union yields the set $\{\{a\}, \{b\}, \{c\}, \{a, b\}, \{b, c\}, \{a, c\}, \{a, b, c\}\} = \wp^+(\{a, b, c\})$. Given that the subject *these boys* denotes $\{a, b, c\}$, the sentence comes out true in this situation.

12.1.3 Rullmann on Partial Binding

In order to deal with partial binding, Rullmann (2003) introduces further assumptions. As remarked above, under a semantic approach like Rullmann's, partial binding is rather straightforward given a mechanism that allows pronouns to bear multiple indices. There are two formal apparatuses that Rullmann introduces. Firstly, he postulates two series of indices for singular and plural individuals, respectively.

(513) a. Singular indices: $1^s, 2^s, 3^s, \dots$
b. Plural indices: $1^p, 2^p, 3^p, \dots$

It is required that for any singular index n^s , $g(n^s) \in \text{SG}$, and for any plural index n^p , $g(n^p) \in \text{PL}$, for all assignment functions g .

Secondly, Rullmann makes use of set indices which are finite sets of singular and/or plural indices, e.g. $\{5^s, 10^p\}, \{6^s, 22^s, 9^p\}$ (cf. Higginbotham 1983, Sportiche 1985, Buring 2005). The interpretation of a set index is a plurality consisting of the values of all singular indices and the members of the values of all plural indices.

(514) For any set index S and for any assignment g ,
 $g(S) = \{d \in \text{SG} : d = g(n^s) \text{ for some } n^s \in S \text{ or } d \in g(m^p) \text{ for some } m^p \in S\}$

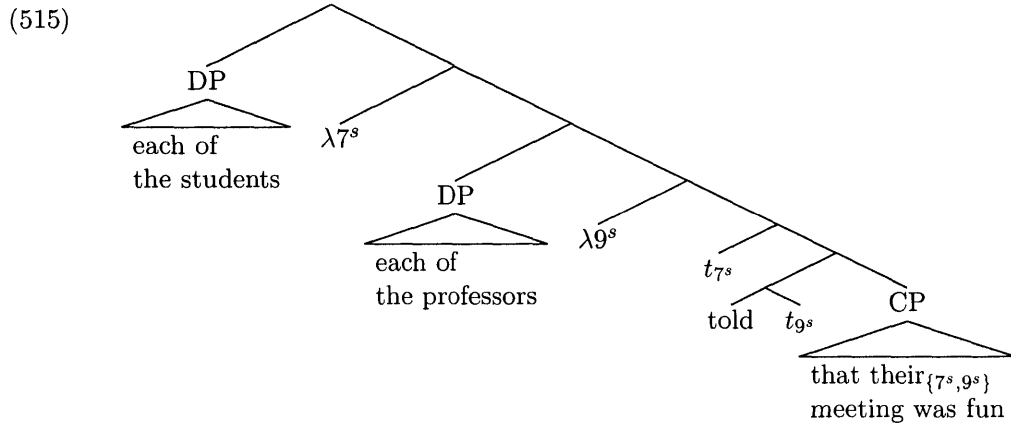
It is assumed that singular pronouns only bear singular indices, while plural pronouns can bear either plural indices or set indices. As a result, a singular pronoun can only denote an

atomic individual, while a plural pronoun always denotes a plural individual.

In this setting, partial binding can be accounted for in the following manner. The key assumption is that a set index on a plural pronoun may have a singular index as its member, which can be bound by a singular quantifier. Consider the example in (492) again.

(492) Each of the students told each of the professors that their meeting was fun.

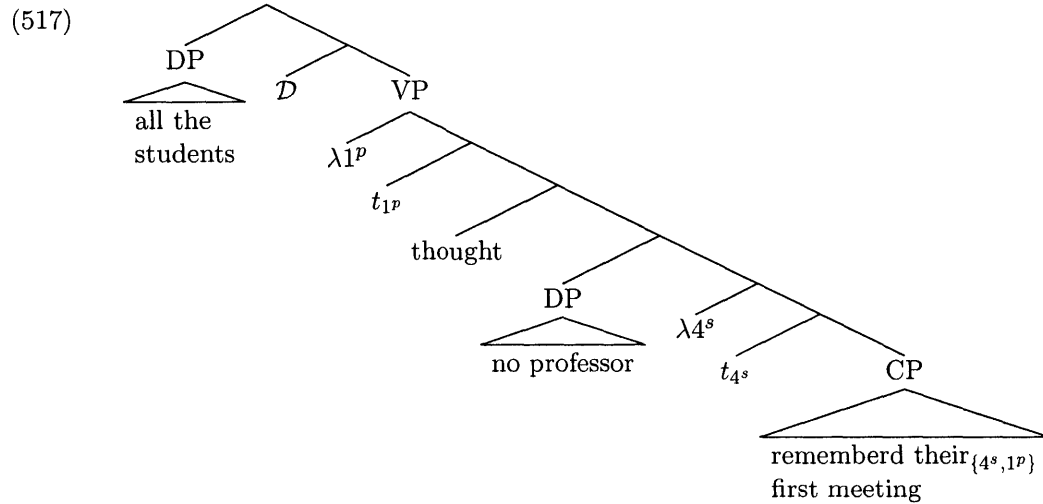
The plural pronoun *their* here can have $\{7^s, 9^s\}$ as its set index, for example. Then each of these singular indices can be bound by a singular quantifier. Consequently, the singular pronoun co-varies with two singular quantifiers. These binding relations are depicted in the following tree diagram.



The same mechanism accounts for the combination of the two phenomenon as well. Consider the following example.

(516) All the students thought no professor remembered their first meeting.

The quantifier *all the students* is a plural quantifier ranging over pluralities. In order to achieve binding, *their* should have a set index with a singular index and a plural index, say $\{4^s, 1^p\}$, where 4^s is bound by *no professor* and 1^p is bound by *all the students*.



The constituent labeled VP denotes the set of plural individuals:

$$(518) \quad \left\{ X \in \text{PL}: \begin{array}{l} X \text{ thought no professor } y \text{ remembered} \\ \text{the first meeting between } X \text{ and } y \end{array} \right\}$$

With the distributivity operator, it captures the correct meaning that each of the students x thought that no professor y remembered x and y 's first meeting.

Although elegant, Rullmann's account faces some empirical challenges. They might not be insurmountable, but their solutions are far from trivial.

12.1.4 Problem 1: Interaction with Person Features

Rullmann (2004) attempts to extend the account presented above to deal with the interaction with person features. His idea is that indices on pronouns affect how they are pronounced. More specifically, he assumes that there are two distinguished singular indices, s and h , that pick out the speaker and the hearer, respectively. The spell-out rules for the singular pronouns are as follows.

- (519) A pronoun with a singular index i^s is realized as:
- a. a first person pronoun (*I, me, my*, etc.), if $i^s = s$
 - b. a second person pronoun (*you, your*, etc.), if $i^s = h$
 - c. a third person pronoun (*he, his, him, she, her, it, its*, etc.), otherwise

The person feature of a plural pronoun with a set index is determined by the following rule:

- (520) A pronoun with a set index I is realized as:
- a. a first person pronoun (*we, us, our*, etc.), if $s \in I$
 - b. a second person pronoun (*you, your*, etc.), if $h \in I$ and $s \notin I$
 - c. a third person pronoun (*they, their*, etc.), otherwise

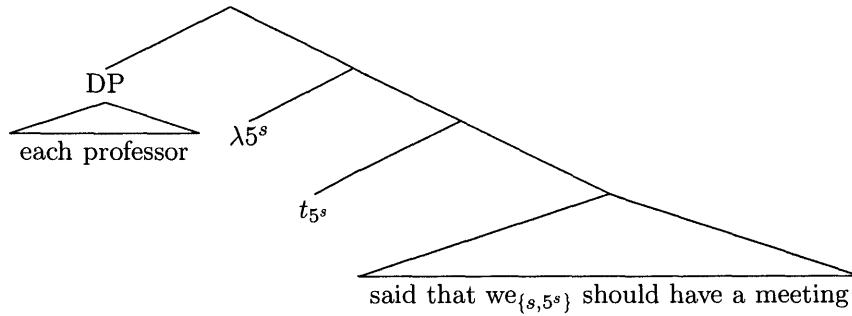
Thus, according to this idea, what a bound pronoun looks like is not determined by the feature composition of its antecedent or antecedents, but what indices it carries.

This analysis nicely handles partial binding involving person features. Consider the following example.

- (521) Each professor said that we should have a meeting.

The pronoun *we* here can be read as ranging over a pair consisting of one professor and the speaker. This can be analyzed with a set index containing s and one more singular index, say, 5^s , which is bound by the quantifier *each professor*. Thus, the pronoun denotes the pair consisting of s and each of the professors, and is pronounced as *we*, because its index is a set index that contains s . This state of affairs is depicted in the following tree diagram.

(522)



However, Rullmann himself points out that this analysis runs into a problem when person features are involved in semantically singular plural pronouns. Consider the following example.

(523) We all think that we are the smartest student.

Firstly, *we* in the matrix clause has a set index that contains *s*, e.g. $\{s, 5^s, 8^p, 12^s\}$, and denotes a set of individuals including the current speaker. What about *we* in the embedded clause? It should also have a set index containing *s*, as it is pronounced as a plural first person pronoun. However, then, how does that denote a singleton individual? The only possibility seems to be to say that the set index is the singleton $\{s\}$. This leads us to say that *s* is also bindable. However, notice that *we* in the matrix clause itself cannot bind a singular index *s*, because its denotation is a plural individual. Rullmann suggests that in this case, the distributivity operator is the binder for *s* in (523). The binding relations are depicted in the following.

(524) $we_{\{s,5^s,8^p,12^s\}}$ all λs think that $we_{\{s\}}$ are the smartest.

Rullmann does not specify exactly how such a structure is interpreted, but instead he points out a problem. That is, if *s* is bindable this way, then the pronoun in the embedded clause does not have to be plural for the sentence to receive a bound pronoun interpretation. Thus, it predicts that (525) also has a bound pronoun reading, contrary to fact.

(525) We all think that I am the smartest.

This should be able to have the following representation, where *s* is bound by *all* due to the same mechanism as (524).

(526) $we_{\{s,5^s,8^p,12^s\}}$ all λs think that I_s are the smartest.

The pronoun is pronounced as *I*, because its index is a singular index. However, (525) does not have a bound pronoun interpretation.

Notice furthermore that the index that *all* introduces does not have to be *s*. Thus, both of the following are predicted to have a bound pronoun interpretation, again contrary to fact.

- (527) a. We all $\lambda 8^s$ think that $they_{8^s}$ are the smartest.
- b. We all $\lambda 2^s$ think that he_{2^s} is the smartest.

The gist of the problem here is that the two occurrences of *we* in (523) are not directly related under this account, and nothing forces them to have the same phi features. Recall

the generalization from the discussion on person features that the binder and bindee have to have the same person features. This generalizes to semantically singular plural pronouns. They require the presence of a binder with the same phi features. The account suggested by Rullmann fails to capture this.

12.1.5 Problem 2: Singular *They*

Rullmann makes the prediction that plural DPs never bind singular pronouns. The reason is that because plural noun phrases always bear plural indices or set indices, while singular pronouns never do, they can never stand in a binding relation. On the other hand, singular noun phrases are allowed to bind plural pronouns, which accounts for partial binding in sentences like (492).

(492) Each of the students told each of the professors that their meeting was fun.

However, it should be realized that a plural pronoun can bear a singleton set index, like $\{23^s\}$. A pronoun with $\{23^s\}$ is by assumption a plural pronoun, but its denotation is a singleton individual. Thus, $they_{\{23^s\}}$ should combine with a predicate like *are the smartest student*, which can only be true of a single individual at a time. Furthermore, it is predicted that a singular binder index $\lambda 23^s$ can bind such a pronoun. In other words, a singular noun phrase should be able to bind a plural pronoun with a singleton set index.

Fortunately, such cases are found in English, namely the so-called singular *they*. Rullmann (2003) gives the following examples. Here % marks that there is a dialectal variation in the acceptability of these sentences.

- (528) a. %Someone left their coat on the table.
 b. %Every student thinks they're smart.

In the relevant dialects, the plural pronouns, *their* and *they*, can be bound by singular quantifiers. These readings can be analyzed as follows.

- (529) a. Someone $\lambda 8^s$ left their $_{\{8^s\}}$ coat on the table.
 b. Every student $\lambda 2^s$ thinks they $_{\{2^s\}}$ 're smart.

However, this is a very general mechanism, and without a constraint, this account actually suffers from overgeneration problems, as Rullmann himself points out. For example, it is predicted that any singular noun phrase can bind a plural pronoun. However, a sentence like (530) does not admit a coreferential interpretation even in the relevant dialects.

(530) John left their coat on the table.

If the following binding relation is allowed, a coreferential reading is wrongly predicted to be available.

(531) John $\lambda 6^s$ left their $_{\{6^s\}}$ coat on the table.

Rullmann notes that it is not the case that the antecedent need be quantificational, since sentences like (532) are acceptable under the coreferential reading.

(532) The author of this article criticized their own account.

Instead, he suggests that the constraint here is that the gender of the antecedent is not known. However, it is not immediately clear why such a pragmatic constraint regulates the binding mechanism. Furthermore, it needs to be assumed that this constraint is not operative when the antecedent is quantificational.

Also, perhaps more significantly, if the relevant mechanism is universally available across languages, singular *they* should be found in many and perhaps all natural languages, but this prediction is not borne out. In fact, most of the languages known so far do not allow singular *they*. Rullmann's account would have to say, therefore, that there is some constraint banning singular *they* in the majority of languages we know, but given the crosslinguistic rarity of singular *they*, it seems to me that it is more plausible that languages without singular *they* are the norm, and something special should be said about (the relevant dialects of) English, rather than the other way around.

12.1.6 Problem 3: Non-c-commanding Antecedents

Recall that semantically singular plural pronouns do not require their antecedents to c-command them. Some examples without c-command are given in (533).

- (533)
- a. The people who voted for John and Bill thought that they would win.
 - b. The students John and Bill taught thought said that they were the best teacher in the world.
 - c. The people who voted for John and me thought we would win.

These cases are clearly not accounted for under Rullmann's (2003) theory without further assumptions. Although a solution due to Dimitriadis (2000) that I will discuss later can in principle be adopted in Rullmann's theory, the question remains how the use of the plural pronoun is forced. This problem is left open here.

12.2 Heim's Minimal Pronoun Approach

As remarked earlier, it is easy to analyze singular denoting plural pronouns using minimal pronouns and Feature Transmission. The binders of semantically singular plural pronouns carry a plural feature, which is simply copied onto the bound minimal pronouns that do not have any restrictions on their denotations. Here are some concrete examples.

- (534)
- a. All of the boys think that they are the smartest student.
 - b. These boys think that they are the smartest student.
 - c. We all think that we are the smartest student.

The bound pronouns here are analyzed as minimal pronouns that inherit the phi features of their binders, including the number features, and hence are compatible with singular denotations.

However, partial binding requires an explanation. Recall that Feature Transmission needs to be obligatory and total in order to prevent overgeneration. To repeat the main point, if it were optional, it would incorrectly predict that (535) has a bound pronoun reading.

- (535) Only you did her homework.

That is, if *her* does not have to inherit the second person feature of its binder, (535) should be able to mean that the female hearer did her homework and nobody else did his or her homework. However, (535) does not have such a reading.

The main puzzle that arises from partial binding is that if a minimal pronoun is bound simultaneously by two singular quantifiers, the pronoun should inherit the singular features, and gets pronounced as a singular pronoun, but this is not what happens in examples like (492).

(492) Each of the students told each of the professors that their meeting was fun.

Similarly, the person feature of the binder does not have to be always realized on a bound pronoun. Consider the following example.

(536) Only you said that we would make a good couple.

Here, *we* ranges over pairs consisting of the speaker and one of the relevant people that includes the hearer. In order to capture this reading, *you* needs to partially bind *we*. However, the bound pronoun here is not a second person pronoun.

Heim (2008b) proposes a solution to partial binding that also correctly captures the interaction with person features. Like Rullmann, she assumes multiple indexing, which is necessary under any account of partial binding. Unlike Rullmann, however, she does not distinguish singular indices from singleton set indices, and correspondingly atomic individuals from singleton sets of individuals. One can therefore assume that indices are always sets, and $i := \{i\}$, and also regard atomic individuals and singleton individuals as ontologically equivalent $a := \{a\}$.

The key ingredient in Heim's theory is the structure of indices. She assumes that Feature Transmission can target an index, passing the phi features of the binder to the index, instead of a minimal pronoun itself. As a consequence, a set index may consist of indices with different phi features, depending on their binders. What will happen in such a situation? Heim proposes the spell-out rules that determine the feature of an entire pronoun based on the features of its parts.

- (537) A pronoun with a set index I is
- a. a first person pronoun, if some $i \in I$ is first person;
 - b. a second person pronoun, if no $i \in I$ is first person and some $i \in I$ is second person;
 - c. a third person pronoun, otherwise.

Importantly, those features on indices are only relevant at the PF interface, and not semantically interpreted. For number features, Heim (2008b:54) suggests to treat pronouns with (non-singleton) set indices as always plural, both semantically and morphologically.

Let us look at some examples to see how her account works. Firstly, if the binders are third person, the bound pronoun has to be third person plural. Take (492) again.

(492) Each of the students told each of the professors that their meeting was fun.

This can be analyzed as involving the following binding relations.

(538) Each of the students $\lambda 8$ told each of the professors $\lambda 4$ that $\emptyset_{\{8,4\}}$ meeting was fun.

The relevant pronoun bears two indices, each of which inherits the third person feature [③] and the singular feature [sg] of their respective binders. According to (537), the pronoun as a whole will be third person, and also it is plural as it has a non-singleton set index. At PF, we have the following representation.

- (539) Each of the students $\lambda 8$ told each of the professors $\lambda 4$ that their_{8[③,sg],4[③,sg]} meeting was fun.

Heim's account also explains the interaction with person features. For example, (536) above can be analyzed as follows. Suppose that *we* here has a first person index that denotes the current speaker, which I write as *s* here.

- (540) Only you $\lambda 9$ said that *we*_{s,9} make a good couple.

The other index, 9, inherits the second person feature from its binder *you*. Then according to the spell-out above, the entire pronoun is realized as a first person plural pronoun, because *s* is first person.

This account seems to successfully capture the data so far. However, Heim (2008b) herself raises a conceptual objection. The proposed spell-out rules (537) duplicate the semantic rules at the PF interface. That is, a semantic constraint is necessary that requires a pronoun to be first person when its denotation contains the speaker, second person when its denotation contains the hearer but not the speaker, and third person otherwise. This is highly similar to Heim's spell-out rules. However, those features that indices acquire via Feature Transmission are purely morphological, and semantics is blind to them, and in order to ensure the correct forms, the semantic restrictions must be duplicated at the PF interface as spell-out rules. Heim remarks on this issue at the end of her paper:

This paper has developed a mixed semantic and syntactic account of the distribution of φ -features on bound pronouns that I believe is more precise and has better empirical coverage than previous accounts of the phenomena. The main message, however, is that we cannot be satisfied with this story. The burden that we have ended up putting on the PF derivation is very likely misdescribed or misplaced. The operation we had to posit in the end for the person features in split-bound pronouns was especially impalatable. But it may well be said that this only vindicates the suspicions that some have already had about the Feature Transmission rule, a PF operation which relies on a syntactic definition of semantic binding. It would certainly be desirable if we could preserve the more natural ideas in the present package (the semantics of features, the existence of underspecified pronouns at LF) and explain away the apparent need for feature-copying operations in the syntax or morphology, unless these can be reduced to independently known syntactic and morphological mechanisms. At the time of this writing, such alternatives are only available in rough sketches or for limited subsets of the data. But far from discrediting or superseding those efforts, the present paper will hopefully help spur their pursuit. (Heim 2008b:55)

Also, it is not immediately clear what this theory would say about non-c-commanding cases, such as (533).

- (533) a. The people who voted for John and Bill thought that they would win.

- b. The students John and Bill taught thought said that they were the best teacher in the world.
- c. The people who voted for John and me thought we would win.

In these cases, it is reasonable to assume that the antecedent and the bound pronouns do not stand in a semantic binding relation, and hence Feature Transmission does not apply. Then, these cases suggest that there is a separate mechanism that accounts for the seemingly semantically inert phi features on bound pronouns.

In the next section, I will put forward a modification of the analysis of bound first and second person pronouns introduced in Section 10 which completely dispenses with Feature Transmission, but instead shifts the burden to the syntax of indices. Again, the resulting theory is highly reminiscent of Heim's in many respects, but crucially it does not require a semantics/morphology duplication as all the information is placed in syntax, which mediates the semantic and morphological components of grammar. Also an account of sentences like (540) can nicely be integrated.

13 Complex Indices and Person and Number Features on Bound Pronouns

In this section, I will offer an alternative analysis based on the proposal made in Section 10 that does not require a PF process like Feature Transmission, but postulates indices that carry more information than standardly assumed. In particular, I will give an account of semantically singular plural pronouns with or without c-commanding antecedents, using (Skolemized) choice functions. I will also show that partial binding and the interaction with person features can be explained without running into the duality problem discussed above, unlike Heim's minimal pronoun approach.

13.1 Indices with Number Features

As a first step, I propose that number features are represented as part of the indices. Recall that in the analysis proposed in Section 10, indices are specified for person. From now on I assume that they also carry number features e.g. $8_e[\textcircled{2}, pl]$, $2_e[\textcircled{3}, sg]$, $1_e[\textcircled{1}, pl]$, etc. I assume a very simple syntax-morphology mapping rule: pronouns with a singular index like $61[\textcircled{2}, sg]$ are singular, and pronouns bearing all other kinds of indices are plural (see below for more complex indices).

Also, in order to arrive at the correct semantics for plural first and second person pronouns, we need to change the admissibility condition for assignment functions as follows.

(541) *Admissibility Condition for Assignment Functions*

In evaluating an utterance of a sentence with respect to context c , possible world w and assignment function g , g is admissible only if for any $i \in \mathbb{N}$ and for any $num \in \{sg, pl\}$,

- a. $a_c \in g(i[\textcircled{1}, num])$;
- b. $h_c \in g(i[\textcircled{2}, num])$ and $a_c \notin g(i[\textcircled{2}, num])$;
- c. $a_c \notin g(i[\textcircled{3}, num])$ and $h_c \notin g(i[\textcircled{3}, num])$.

As in the case of person features, binder indices are also assumed to carry number features, and noun phrases with $[sg]$ can only introduce singular binder indices and those with $[pl]$ can only introduces plural binder indices.

The mechanism laid out here accounts for sentences like the following in essentially the same way that we account for *Only I did my homework*.

- (542) a. Only John and Mary like the paper they wrote.
 b. Only we like the paper we wrote.

That is, the values of the plural bound pronouns here are not always plural, but that is not required since the predicate here simply denotes the function $\lambda x_e. x$ likes the paper x wrote, where x is number neutral.

13.2 Semantically Singular Plural Pronouns and the Distributivity Operator

Now let us discuss semantically singular plural pronouns with c-commanding antecedents. Cases involving non-c-commanding antecedents are discussed in the next subsection. The idea I pursue is that the effect of semantically singular plural pronouns is due to the work of the distributivity operator. Notice that semantically singular pronouns occur in sentences that are read distributive with respect to the plural binder. Consider the following example.

- (491) These boys think that they are the smartest student.

The plural phrase *these people* are distributed with respect to the predicate *think that they are the smartest student* in the sense that each of them thinks so separately, rather than collectively.

Recall at this moment that distributive predicates in general may take plural subjects, and give rise to the following inference: If a predicate P is distributive, then *John and Bill P* implies that *John Ps* and *Bill Ps*. Previous studies argue that this distributive inference are brought about by the distributivity operator, defined as (543) (Link 1983, 1987, Roberts 1987, Lasersohn 1998, Winter 2001).¹²³

$$(543) \quad \llbracket \mathcal{D} \rrbracket^{w,g} = \lambda P_{\langle e,t \rangle} . \lambda X_e . \forall x \in X [P(x) = 1]$$

In examples like (544), this operator is phonologically null, but in some cases like (545), it is overtly realized as *all*, *each*, *both*, etc.

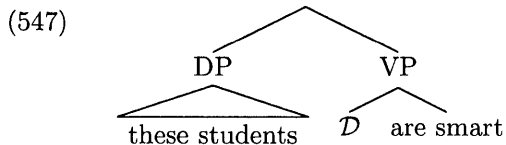
- (544) a. Most of the students are sleeping.
 b. These students are smart.
 (545) a. These students are all sleeping.
 b. These people each came to my office.
 c. The man and woman both paid \$10.

Let us analyze (544b) to see how it works. It is assumed that *are smart* is inherently singular and never takes a plurality as its subject.

$$(546) \quad \llbracket \text{smart} \rrbracket^{w,g} = \lambda x_e . x \text{ is smart}$$

The sentence is assumed to have the following LF structure.

¹²³As mentioned earlier, I assume that the distributivity operator decomposes a plural individual down to its atomic parts, and ignore the issue of non-atomic distribution throughout. In fact, adding covers on top of what is proposed here is a routine (Schwarzschild 1996).



The constituent labeled VP is of type $\langle e, t \rangle$ that may take a plural individual, and hence can combine with *these students*. \mathcal{D} universally quantifies over its atomic parts, and hence the predicted reading is that each individual in the plurality denoted by *these students* is smart, which is what we want. Notice that \mathcal{D} validates the distributivity inference.

Notice that according to the definition of the distributivity operator in (543), the plurality information of the binder is lost under the scope of the distributivity operator. That is, for a pronoun under its scope, there is no way to know whether there is a plural noun phrase above \mathcal{D} that gets distributed by \mathcal{D} , or only a singular noun phrase. Recall that there is a contrast between free and bound pronouns, repeated here.

- (548) a. #They are the smartest student.
 b. These boys \mathcal{D} think that they are the smartest student.

In order to account for this contrast while maintaining that the plural feature on *they* is interpreted in both cases, *they* in (548b) needs to be able to know somehow that there is a plural antecedent *these boys* that it is related to. However, according to the definition of \mathcal{D} above, this information is not locally available. This illustrates the essence of the present problem, i.e. there needs to be some long distance relation between the binder noun phrase and the plural bound pronoun across the distributivity operator. The idea I will pursue here is that *they* in (548b) has access to the way in which its plural binder is distributed by \mathcal{D} .

First I propose to change the definition of the distributivity operator. Specifically, I claim that it universally quantifies over choice functions, rather than over atomic individuals. Choice functions can be understood as different ways of choosing an atomic individual out of a plurality. In order to avoid overgeneration, we restrict the domain of quantification to the choice functions that are only defined for the plurality in question.

- (549) a. $[[\mathcal{D}]]^{w,g}(P)(X) \Leftrightarrow \forall f \in \mathbf{RelCF}(X)[P(f(X))]$
 b. $\mathbf{RelCF}(X) = \{f \mid f(X) \in X \wedge \mathbf{dom}(f) = \{X\}\}$

The net effect is the same as before, but importantly we can make it so that the choice functions so introduced can be reused within the scope of \mathcal{D} . To achieve this, I assume that \mathcal{D} modifies the assignment function in the following way.

$$(550) \quad \left[\mathcal{D}_{i_{\langle e, e \rangle}} \text{XP} \right]^{w,g} = \lambda X_e. \forall f \in \mathbf{RelCF}(X) [[\text{VP}]^{w,g[i_{\langle e, e \rangle} \mapsto f]}(f(X))]$$

I assume that plural individuals are of type e and hence choice functions are of type $\langle e, e \rangle$ from plural individuals to atomic individuals.¹²⁴

The crucial assumption is that a pronoun may refer back to the choice functions introduced by \mathcal{D} . In order to achieve this technically, I assume a complex index of the form $9_{\langle e, e \rangle}(5_e[\mathbb{3}, p^l])$. The idea is that the value of the choice function index $9_{\langle e, e \rangle}$ applies to the

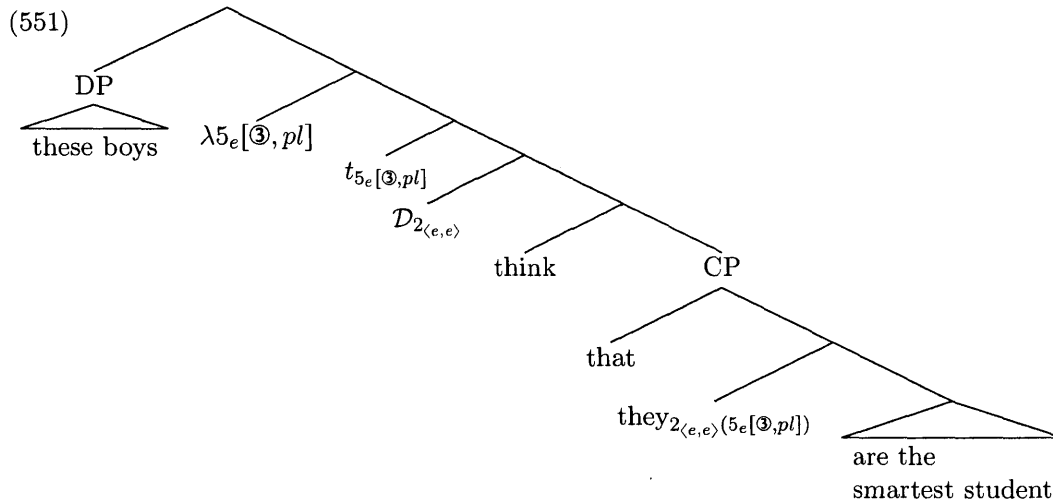
¹²⁴Since we can regard atomic individuals as singleton sets, we can define D_e as the set of sets of individuals that forms a join-semilattice with respect to \subseteq . In this setting, one can understand the \in sign in the above definitions as designating ‘a singleton subset of’.

value of the third person index $5_e[\mathfrak{Q}, pl]$. Thus, a pronoun bearing this index is interpreted as $g(9_{\langle e,e \rangle})(g(5_e[\mathfrak{Q}, pl]))$.

Using this mechanism, we can account for semantically singular plural pronouns. Take the following sentence again.

(491) These boys think that they are the smartest student.

I assume the following LF representation for this sentence. The subject quantifier is vacuously moved to introduce the binder index $\lambda 5_e$.



Notice that the index $5_e[\mathfrak{Q}, pl]$ is bound by *these boys*, and as a consequence, $g(5_e[\mathfrak{Q}, pl])$ on the pronoun also denotes a plural individual consisting of the relevant boys. Crucially, the same choice function $g(2_{\langle e,e \rangle})$ introduced by \mathcal{D} applies to both the subject and the pronoun at the same time, and consequently they co-vary. The predicted reading, therefore, is that each of these boys thinks that he is the smartest student, which is what we want here. The binding relation between *these boys* and *they* are strictly speaking not necessary, and *they* maybe have a different index $i_e[\mathfrak{Q}, pl]$ with $i \neq 5$ and have the same truth conditions, insomuch as $i_e[\mathfrak{Q}, pl]$ that *they* bears has the denotation of *these boys* as its value.

Under this analysis, furthermore, the interaction with person features is rather straightforward. Consider (496) again.

(496) We all think that we are the smartest student.

It is assumed that *all* is an overt realization of \mathcal{D} . The structure assumed here is isomorphic to (550), and the desired reading is captured. That is, the predicted meaning is that each of us thinks that he or she is the smartest student. Crucially, an index of the form $i_{\langle e,e \rangle}(j[\mathfrak{Q}, pl])$ is assumed to be realized as a plural first person pronoun (similarly for second person). The rule of thumb is that the argument index determines the shape of the pronoun.

The above account correctly rules out sentences involving a person or number mismatch. consider the following sentences, none of which have a bound pronoun reading.

- (552) a. #These people think that we are the smartest student.
 b. #We think that they are the smartest student.

In these sentences, the restricted choice functions cannot apply to the relevant pronouns, because they are not co-extensive with the subject.

Also, it is correctly predicted that the relevant pronoun cannot be singular to derive the relevant reading, since in that case the referent is fixed to a particular individual and cannot co-vary with the subject.

- (553)
- a. These boys think that he is the smartest student.
 - b. These boys think that I am the smartest student.
 - c. We all think that I am the smartest student.
 - d. We all think that he is the smartest student.

13.3 Semantically Singular Plural Pronouns without C-command

Recall that semantically singular plural pronouns do not require their antecedents to c-command them, as in (533).

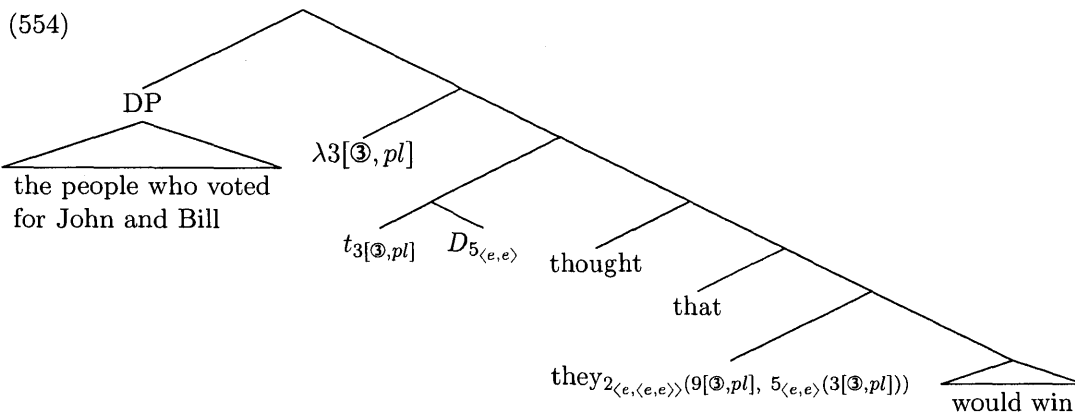
- (533)
- a. The people who voted for John and Bill thought that they would win.
 - b. The students John and Bill taught thought said that they were the best teacher in the world.
 - c. The people who voted for John and me thought we would win.

In order to account for these cases, Dimitriadis (2000) makes use of E-type pronouns that have a complex structure involving a bound pronoun and a functional relation (cf. Cooper 1979, Engdahl 1986, Heim & Kratzer 1998, Jacobson 2000, to appear). That is, he claims that the relevant pronouns consist of two parts, a function f and a variable x , where x is bound by the plural subject, and f returns for x a unique individual that stands in a particular relation with x . For instance, in the case of (553a), *they* is analyzed as denoting $f(x)$ where x is each of the relevant people, and $f(x)$ is the candidate that x voted for.

A shortcoming of Dimitriadis's (2000) analysis is that it does not account for the effect of phi features on these pronouns. In all of the sentences in (533), the denotation of the pronoun is singular, and there is no obvious reason why a singular pronoun cannot be used here. Similarly, it is unclear where the first person feature of (533c) comes from.

I claim that these pronouns also involve choice functions, but a special kind, namely so-called Skolemized choice functions (Chierchia 2001, Winter 2001, Kratzer 1998b, Schlenker 2006). Skolemized choice functions take a set X , just like a normal choice function, but also take n arguments, and return a member of X . A normal function can be thought of as a special case where $n = 0$. In order to account for the above examples, I use Skolemized choice functions with one additional slot.

Let us take (533a) as an example. I analyze *they* here as involving the plurality consisting of John and Bill, $\{j, b\}$. It also has a part that is bound by the subject, whose denotation I write as A . In this case, the distributivity operator distributes this subject with choice functions f . Thus, $f(A)$ is an atomic part of A and serves as the semantic subject of *thought*. Now the meaning of *they* can be analyzed with a Skolemized choice function g as $g(\{j, b\}, f(A))$, where g returns either of j or b that $f(A)$ voted for. This is achieved by the following LF, for instance.



The relevant reading is captured, if $g(9[\mathbb{3}, pl])$ is the plurality consisting of John and Bill, and $g(2_{\langle e, \langle e, e \rangle \rangle})$ is the Skolemized choice function $\lambda X_e. \lambda y_e. \text{the atomic individual } x \in X \text{ such that } y \text{ voted for } x$.

Similarly, *we* in (533c) can be assigned an index like $4_{\langle e, \langle e, e \rangle \rangle}(7[\mathbb{1}, pl], 10_{\langle e, e \rangle}(9[\mathbb{3}, pl]))$. The assumption here is that a pronoun with such an index that contains $\mathbb{1}$ is realized as a first person plural pronoun.¹²⁵

I have just demonstrated that by complicating the structure of indices by number features and Skolemized choice functions, semantically singular plural pronouns with or without a c-commanding antecedent are explained.

13.4 Partial Binding and Complex Indices

Let us now turn to partial binding. As remarked above, in order to account for partial binding, a pronoun must be allowed to refer to multiple indices, and set indices are assumed here for this purpose. A pronoun with a set of indices denotes the sum of the values that the assignment function g assigns to the members of the set index. With Heim, I do not draw a distinction between atomic individuals and singleton sets, and I assume $a := \{a\}$. Also we can equate atomic indices with singleton indices.

$$(555) \quad \llbracket \text{they}_I \rrbracket^{w,g} = \bigcup_{i \in I} g(i)$$

At this point, our assumptions about the semantics of plural first and second person pronouns should be spelled out. I assume that when they carry a set index they are subject to the following mapping constraint.

- (556) A pronoun with a set index I is
- a. a first person plural pronoun, if any $i \in I$ has $[\mathbb{1}]$;
 - b. a second person plural pronoun, if no $i \in I$ has $[\mathbb{1}]$ and some $j \in I$ has $[\mathbb{2}]$;
 - c. a third person plural pronoun, otherwise.

¹²⁵ Notice that the same reading cannot be expressed by a proper name *John and Bill* (Dimitriadis 2000).

- (i) The people who voted for John and Bill thought that they would win.

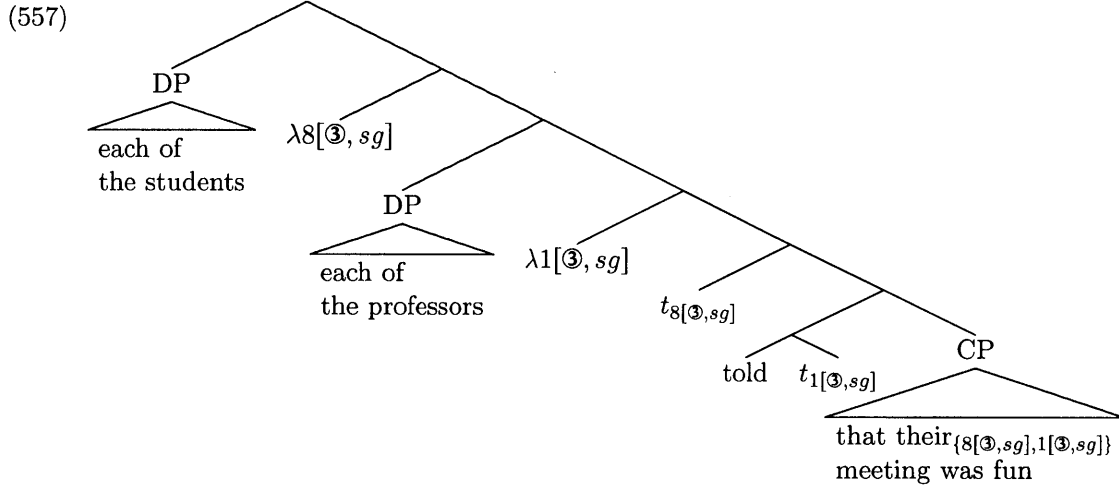
This is explained on the assumption that a complex index like $2_{\langle e, \langle e, e \rangle \rangle}(9[\mathbb{3}, pl], 5_{\langle e, e \rangle}(3[\mathbb{3}, pl]))$ can only appear on pronouns.

This is similar to Heim’s minimal pronoun account, but to stress the difference again, these person features are not only morphologically relevant but also semantically interpreted, unlike under the minimal pronoun approach.

With this mechanism, partial binding is straightforwardly captured. Consider (492) again.

(492) Each of the students told each of the professors that their meeting was fun.

The relevant reading is captured by the following LF, where *each of the professors* is QRed.

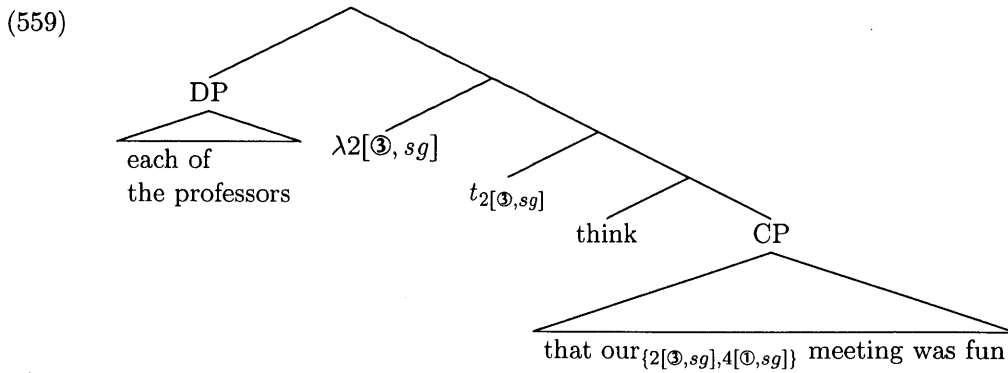


Since *their* has a set index consisting of $8[3, sg]$ and $1[3, sg]$, it denotes the plural individual $\{g(8[3, sg]), g(1[3, sg])\}$, which is a pair of a student and a professor, as desired. Also it is correctly predicted to be realized as a plural third pronoun, as its index is not a single singular index, but a set of such indices, and none of them are specified as first or second.

The interaction with person features can also be accounted for, with the assumption that indices themselves carry person information. Consider the following sentence.

(558) Each of the professors thinks that our meeting was fun.

One can read *our* here as denoting a pair consisting of the speaker and each of the professors. Assuming from the previous section that person features are part of indices, we can give the following LF representation.



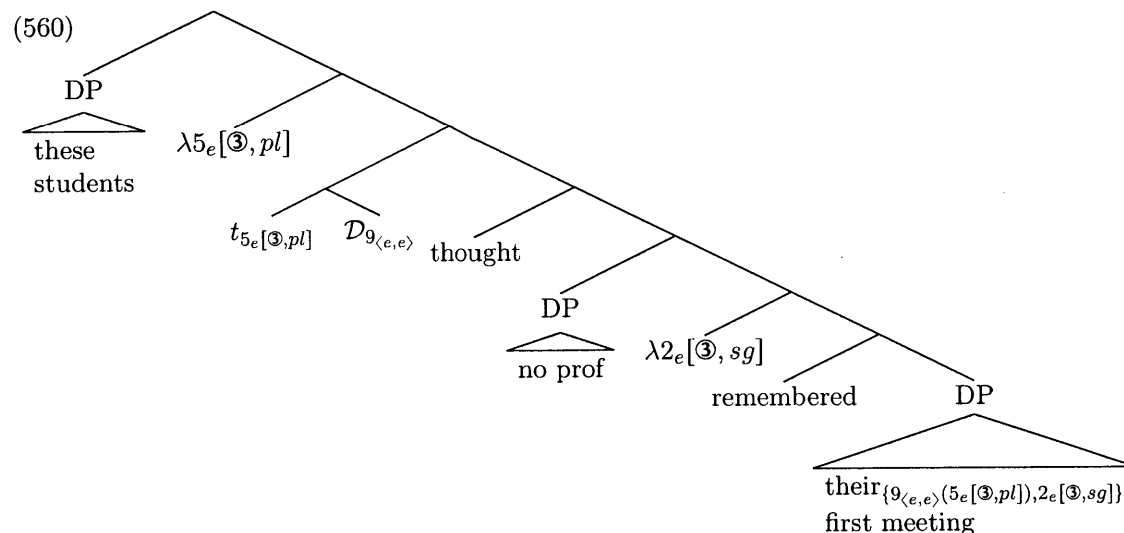
The denotation of *our* here is a pair of individuals consisting of $g(4[\textcircled{1}, sg])$, who is the current speaker, and $g(2[\textcircled{3}, sg])$, which co-varies with *each of the professors*. This captures the reading we are after, and also the shape of the bound pronoun.

13.5 Distributivity + Partial Binding

Recall that the two phenomena above can co-occur in the same pronoun, as illustrated by (494) above.

(494) These students thought that no professor remembered their first meeting.

The relevant reading of this sentence requires distribution over the denotation of *these students*, and also partial binding into *their*. This is already captured by the mechanism at hand. For instance, we can analyze the relevant reading of (494) with the following LF.



The pronoun *their* has a complex index $\{9\langle e, e \rangle(5_e[\textcircled{3}, pl]), 2_e[\textcircled{3}, sg]\}$, which denotes a plurality consisting of one of the students and one of the professors.

Again, extension of this analysis to cases involving person features is straightforward. Here is an example due to Rullmann. Suppose that a man is talking in front of all of his ex-wives.

(561) Even in the middle of the divorce proceedings, you all/each pretended that we were a happy couple. (Rullmann 2004:166)

Under the intended reading, *we* denotes a pair of the speaker and one of the wives at a time. Thus, a subpart of the denotation of *we* needs to be bound. This is captured in the following simplified LF representation.

(562) you $_{5[\textcircled{2}, pl]}$ all $_{8\langle e, e \rangle}$ pretended that we $_{\{7_e[\textcircled{1}, sg], 8\langle e, e \rangle(5_e[\textcircled{2}, pl])\}}$ were a happy couple.

13.6 Summary

The proposed account of partial binding and the interaction with person features is very similar to Heim's (2008b) minimal pronoun account in that indices bear phi features and they determine the morphological shape of the pronoun. However, one big difference is that the same phi features are present throughout the derivation, and are visible to semantics as well. Thus the conceptual problem that Heim raises against her own account does not arise here. Also, we dispensed with Feature Transmission by directly building into the mechanism of semantic binding the requirement that the binder and bindee need to share phi features. In other words, instead of capturing this generalization in morphology, we do so in the syntax of indices and semantic binding. In addition, by allowing indices to refer to choice functions, it accounts for semantically singular plural pronouns with and without c-command. Especially those without c-command are not straightforwardly captured under a minimal pronoun account like Heim's (2008b), as pointed out in the previous section.

13.7 Further Issues

13.7.1 Gender Features

In English, person and number features interact as they can co-occur on the same pronoun, but gender features do not, as they are confined to third person singular pronouns. However, something similar to the case of person features is observed with gender features. Take the following sentence.

(563) Of John, Bill and Mary, only Mary did her homework.

This sentence has bound and free pronoun readings, just like (430).

(430) Only I did my homework.

In the literature (Cable 2005, Kratzer 1998a, Heim 2008b, Jacobson to appear, Schlenker 2003b, Spathas 2010), it is generally considered that these two cases should be given a parallel account, with the presumption that the correct bound pronoun reading of (562) cannot be derived without an additional assumption. The problem is often cast in terms of the partial function view of presuppositions. That is the predicate in (562) denotes the partial function in (564).

(564) $\lambda x_e: x$ is female. x did x 's homework

The alternative propositions are obtained by applying (564) to John and Bill, but that will yield a presupposition failure. Therefore, we need a mechanism that blocks this universal presupposition.

In Part I of the present dissertation, however, I pointed out that the partial function view is not expressive enough, and proposed a two dimensional theory of presupposition projection. Under this view, the universal reading is not necessarily predicted for (563) (cf. Section 9.2.1). That is, this problem arises on the assumption that *only* gives rise to a universal presupposition with respect to the set of alternatives C (cf. Schlenker 2009; but see Walker 2011). The following examples *prima facie* suggest that this is indeed the case.

(565) Of John, Bill and Mary,
a. only Mary stopped smoking.

- b. only Mary knows that she is smart.

Intuitively, (565a) suggests that John, Bill and Mary all used to smoke, and (566b) suggests that all of them are smart.

Recall from Part I that there are two kinds of presuppositional predicates. Predicates like *stopped smoking* and *knows that she is smart* have assertive meanings that entail the presupposition. On the other hand, gender presuppositions are generally not entailed by the assertive meaning of the predicate. Interestingly, other predicates that do not have an entailed presupposition behave like gender features under *only*. For instance, the uniqueness presupposition of a singular definite description does not universally project (von Heusinger 2007, Riester & Kamp 2010, Walker 2011).¹²⁶

- (566) Of John, Bill and Mary, only Mary published the paper that she wrote this semester.

This sentence presupposes that Mary wrote a single paper this semester, but does not yield an inference that John and Bill also wrote exactly one.

Given this property of *only*, it is not clear whether (563) requires an explanation in the first place, although it surely seems to yield a universal presupposition for certain presupposition triggers. This requires a deeper understanding of the semantics of *only*, and more broadly the interaction between presupposition projection and focus constructions, which I will leave for future research.

13.7.2 First Person Plural Pronouns Bound by Quantifiers

Rullmann (2008, 2010) observes that first person pronouns can be bound by third person quantifiers in limited cases. Here are some of his examples.

- (567) a. Each of us has a right to control **our** own body.
b. Each of us has experienced a strong sense of pride as an educator when a student says that **we** did an excellent job of teaching and motivating he or her to learn.
c. Each of us has our own philosophy regarding how to help India.
- (568) a. Most of us as men are experts on women, until **we** marry one.
b. Most of us have moments when we forget where **we** left the car keys or forget what **we** went to the grocery store for.

The condition seems to be that the domain of quantification needs to contain the speaker. Especially intriguing here is the data in (567), where the quantifier is singular, but the bound pronoun is plural. This is problematic for the minimal pronoun approach.¹²⁷ Quite interestingly, it has to be plural, and cannot be singular, although the binder is singular. Thus the following sentence, for instance, does not have a bound pronoun interpretation.

¹²⁶ Walker (2011) further claims that even sentences like (565) do not always have universal presuppositions. He also observes that strong presupposition triggers give rise to universal inferences.

¹²⁷ Rullmann (2008, 2010) himself pursues a semantic account of these patterns, but his assumptions about the semantics of *we* gives rise to a problem analogous to the problem of the variable semantics for first and second person pronouns. That is, he assumes that *we* denotes a simple variable with a presupposition about its denotation that it includes the speaker. However, given the projection properties of *most* (cf. Part I), this predicts that the inference one should get for sentences like (568) is that the speaker is one of the people who satisfy the nuclear scope, but it seems to me that such an implication is absent in (568).

(569) Each of us thinks I'm smart.

Under my account, one can regard these cases as special cases of semantically singular plural pronouns without c-commanding antecedents. Thus, they can be analyzed with Skolemized choice functions in the following manner.

(570) Each of us_{2[\mathbb{O},pl]} $\lambda 1[\mathbb{Q},sg]$ has a right to control our_{7_{\langle e,\langle e,e \rangle \rangle}(2[\mathbb{O},pl],1[\mathbb{Q},sg])}} own body.

What would be the value of the Skolemized function? In order to arrive at the intended reading, it should be $\lambda X_e.\lambda y_e.$ the $x \in X$ such that $x = y$. This Skolemized function effectively does the same thing as a normal choice function, but it crucially tolerates the person mismatch here.

However, if such a Skolemized function is available, it will overgenerate bound pronoun readings for sentences like the following.

(571) Each of these cars satisfied their owner.

In other words, it predicts singular *they* to be available more without restrictions. Since the sentences above are problematic for all accounts, I will leave this issue for future research.

13.7.3 Relative Clauses

As mentioned in fn.99 above, there is another set of environments where bound first and second person pronouns are found. Here is an example due to Partee (1989).

(572) I'm the only one around here who will admit that I could be wrong.

This sentence has a reading that is paraphrased by (573).

(573) I will admit that I could be wrong, but no other people around here will admit that they could be wrong.

That is, that *I* in the embedded clause of (573) is bound. What is it bound by? Interestingly, in order to get the interpretation (573), we have to say that the relative pronoun *who* is the binder, since the relative clause should denote the function $\lambda x_e.$ x will admit that x could be wrong.

Under the minimal pronoun approach, therefore, it has to be assumed that *I* in the embedded clause is a minimal pronoun, but if the binder is *who*, how does it inherit a first person feature? Kratzer (2009) claims that there is a chain of local binding relations with *I* in the matrix clause at one end, the minimal pronoun at the other, and the relative pronoun *who* sitting in the middle. As a consequence, all of these are marked first person at PF, although in English *who* does not overtly realize a first person feature in its morphology. Kratzer further motivates her account based on data from English and German where the verbal agreement in the embedded clause plays a role in establishing the relevant semantic binding. For example, she raises the following example, claiming that its bound interpretation is harder to obtain than that of the previous example.

(574) I'm the only one around here who is willing to admit that I'm wrong.

the idea is that in (574), there is a copula *is* that is incompatible with first person, unlike in (573), and this intervenes the chain of agreements.

However, there seems to be inter-speaker variation in judgments here, in addition to crosslinguistic variation (Cable 2005, Kratzer 2009, Maier & de Schepper 2010). Cable

(2005), for example says of (573) and (574) that he or the speakers he consulted could not detect the contrast between the two sentences. Cable further adduces the following examples to show that morphological syncretism is not a necessary factor.

- (575)
- a. I am the only person who talks to my father.
 - b. I'm the doctor who comes when you call me.
 - c. I am the only person who tells my father to hug me.
 - d. I am the biographer who writes about my own father.

Also Maier & de Schepper (2010) shows with quantitative data that syncretism is not required in Dutch to obtain bound interpretations in the relevant cases. Due to the complex pattern of variations, I have to leave this topic for further research.

Another recalcitrant feature of this construction is that in all of these cases, third person pronouns are also available, or even preferred for some speakers, to express the relevant bound pronoun readings. Recall that in a focus construction case, the binder and bindee need to have the same person. For instance, only (576a), but not (576b), has a bound pronoun reading.

- (576)
- a. Only I did my homework.
 - b. Only I did his homework.

See Kratzer (2009) for a possible account of the optionality in relative clauses cases under the minimal pronoun approach.

Part III

Person Features and Indexical Shifting

Synopsis: In this final part of the dissertation, I investigate the interpretation of person features in attitude constructions. It is known that in certain attitude constructions in certain languages, the denotations of first and second person pronouns are systematically affected, the phenomenon I call *indexical shifting*. I will closely examine data drawn from previous studies (Anand 2006, Anand & Nevins 2004, Schlenker 1999, 2003b) as well as novel observations from Uyghur and Japanese, and discuss issues regarding the universals and variation in indexical shifting.

Organization: Section 14 introduces the phenomenon of indexical shifting, and two possible theoretical analyses. Section 15 is devoted to the presentation of data from Uyghur, which is shown to have properties that are not shared by other languages with indexical shifting. Using these properties, I will criticize in Section 16 the two analyses of indexical shifting alluded to in Section 14, and offer an account in Section 17 that captures the novel data from Uyghur as well as the data in languages like Amharic and Zazaki discussed in the literature. In Sections 18 and 19, I will closely examine the semantics of first and second person pronouns in indexical shifting environments, and observe a difference between Uyghur and languages like Amharic and Zazaki. In order to explain the data, I postulate semantic variation in the meaning of second person pronouns. The discussion here has some theoretical consequences on issues such as what contexts are in the linguistically relevant sense, and how the semantics of attitude predicates should be analyzed. The proposed analysis is further tested against new data drawn from Japanese, which I claim is also an indexical shifting language. Section 20 summarizes the discussion and some further issues.

14 Introduction to Indexical Shifting

Previous studies revealed that languages differ with respect to how first and second person pronouns are interpreted in attitude constructions. Specifically, in certain languages, they can be interpreted relative to contexts other than the one in which the utterance of the sentence containing them is being made, when embedded under an attitude predicate like *say*. For instance, *John said that I was hungry* can be used to mean that John said John was hungry, rather than that John said the speaker was hungry. This can be understood as ‘shifting’ the context against which the first person pronoun is interpreted to the context of the reported utterance, where John was the speaker. I refer to this phenomenon as *indexical shifting*.

Arguably, indexical shifting is unavailable in English and other major Indo-European languages, at least the kind that shifts first and second person pronouns (see Santorio 2010, Schlenker 1999, 2003a,b for related phenomena in relatively well studied languages). Since Schlenker’s (1999) seminal work, the following languages have been reported to license indexical shifting of first and second person pronouns:

- Amharic (Semitic; Leslau 1995, Anand & Nevins 2004, Anand 2006)
- Aghem (Niger-Congo; Hyman 1979 cited in Schlenker 1999, Anand 2006)
- Zazaki (Iranian; Anand & Nevins 2004, Anand 2006)
- Slave (Athabaskan; Rice 1986, Anand & Nevins 2004, Anand 2006)
- Navajo (Athabaskan; Schauber 1979, Speas 1999, Schlenker 1999)
- Matsigenka (Panoan; Ludwig, Munro, Fleck & Sauerland to appear)
- Nez Perce (Sahaptian; Deal 2008, 2011)

- Catalan Sign Language (Quer 2005)
- Turkish (Turkic; Gültekin Şener & Şener 2011)

In what follows, I will closely examine data from Uyghur and Japanese, together with some data from previous studies including the ones cited above, and discuss perspectives the phenomenon of indexical shifting offers on the semantics of first and second person pronouns. For the rest of this section, I will review the theoretical background of the present topic.

14.1 Indexicals in Intensional Contexts and Kaplan's Conjecture

Kaplan (1977) pioneered the formal semantic analysis of first and second person pronouns and other indexicals, and claimed that indexicals are "directly referential."¹²⁸ To understand what he means by this, let us look at two expressions *I*, an indexical, and *the author of this dissertation*, a definite description, which Kaplan claims is not directly referential. If I use these expressions, the reader understands them as both referring to me, Yasu Sudo. Thus, the following sentences are truth-conditionally equivalent, when uttered by me.

- (577) a. I live in Cambridge, MA.
 b. The author of this dissertation lives in Cambridge, MA.

Although the subjects in (577a) and (577b) both refer to the same individual, Kaplan pointed out that they do so by distinct means. The crucial difference crops up in intensional constructions like the following.

- (578) a. I could have been Kirill.
 b. The author of this dissertation could have been Kirill.

These two sentences convey patently different ideas.¹²⁹ That is, (578a) is probably an outlandish claim for me to make, while (578b) is more or less sensible and could well come out true if I asked my friend Kirill Shklovsky to be my ghostwriter. Essentially, the difference here is that (578a) conveys that the two individuals in question, Yasu Sudo and Kirill Shklovsky, could be the same individual, while (578b) is not about the identity of two individuals, but merely means that Kirill could have written this dissertation.

The relevant reading of (578b) is straightforwardly captured in the standard possible worlds semantics. It is assumed that the referent of a definite description is determined by its intension which is modeled as a function of type $\langle s, e \rangle$, where s is the type of possible worlds and e is the type of individuals. As a result, the referent of a definite description may be different in different possible worlds. More concretely, we can analyze the meaning of the definite description in (578b) as in (579). I will not analyze the meaning of the demonstrative noun phrase *this dissertation* contained this definite description, and assume that it simply picks out this document that you are reading right now (cf. references cited

¹²⁸ Demonstratives are often included in the class of indexicals as their denotations are clearly context sensitive (Kaplan 1977), but at the same time, they are considered somewhat different from the prototypical members of the class in the way in which their referents are determined. I do not have anything to add to the theory of demonstratives in this dissertation, and refer the interested reader to works such as Zeevat (1999), King (2001), Roberts (2002), Wolter (2006), and Elbourne (2008).

¹²⁹ A caveat is in order. (578b) is actually ambiguous between the *de re* and *de dicto* readings of the definite description, and under the *de re* reading, the two sentences mean roughly the same thing. What we are interested in here is the *de dicto* reading of the definite description.

in fn.128 above).

(579) $\llbracket \text{the author of this dissertation} \rrbracket^{c,w,g} = \text{the author of this dissertation in } w$

What is crucial here is that depending on the world index, the denotation of this expression changes. For example, in the actual world, it is me, but in a possible world where Kirill wrote this document, the referent is Kirill.

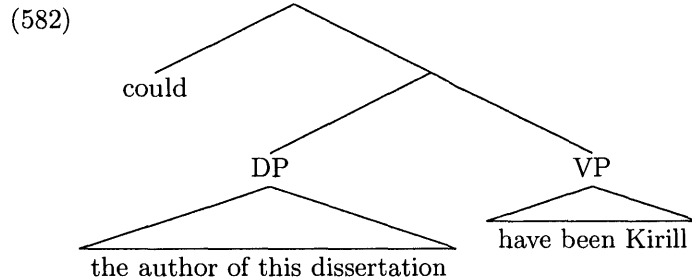
Possible world semantic models modals like *could* as quantifiers over possible worlds. For example, *could* can be given the following denotation. For expository purposes, I assume a naive analysis of *could*, especially with respect to the domain of quantification, but nothing crucial hinges on this. The only important assumption here is that it somehow quantifies over possible worlds.

(580) $\llbracket \text{could} \rrbracket^{c,w,g} = \lambda p_{\langle s,t \rangle}. \text{there is a possible world } w' \text{ compatible with what the situation could have been in } w \text{ such that } p(w') = 1$

For the purposes of compositional computation, the following rule of *Intensional Functional Application* is postulated (Heim & Kratzer 1998).

(581) *Intensional Functional Application*
 If α has β and γ as its daughter constituents such that $\llbracket \beta \rrbracket^{c,w,g}$ is of type $\langle \langle s, \sigma \rangle, \tau \rangle$ and the intension of γ , i.e. $\lambda w'. \llbracket \gamma \rrbracket^{c,w',g}$, is of type $\langle s, \sigma \rangle$ for some semantic types σ and τ , then $\llbracket \alpha \rrbracket^{c,w,g} = \llbracket \beta \rrbracket^{c,w,g}(\lambda w'. \llbracket \gamma \rrbracket^{c,w',g})$.

In this setting, the intended reading of the example in (578b) above can be analyzed as follows. Let us assume the following syntactic structure where *could* takes scope above the definite subject.



Then, the predicted truth conditions are: there is a possible world w' compatible with what the situation could have been in w such that the author of this dissertation in w' is Kirill. This captures the relevant reading of (578b).

How should the semantics of *I* be analyzed? The contrast in (578) suggests that it should be given a different meaning from a definite description. In particular, assuming that the structure isomorphic to (582) is available for (578a), its denotation should not vary across possible worlds. More concretely, in (578a), the subject unambiguously refers to me, Yasu Sudo, and there is no interpretation of this sentence where the subject refers to a hypothetical author of this dissertation unlike (578b).

To capture this, Kaplan proposes that the referents of indexicals have constant intensions, and hence their denotations are insensitive to possible worlds. Such phrases are called

directly referential.^{130,131} Kaplan uses the indexical semantics where first and second person pronouns denote a constant intension. That is, their denotation is insensitive to the possible world parameter w .

- (583) a. $\llbracket I \rrbracket^{c,w,g} = a_c$
 b. $\llbracket \text{you} \rrbracket^{c,w,g} = h_c$

As a result, the denotation of I cannot vary under the scope of a modal, which captures the contrast in (578) above.

Notice that under the variable semantics and the complex index approach advocated in Section 10 as well, the meanings of first and second person pronouns are insensitive to the possible world parameter w , and hence their direct referentiality is captured. I will assume the indexical semantics for the bulk of this part, and come back to the complex index approach in Section 20.1.

Generally, the denotations of first person pronouns are not affected by any modals, unlike definite descriptions, as predicted by Kaplan's analysis. Let us look at some more examples of intensional contexts.¹³² Suppose the speaker is me, Yasu Sudo.

- (584) a. John thought that I was Natasha.
 b. John thought that the author of this dissertation was Natasha.

These sentences report different states of John's mind. Similarly, the sentences in (585) are about different hypothetical situations.

- (585) a. If I were a syntactician, this chapter would have been about comparatives.
 b. If the author of this dissertation were a syntactician, this chapter would have been about comparatives.

Analogous contrasts obtain with second person pronouns, as well.

- (586) a. John thought that you were Natasha.
 b. John thought that the reader of this dissertation was Natasha.
 (587) a. If you were a syntactician, I would be a phonologist.
 b. If the reader of this dissertation were a syntactician, I would be a phonologist.

Thus, by assuming that the denotations of first and second person pronouns are only sensitive to the context parameter c and not to the possible world parameter w , we can model their rigidity in intensional contexts. As Kaplan himself remarks, however, the

¹³⁰Strictly speaking, those phrases that are insensitive to possible worlds are called rigid designators, and directly referential terms are those that lack Fregean senses (*Sinns*), the ways in which extensions/referents (*Bedeutungs*) are determined. Intensions in possible worlds semantics are standardly understood to be models of Fregean senses (Hintikka 1962, 1969), and hence rigid designation is taken to be a formalization of direct referentiality. Although Kaplan (1977, 1989) stresses that it is merely one possible way of formally capturing the notion of direct reference, and is not necessarily the only way, I will use these terms somewhat loosely here.

¹³¹As mentioned in fn.128, demonstratives are often analyzed as directly referential as well. Kripke (1980) also claims that proper names are also directly referential, and this position has entertained some popularity (Abbott 2002, 2004), but different views have been also defended by many (Bach 1981, 2002, Burge 1973, Geurts 1997, 1999, Katz 1977, 1990, 1994, Matushansky 2008, Rothschild 2007). I have nothing to add to this debate in this dissertation.

¹³²As before, the definite description admits a *de re* reading in the examples below, which would more or less be synonymous with the corresponding sentences with I .

semantic system that we are assuming here is actually highly expressive and one can in principle define operators that alter the denotations of first and second person pronouns, i.e. operators that manipulate contexts, just as modals manipulate possible worlds. Consider the following hypothetical operator *Op*.

$$(588) \quad \llbracket Op \varphi \rrbracket^{a,h,g,w} \Leftrightarrow \text{for some } c', \llbracket \varphi \rrbracket^{c',g,w} = 1$$

Although this particular operator might not be found in a real natural language, if an operator like this existed, it would be possible to refer to someone other than the speaker of the current context by *I*. Noticing that such operators are impossible to find in English, Kaplan (1977:§8) made a famous conjecture to the effect that they do not exist in English, and called them *monsters* (see also Lewis 1980).

(589) *Kaplan's Conjecture*
No operators in English manipulate the context parameter.

This conjecture entails that indexicals are always interpreted relative to the actual context of utterance, regardless of the syntactic environments they appear in.¹³³ It is not clear whether Kaplan intended to include other languages than English in the scope of his conjecture, but some later researchers took it to be a semantic universal, most notably Schlenker (1999, 2003b).

14.2 Schlenker's Counterexamples

Schlenker (1999, 2003b) raised empirical evidence against Kaplan's conjecture as a language universal, claiming that monsters can be found in certain languages like Amharic.¹³⁴ Specifically, in an attitude report construction in this language, indexicals, including first and second person pronouns, can receive interpretation relative to the reported context of utterance, rather than the context in which the report is taking place. Consider the following Amharic sentences.

- (590) *Amharic*
- a. John [jiəgna ləmin n-ññ] yil-all?
John [hero why COP.PRES-1s] says-3sm
'Why does John say that {I am, he is} a hero?'
(Anand 2006:82; emphasis added)
- b. [min amt'-a] ind-al-ə-ññ al-səmma-hu-mm.
[what bring.IMPER-2m] COMP-say.PF-3m-1sO NEG-hear.PF-1s-NEG
'I didn't hear what he told me to bring.'
(Leslau 1995:779; emphasis added)

In (590a), the first person feature may refer to John, rather than the speaker of the entire

¹³³Quotations are clearly exceptions to this generalization. However, Kaplan (1977) did not take them to be a counterexample, as he considers quoted expressions to be not *used* but just *mentioned*. Yet, indexicals in *mixed quotations* which are both *used* and *mentioned* pose a serious challenge, as they may refer to non-actual contexts (cf. Cumming 2005, Geurts & Maier 2005, Maier 2007).

¹³⁴Schlenker in fact argues that monsters are present in more familiar languages like English and German, as well, although their effects cannot be seen with person pronouns (see Israel & Perry 1996, Lewis 1979a, Percus & Sauerland 2003, Pearson 2012, Santorio 2010, Schlenker 1999, 2003a,b). I will exclusively focus on person pronouns in this dissertation.

sentence, and similarly in (590b), the second person feature can refer to the present speaker (although it is not indicated in the original translation, the second person subject of the embedded clause presumably can refer to the current hearer as well). This pattern is expected if these indexicals are interpreted relative to the reported context. That is, John is the speaker of the reported context in (590a), and likewise the present speaker is the hearer of the reported context in (590b).

Notice importantly that the embedded clauses of these examples cannot be direct quotations. Since direct quotations resist long-distance semantic relations such as *wh*-quantification from outside (Quine 1960, Schlenker 1999, Anand 2006, Oshima 2006, Capelen & LePore 2008), the *wh*-phrases taking non-local scope in these examples ensure that they are not direct quotation.¹³⁵

The logic of Schlenker’s claim based on this observation is the following: the availability of indexical shifting in a construction like (590) suggests that a monster resides in that construction, and hence it is a counterexample to the Kaplan’s surmise. However, I would like to point out that there is another way of making sense of the data in (590) without recourse to monsters, whereby saving Kaplan’s conjecture. Let us now look at this conservative view and Schlenker’s account with monsters.

14.3 Two Theories of Amharic Indexical Shifting

14.3.1 Ambiguity Theory

I start with an alternative to Schlenker’s semantics with monsters that does not run counter to Kaplan’s conjecture. The idea is actually mentioned in passing by Schlenker (2003b:fn.5) himself (see also Anand 2006:§2.6.3, Higginbotham 2003, Safir 2004): Amharic indexicals are merely ambiguous between true indexicals and what are called logophoric pronouns or *logophors*.¹³⁶

Logophors are expressions found in languages like Ewe and Mupun that appear predominantly in complement clauses to attitude predicates and refer to the speaker or the hearer of the reported context (Clements 1975, Culy 1994, 1997, Sells 1987, Schlenker 1999, 2003a,b, Pearson 2012).¹³⁷ (591a) is an example of the Ewe logophor *yè* taken from Clements (1975) cited in Schlenker (1999).

- (591) kofi be yè-dzo.
 Kofi say LOG-leave
 ‘Kofi said that he left.’

Here the logophor *yè* obligatorily refers to Kofi. Interestingly, this item is not licensed in matrix clauses or relative clauses as shown in (592).

- (592) a. *yè dzo. (Pearson 2012)
 LOG leave

¹³⁵(590b) has an additional complication as the most embedded clause is an imperative. The literal translation of the sentence is: I did not hear what_i he said “bring *t_i*!” . As Crnić & Trinh (2009a,b) and Kaufmann (2012) claim, imperatives seem to be embeddable at least in certain contexts, despite the common presumption to the contrary.

¹³⁶Anand (2006) also mentions this analysis, but rejects it for it cannot account for two constraints on indexical shifting he observes: *Shift-Together Constraint* (Anand & Nevins 2004) and *No Intervening Binder*.

¹³⁷In Mupun, there are logophors that refer to the hearer, while Ewe has only those that refer to the speaker (Schlenker 1999).

- b. *ama dɔ ŋku nyɔnuvi hi dze yè gbɔ dyi.
 Ama set eye girl WH stay LOG side on
 ‘Ama set eye on (remembered) the girl who stayed with her.’ (Clements
 1975 cited in Schlenker (1999))

Given the existence of items like Ewe *yè*, it is a possibility that Amharic also has such pronouns, and also nothing prevents them from having the same morphological shape as first or second person pronouns. According to this analysis, therefore, Amharic ‘first/second pronouns’ are systematically ambiguous between two readings as a result of an accidental homophony. Under the indexical reading, they are just like English first/second pronouns and refer to the speaker, hearer, etc. of the context of the current utterance, while under the logophor reading, they refer to the speaker, hear, etc. of the reported context and moreover appear only in attitude reports.

Schlenker (2003b) dismisses this analysis rather quickly, noting that homophony is conceptually undesirable. However, given that indexical shifting is optional in Amharic, it basically can account for the data. Let us call this theory the ‘Ambiguity Theory’ of indexical shifting. Notice in particular that the Kaplanian conjecture is kept intact under this analysis.

14.3.2 Schlenker’s Theory

What Schlenker proposes instead is to entirely abandon the Kaplanian conjecture. He maintains that attitude predicates in all languages are in fact monsters and denote quantifiers over contexts and hence manipulate contexts (cf. Israel & Perry 1996). For example, the verb *say* is assigned the following denotation that takes a function of type $\langle k, t \rangle$ as its first argument, where k is the semantic type of possible contexts, and universally quantifies over possible contexts c' .

$$(593) \quad \llbracket \text{say} \rrbracket^{c,g}(p_{\langle k,t \rangle})(x_e) \Leftrightarrow \\ \text{for all } c' \text{ such that } x = a_{c'} \text{ and } w_{c'} \text{ is compatible with } x \text{ says in } w_c, p(c') = 1$$

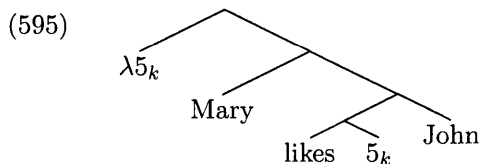
For this to work technically, a number of assumptions need to be made. As I will make the essentially same assumptions in my account presented in Section 17, let us introduce them at this point. For uniformity’s sake, I will use different notations from Schlenker and make some assumptions that he does not make, but the underlying ideas are kept intact in the following exposition.

The denotation of an embedded clause is assumed to be a function of type $\langle k, t \rangle$, and serves as the first argument of *say*. Let us make use of binder indices λi_k to arrive at this denotation. A binder index triggers the rule of Generalized Predicate Abstraction (cf. Heim & Kratzer 1998).¹³⁸

$$(594) \quad \textit{Generalized Predicate Abstraction} \\ \text{If } \alpha \text{ has } i_\tau \text{ and } \beta \text{ as its daughters where } i \in \mathbb{N} \text{ and } \tau \text{ is some semantic type, then} \\ \llbracket \alpha \rrbracket^{c,g} = \lambda x_\tau. \llbracket \beta \rrbracket^{c,g[i_\tau \rightarrow x]} .$$

For example, the following clause denotes a function of type $\langle k, t \rangle$.

¹³⁸I assume that indices carry the type information of its referent, which is represented as a subscript to the numerical index, and furthermore that the assignment function g has $\mathbb{N} \times \text{TYPE}$ as its domain and $\bigcup_{\tau \in \text{TYPE}} D_\tau$ as its range, where TYPE is the set of semantic types.



Notice that the predicate *likes* combines first with 5_k , which I assumed is a pronoun denoting a context, i.e. $\llbracket 5_k \rrbracket^{c,g} = g(5_k)$. This pronoun serves the purpose of fixing the world of evaluation for the predicate. More concretely, *likes* is given the following denotation.

(596) $\llbracket \text{likes } i_k \rrbracket^{c,g} = \lambda x_e. \lambda y_e. y \text{ likes } x \text{ in } w_{g(i_k)}$

Although the context $g(i_k)$ also contains a speaker and a hearer, *likes* is only sensitive to its world parameter $w_{g(i_k)}$ and ignores the other aspects of the context. This might seem superfluous, but the meanings of other lexical items could be sensitive to other parameters of $g(i_k)$. Additionally, one could also assume that proper names like *Mary* and *John* above also combine with a context pronoun, but since their meanings are context independent, such occurrences of context pronouns will not have any truth conditional effects. To simplify the exposition, I will only represent those context pronouns that are relevant for the truth conditions.

Just like embedded clauses, matrix clauses are assumed to have a binder index λi_k , and denote a function of type $\langle k, t \rangle$. Also, by assumption the context that the topmost binder index introduces is the current context of utterance, which is ensured by the following rule.

(597) Sentence *S* is true with respect to context *c* and assignment *g* if and only if $\llbracket S \rrbracket^{c,g}(c) = 1$.

According to this rule, the sentence (595) is true with respect to context *c* just in case Mary likes John in the world of the context denoted by the context pronoun 5_k , namely *c*. Notice also that *c* also appears as a parameter of the interpretation function. This will be used for interpreting first and second person pronouns in language like English, as we will see now.

Schlenker (2003b) assumes that the above mechanism including the ‘monstrous’ semantics for attitude predicates is universal across languages, and proposes that the crosslinguistic difference regarding indexical shifting stems from the difference in the semantics of first and second person pronouns.¹³⁹ Adopting the variable semantics, he analyzes first and second person pronouns in English as variables with presuppositions regarding their values. For instance, first person pronouns are given the following denotation.

(598) *English*
 $\llbracket \text{me}_n i_k \rrbracket^{c,g} = \begin{cases} g(n) & \text{if } g(n) = a_c \\ \text{undefined} & \text{otherwise} \end{cases}$

The value $g(n)$ is presupposed to be the speaker of the current context of utterance a_c , and the context pronoun is superfluous here.

¹³⁹Schlenker (1999) proposes a minor variant of this theory that places the crosslinguistic difference in the morphosyntactic restrictions, rather than in the semantics but this technical difference is immaterial here (see Schlenker 2003b for comparison). Also notice that the partial function approach to presuppositions is assumed in (598). Although I criticized this approach in the first part of this dissertation, I will stick to Schlenker’s formulation, as it is trivial to modify his theory in this regard.

On the other hand, Amharic first person pronouns are interpreted as definite descriptions whose denotation depend on the context pronoun i_k that they combine with.¹⁴⁰

(599) *Amharic First Person Pronoun*

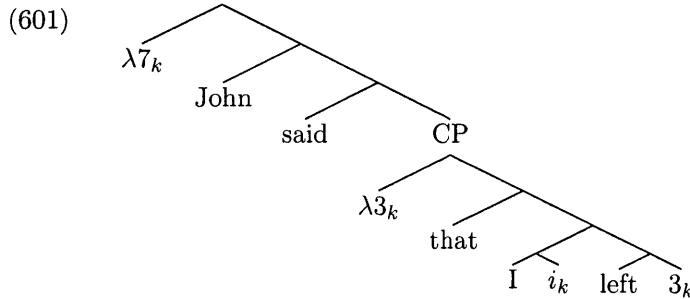
$$\llbracket \widehat{\text{me } i_k} \rrbracket^{c,g} = \begin{cases} a_{g(i_k)} & \text{if there is a unique speaker of } g(i_k), a_{g(i_k)}, \text{ exists} \\ \text{undefined} & \text{otherwise} \end{cases}$$

In English a first person pronoun is interpreted relative to the context parameter of the interpretation function, which is always guaranteed to be the current context of utterance a_c , no matter where the first person pronoun appear in the sentence. On the other hand, in Amharic, it depends on what binds i_k . Importantly in an embedded context, an attitude predicate might bind it, in which case the pronoun denotes a different individual from a_c .

Let us look at a concrete example to see how this analysis works. I abstract away from the interpretation of tense and concentrate on the denotation of the first person pronoun.

(600) John said that I left.

This sentence is given the following schematic LF. It is assumed that each context pronoun has an index that is bound by some binder index. Thus, $i = 3$ or $i = 7$.



In English, the first person pronoun I is interpreted relative to the current context of utterance, as its presupposition demands that its denotation be the speaker of c , regardless of the context pronoun that it combines with. Thus, the same interpretation is derived with $i = 7$ and with $i = 3$. On the other hand, in Amharic, the denotation of I depends on i_k . If $i = 7$, its denotation will be the speaker of the current context of utterance, as in English, due to the rule in (597). On the other hand, if $i = 3$, it denotes the speaker of a different context. Recall that the semantics of *say* quantifies over contexts where the attitude holder, John in this case, is the speaker. Thus, when $i = 3$, the first person pronoun denotes John, rather than the current speaker. This captures the shifting of first person pronouns.

To recapitulate, according to Schlenker's theory, all attitude predicates in all natural languages are monsters, directly contradicting Kaplan's conjecture. The crosslinguistic difference between English and Amharic is located in the lexical specifications of presuppositions of the indexical items. In English, first and second person pronouns are specified as

¹⁴⁰As Schlenker points out, Amharic first person pronouns cannot be analyzed as a free variable with a presupposition. Consider the following analysis that would be on a par with (598).

$$(i) \quad \llbracket \widehat{\text{me}_n i_k} \rrbracket^{c,g} = \begin{cases} g(n) & \text{if } g(n) = a_{g(i_k)} \\ \text{undefined} & \text{otherwise} \end{cases}$$

In an Amharic example like *John said that I am a hero*, this pronoun would be a free pronoun, and would not be able to vary across different contexts that *said* quantifies over, since its value is fixed to be $g(n)$.

only sensitive to the current context of utterance, while in Amharic, they can be relative to the contexts that attitude predicates introduce.

14.4 Outlook

In the next section, I will examine indexical shifting in Uyghur in detail. It is currently acknowledged that languages with indexical shifting are not homogeneous in certain respects (Anand 2006), and I will show that Uyghur indexical shifting has a number of peculiar properties, some of which can be used to elucidate the inadequacies of the Ambiguity Theory and Schlenker's theory introduced above. I proposed my analysis in Section 17, which is largely based on Anand & Nevins's (2004) and Anand's (2006), and discuss there and in subsequent sections the universals and variation in indexical shifting.

15 Indexical Shifting in Uyghur

Uyghur is an eastern Turkic language spoken by 8-10 million speakers mainly in the Xinjiang Autonomous Region of China and some parts of Kazakhstan. It possesses the usual Turkic features including SOV as the canonical word order, free scrambling of noun phrases, radical *pro*-drop, highly agglutinative verbal morphology, allomorphy involving vowel harmony, and case suffixes on nouns with nominative being null (see Hahn 1991, De Jong 2007 for descriptive grammars).

I will show in this section that indexical shifting is found in an attitude report construction in Uyghur. I also observe several grammatical restrictions on indexical shifting unique to this language that will be used to refute the analyses mentioned in the previous section.¹⁴¹

15.1 Nominalized vs. Finite Complements

Uyghur has two forms of complement clauses in attitude report constructions: nominalized and finite complement clauses. Some attitude predicates are only compatible with nominalized complements (e.g. *ishen*- 'trust'), some others are only compatible with finite complements (e.g. *chapl*- 'accuse'; this class appears to be very small in number), and the others are compatible with both types (e.g. *de*- 'say').¹⁴² For the moment, I will primarily confine my attention to the verb *de*- 'say'.¹⁴³ The following examples demonstrate that *de*- can appear with either a nominalized complement clause as in (602a) or a finite complement clause as in (602b).

(602) a. *Nominalized Complement*

¹⁴¹What is reported in this section and Section 17 is largely based on a joint work with Kirill Shklovsky, (Shklovsky & Sudo to appear).

¹⁴²In our fieldwork, Kirill Shklovsky and I have checked about 50 attitude predicates, but have not been able to find a semantic generalization with respect to the type of the complement.

¹⁴³Attitude predicates other than *de*- require an additional morpheme *dep* at the end of a finite complement clause (but not with a nominalized clause), which is arguably related to the verb *de*- and the polysemous verbal suffix *-p*. Thus, it is a possibility to analyze '*φ dep*' as a tenseless controlled clause that means *while saying φ*, but this analysis is inadequate for certain attitude predicates such as *angla*- 'hear'. Thus, there is at least a use that is semantically bleached. I will not be committed to a particular analysis of this item in this dissertation, and gloss it as a complementizer. See Şener (2008:fn.5) and references therein for a similar analysis for Turkish *diye*.

- Ahmet [Tursun-ning kit-ken-lik-i-ni] di-di.
 Ahmet [Tursun-GEN leave-REL-NML-3-ACC] say-PAST.3
 ‘Ahmet said that Tursun left.’
- b. *Finite Complement*
 Ahmet [Tursun(-ni) ket-ti] di-di.
 Ahmet [Tursun(-ACC) leave-PAST.3] say-PAST.3
 ‘Ahmet said that Tursun left.’

In a nominalized complement clause, the main verb does not bear a tense suffix, and appears with a relative clause suffix *-ken* instead together with the nominalizer *-lik* and a possessive agreement that marks the person of the embedded subject, which is genitive marked. The entire clause is case marked by the accusative suffix *-ni* in (602a). The case marking on the nominalized clause depends on the matrix attitude predicate: some select for accusative complements (e.g. *de-* ‘say’), some select for dative complements (e.g. *qoshul-* ‘agree’), some select for ablative complements (e.g. *guman qil-* ‘suspect’), etc. In a finite complement clause, on the other hand, the embedded predicate is fully tensed and the clause is in a form that can function as an independent sentence on its own. Also the clause is not case marked. The morphological case of the subject in a finite complement clause can be accusative or nominative as indicated by the parentheses in (602b).

Although pairs like (602) are basically synonymous, the interpretations of these two attitude constructions diverge when they contain indexicals. That is, in nominalized complements, all indexicals must be interpreted relative to the actual context of utterance, while in finite complements, nominative subjects obligatorily receive interpretations relative to the reported context of utterance. This is demonstrated by the following pair of sentences containing first person pronouns.

- (603) a. *Nominalized Complement*
 Ahmet [**mening** kit-ken-lik-im-ni] di-di.
 Ahmet [1sg.GEN leave-REL-NMLZ-1sg-ACC] say-PAST.3
 (i) SHIFTED: *‘Ahmet said that Ahmet left.’
 (ii) NON-SHIFTED: ‘Ahmet said that I left.’
- b. *Finite Complement*
 Ahmet [**men** ket-tim] di-di.
 Ahmet [1sg leave-PAST.1sg] say-PAST.3
 (i) SHIFTED: ‘Ahmet said that Ahmet left.’
 (ii) NON-SHIFTED: *‘Ahmet said that I left.’

Unlike the pair in (602), the sentences in (603) are truth conditionally distinct. The sentence with a nominalized complement clause in (603a) is semantically similar to its English analogue, and the first person pronoun refers to the speaker of the entire report. I call this interpretation a *non-shifted* interpretation. By contrast, the first person pronoun in the finite complement clause in (603b) must be interpreted as the attitude holder Ahmet, who is the speaker of the reported context. I call this interpretation a *shifted* interpretation.

The same contrast obtains with second person pronouns too, as exemplified by (604). These examples do not contain overt second person pronouns, but the person of the implicit subject is indicated by the verbal agreement.

- (604) a. *Nominalized Complement*

Tursun Muhemmet-ke [*pro* xet jaz-ghan-lik-**ing**-ni] di-di.
 Tursun Muhemmet-DAT [*pro* letter write-REL-NML-2sg-ACC] say-PAST.3
 (i) SHIFTED: *‘Tursun told Muhemmet that Muhemmet wrote a letter.’
 (ii) NON-SHIFTED: ‘Tursun told Muhemmet that you wrote a letter.’

b. *Finite Complement*

Tursun Muhemmet-ke [*pro* xet jaz-**ding**] di-di.
 Tursun Muhemmet-DAT [*pro* letter write-PAST.2sg] say-PAST
 (i) SHIFTED: ‘Tursun told Muhemmet that Muhemmet wrote a letter.’
 (ii) NON-SHIFTED: *‘Tursun told Muhemmet that you wrote a letter.’

The generalization is that nominalized complements are just like English indirect speech in that indexicals contained in them are interpreted relative to the context of the current utterance, whereas in finite complement clauses, indexicals are always interpreted relative to the context of the reported utterance.

At this moment one might wonder whether finite complement clauses are just obligatorily quotational, in which case the shifting facts above are not at all surprising (cf. fn.133 above). In the next subsection, several pieces of evidence are adduced to show that finite clausal complements need not be quotations, and hence indexical shifting is real.

15.2 Finite Clausal Complements Need Not Be Quotations

In this subsection, it is demonstrated that even when the embedded finite clause cannot be quotational, indexical shifting obligatorily takes place. Generally, quotations forbid syntactic and semantic relations to hold between material inside and outside the quotation (cf. Anand 2006, Oshima 2006, Schlenker 1999 and references therein for the distinction between quotations and non-quotations as well as for tests to distinguish them). For example, overt movement cannot take place from a quotation, as demonstrated by (605).

(605) *Who did John whisper, “Bill likes”?

Here, since *whisper* does not take a non-quotational clausal complement, the embedded clause is guaranteed to be a direct quotation. Similarly, Negative Polarity Items (NPIs) like *ever* are not licensed from a negative element that lies outside of the quotation.

(606) *Nobody whispered, “Bill has ever been to Paris.”

Compare this to cases in complement clauses, which are grammatical.

(607) a. Who did John say Bill likes?
 b. Nobody said that Bill has ever been to Paris.

Also, direct quotations are not just required to be synonymous with what is reported, but also must be verbatim.

(608) CONTEXT Bill said “Mary and Sue met.”
 a. Bill said “Mary and Sue met.”
 b. #Bill said “Sue and Mary met.”

I will use three grammatical phenomena in Uyghur that guarantee the non-quotation interpretation of the embedded clause, which are similar to the English phenomena like the ones we have just seen: (i) long-distance licensing of Negative Concord Items (NCIs),

(ii) long-distance wh-questions, and (iii) non-verbatim reports. These tests indicate that indexical shifting obligatorily takes place in finite complement clauses in Uyghur.

15.2.1 Long-distance Licensing of Negative Concord Items

In Uyghur, NCIs such as *hichkim* ‘nobody’ require a negative licenser, typically a negative suffix on the main verb, as illustrated by the following example.¹⁴⁴ I gloss NCIs in Uyghur with ‘N-words’ like *nobody* in English.

- (609) men **hichkim**-ni kör-*(**mi**)-dim.
 1sg.NOM nobody-ACC see-*(NEG)-PAST.1sg
 ‘I saw nobody.’

NCIs in Uyghur can be long-distance licensed, as demonstrated by (610).

- (610) Tursun [men **hichkim**-ni kör-dim] di-**mi**-di.
 Tursun [1sg nobody-ACC see-PAST.1sg] say-NEG-PAST.3
 a. SHIFTED: ‘Tursun didn’t say that Tursun saw anyone.’
 b. NON-SHIFTED: *‘Tursun didn’t say that I saw anyone.’

Here, the NCI *hichkim* contained in the embedded clause is licensed by the negation *-mi* on the matrix attitude predicate. This makes it unlikely that the embedded clause is a quotation, since it is ungrammatical on its own as (609) above shows.¹⁴⁵ Notice that the indexical subject still obligatorily receives a shifted interpretation, and the non-shifted, English-like reading in (610b) is unavailable.

15.2.2 Long-distance Wh-questions

Second, the exact same point can be made by long-distance wh-questions. Uyghur is a wh-in-situ language, just like other Turkic languages, and a wh-phrase appears in the in-situ position regardless of its scope. In (611), for example, the wh-phrase *kim* ‘who’ appears in the embedded clause but takes the matrix scope.

- (611) Tursun [men **kim**-ni kör-dim] di-di?
 Tursun [1sg who-ACC see-PAST.1sg] say-PAST.3
 a. SHIFTED: ‘Who did Tursun say Tursun saw?’
 b. NON-SHIFTED*‘Who did Tursun say I saw?’

The matrix scope reading of the wh-phrase ensures that the embedded clause is impossible to be a quotation. Nonetheless, the indexical subject still must have the shifted interpretation in (611a).

¹⁴⁴Besides the negative suffix *-mi-*, the negative existential verb *yoq* can license NCIs in Uyghur.

- (i) hichbir alma yoq.
 no apple not.exist
 ‘There are no apples.’

¹⁴⁵Strictly speaking, the quotation reading is in principle not impossible, since ungrammatical expressions can be quoted. However, such a reading is pragmatically highly marked and generally infelicitous except when a special context is set up.

15.2.3 Non-verbatim Report

Third, non-verbatim reports are possible with finite complement clauses. Consider the following example.

- (612) CONTEXT: One day Ahmet and Muhemmet took a test. After the test, I met Ahmet. He said “Only I passed the test (*peqet menla imtihandin öttim*). A while later, I met Muhemmet and he said the exact same thing. Now I tell the teacher what they told me:
Ahmet we Muhemmet [peqet **biz-la** imtahan-din öt-**tuq**] di-di
Ahmet and Muhemmet [only 1pl-FOC test-ABL pass-PAST.1pl] say-PAST.3
‘Ahmet and Muhemmet each said that only he passed the test’

In this context, the quotation reading is false, because neither Ahmet nor Muhemmet said that they both passed the exam, but the sentence is judged true. Therefore, the embedded clause has a non-quotation reading. Furthermore, under the reading that is true in the given context, the first person features of the subject and verbal agreement are still interpreted relative to the reported context.¹⁴⁶

These data show that finite clausal complements are not always quotations in Uyghur, and therefore the shifted interpretation is not due to direct quotations. It should be noted at this point that in Amharic, indexical shifting is completely optional, but in Uyghur it is obligatory for nominative subjects in finite clausal complements. In fact, indexical shifting in most languages studied so far is reported to be optional with Matses being the only exception (Ludwig, Munro, Fleck & Sauerland to appear) (also Slave shows intra-linguistic variation; see Section 19.2). Thus Uyghur instantiates a typologically rare pattern of indexical shifting.

Having convinced ourselves of the existence of indexical shifting in Uyghur, we will discuss another intriguing property of Uyghur indexical shifting that has not been found in other languages, namely, correlation between indexical shifting and morphological case.

15.3 Correlation between Shifting and Case

As I mentioned above, finite complement clauses in Uyghur optionally take accusative subjects, instead of nominative subjects. Interestingly enough, nominative indexical subjects must shift, as we have seen above, but accusative indexical subjects never do. This is shown by the semantic difference between (613a) and (613b) below.¹⁴⁷

¹⁴⁶This sentence is of some interest for theories of phi features on bound pronouns discuss in Part II. The account presented there is straightforwardly extendable to cover this case, while it is more cumbersome to capture it under the minimal pronoun approach. Cf. Section 20.1.

¹⁴⁷Notice that the verbal agreement still has to shift in (613b) and (614b), resulting in an agreement mismatch. The mismatch is obligatory as the ungrammaticality of (i) indicates.

- (i) a. *Ahmet [**meni** ket-**tim**] di-di.
Ahmet [1sg.ACC leave-PAST.1sg] say-PAST.3
b. *Ahmet Aygül-ge [**seni** ket-**ting**] di-di.
Ahmet Aygül-DAT [2sg.ACC leave-PAST.2sg] say-PAST.3

The agreement mismatch is a puzzle for the standard syntactic account of agreement, but I will not discuss it in this dissertation.

- (613) a. Ahmet [**men** ket-tim] di-di.
 Ahmet [1sg leave-PAST.1sg] say-PAST.3
 (i) SHIFTED: ‘Ahmet said that Ahmet himself left.’
 (ii) NON-SHIFTED: *‘Ahmet said that I left.’
- b. Ahmet [**meni** ket-ti] di-di.
 Ahmet [1sg.ACC leave-PAST.3] say-PAST.3
 (i) SHIFTED: *‘Ahmet said that Ahmet left.’
 (ii) NON-SHIFTED: ‘Ahmet said that I left.’

Again, this is a general phenomenon and accusative second person subjects cannot shift either, unlike nominative second person subjects.

- (614) a. Ahmet Aygül-ge [**sen** ket-ting] di-di.
 Ahmet Aygül-DAT [2sg leave-PAST.2sg] say-PAST.3
 (i) SHIFTED: ‘Ahmet told Aygül that Aygül left.’
 (ii) NON-SHIFTED: *‘Ahmet told Aygül that you left.’
- b. Ahmet Aygül-ge [**seni** ket-ti] di-di.
 Ahmet Aygül-DAT [2sg.ACC leave-PAST.3] say-PAST.3
 (i) SHIFTED: *‘Ahmet told Aygül that Aygül left.’
 (ii) NON-SHIFTED: ‘Ahmet told Aygül that you left.’

Incidentally, accusative subjects are not licensed in matrix clauses as shown in (615a), and hence they automatically guarantee that embedded clauses with an accusative subject are not quotations.

- (615) a. professor-(*ni) ket-ti.
 professor-(*ACC) leave-PAST.3
 ‘The professor left.’
- b. Ahmet [professor-(ni) ket-ti] di-di.
 Ahmet [professor-ACC leave-PAST.3] say-PAST.3
 ‘Ahmet said that the professor left.’

The question that immediately arises is whether the accusative subject really belongs to the embedded clause. It is conceivable that it acts like the *of*-phrase in the following English sentence, which is considered to be base-generated in the matrix clause as an additional argument of the attitude predicate.

- (616) John said of MIT students that they are generally rich.

Notice that since Uyghur allows *pro*-drop, the embedded subject might be simply invisible in the presence of an accusative subject. If such an analysis is correct for Uyghur accusative subjects, that they cannot undergo indexical shifting is not at all surprising, as they are not in the embedded clause in the first place. In fact, analyses along these lines have been proposed for accusative noun phrases found in attitude report constructions in other languages such as Japanese (Bruening 2001; see also Şener 2008 for Turkish). However a closer examination reveals that accusative subjects belong to the embedded clause. Below, I will present three empirical arguments to this effect.

15.3.1 Accusative Subjects As Embedded Material

Idiom Chunks

Our first piece of evidence against the matrix generation analysis of accusative subjects is that the subject of a sentential idiom can be accusative. For example, the sentential idiom in (617a) can be embedded in the finite complement construction with the idiomatic subject being accusative as in (617b).¹⁴⁸

- (617) a. toqquz qiz-ning tolghaq teng kel-di.
 nine girl-GEN labor.pains simultaneously arrive-PAST.3
 ‘Times were hard.’
 (lit: “nine girls’ labor pains came all at once.”)
- b. Tursun [toqquz qiz-ning tolghaq-ni teng kel-di] di-di.
 Tursun [nine girl-GEN labor-ACC simultaneously arrive-PAST.3] say-PAST.3
 ‘Tursun said that times were hard.’

On the assumption that idioms must be base-generated as a structural chunk, (617b) suggests that accusative subjects can be generated in the embedded clause.

NCI Subjects

Secondly, an NCI accusative subject can be licensed by the embedded negation, as demonstrated by (618).

- (618) men [hichkim-ni ket-mi-di dep] bil-imen.
 1sg.NOM [nobody-ACC leave-NEG-PAST.3 C] believe-IMPF.1sg
 ‘I believe that no one left.’

As shown in (609) above, NCIs such as *hichkim* ‘nobody’ always require a negative licenser. In fact, NCIs have to be either a clause-mate with or c-commanded by a licenser, as shown by the ungrammaticality of the following example where *hichkim* is in the matrix clause and a negative licenser is only found in the embedded clause.

- (619) *hichkim [Aslan ket-mi-di] di-di.
 nobody [Aslan leave-NEG-PAST.3] say-PAST.3

Thus, the data in (618) indicates that the accusative NCI subject belongs to the embedded clause at least at some point in the derivation when NCI licensing is done.

*Double Accusative Constraint

Thirdly, embedded accusative subjects trigger a language specific constraint in relation to embedded material, namely, the prohibition against two clausemate accusative noun phrases. In Uyghur a single clause cannot contain two accusative marked noun phrases, as reported by Halpert (2009) (see Hiraiwa 2002, 2010, Poser 2002 for the similar restriction in Japanese). For example, we can see the constraint at work in case alternation triggered by causativization. Simply put, the subjects of intransitive verbs bear accusative case under

¹⁴⁸That this idiom is a true sentential idiom rather than an NP idiom is shown by the fact that only with the given verb (*kel-*) does the idiom retain the idiomatic meaning.

causativization, but the subjects of transitive verbs with accusative objects bear dative case. This is illustrated by the following examples taken from Halpert (2009) with her original transcription.

- (620) a. Mamet kul-d-i.
Mamet laugh-PAST-3
'Mamet laughed.'
- b. men Məhamet-ni kül-dür-d-im.
I Mamet-ACC laugh-CAUS-PERF-1sg
'I made Mamet laugh.'

When a simple intransitive sentence like (620a) is causativized, the original nominative subject is realized with accusative case as in (620b). When there is already an accusative object in the source sentence, as in a transitive sentence (621a), on the other hand, the causee argument come out as a dative phrase, and the accusative marking results in ungrammaticality as in (621c). Again the data in (621) are taken from Halpert (2009).¹⁴⁹

- (621) a. Mamet tamaq-(ni) ji-d-i.
Mamet food-(ACC) eat-PAST-3
'Mamet ate food.'
- b. men Mamet-ke tamaq-ni ji-güz-d-um.
I Mamet-DAT food-ACC eat-CAUS-PAST-1sg
'I made Mamet eat food.'
- c. *men Mamet-ni tamaq-ni ji-güz-d-um.
I Mamet-ACC food-ACC eat-CAUS-PAST-1sg

Crucially, for the evaluation of this constraint, the accusative embedded subject counts as an embedded material. That is, if there is an accusative marked object in the embedded clause, accusative marking on the subject is significantly dispreferred, as shown in (622).

- (622) a. Tursun [meni nan yaq-ti] di-di.
Tursun [1sg.ACC bread bake-PAST.3] say-PAST.3
'Tursun said that I made bread.'
- b. *Tursun [meni nan-ni yaq-ti] di-di.
Tursun [1sg.ACC bread-ACC bake-PAST.3] say-PAST.3
'Tursun said that I made bread.'

This data is stronger than the previous two kinds of data in that it suggests that the accusative subject is never generated in the matrix clause.

I conclude from these data that accusative subjects of finite clausal complements must originate in the embedded clause. Then their immunity to indexical shifting is a puzzle. One might think that an accusative subject is generated in the embedded clause but escapes the scope of the attitude predicate. Indeed, if an accusative subject cannot be in the scope of the attitude predicate, it would be unsurprising that it cannot receive a shifted interpretation, and none of the data above show that it needs to be interpreted in the scope of the attitude predicate. However, I will observe in the next subsection that accusative subjects are able

¹⁴⁹As in Turkish, accusative marking on the direct object is generally associated with a 'specific' or 'discourse-familiar' reading, and optional with noun phrases compatible with 'non-specific' readings (see Enç 1991, von Stechow & Kornfilt 2005 for Turkish).

to stay in the scope of the matrix embedding verb.

15.3.2 Scope of the Accusative Subject

I now present two kinds of data showing the scope relations between the accusative subject and the attitude predicate. First, accusative subjects can generally be interpreted *de dicto*. Consider the following example.

- (623) Tursun [**tulpar-ni** kel-di] di-di,
Tursun [winged.horse-ACC arrive-PAST.3] say-PAST.3
'Tursun said that a winged horse arrived,'
... emma tulpar yoq.
... but winged.horse not.exist
but winged horses do not exist.'

In (623), the accusative subject *tulpar* 'winged horse' must be interpreted in the scope of the attitude verb *de-* 'say', as its existence is explicitly denied in the continuation without giving rise to an inconsistency. It is controversial that the *de dicto* reading of the accusative subject here requires at least the noun *tulpar* to be under the scope of the attitude verb *de-* 'say' (Cresswell & von Stechow 1982, Fodor 1970, Montague 1973, Partee 1974, Keshet 2008, 2010, 2011). Thus, the accusative subject should have an option of staying in the scope of the attitude predicate.

Second, for a quantificational accusative subject, the narrow scope reading with respect to the attitude predicate is available, as illustrated by the following example.

- (624) CONTEXT: Ahmet heard from Aslan that one of my friends is from Urumchi but has no idea who that person is. He thought it could be John, it could be Bill, or it could be Sue. He asked me to identify that friend of mine. But actually, I don't have a friend from Urumchi!
Ahmet [**bir dostu-m-ni** Ürümchilik dep] oyla-idu.
Ahmet [one friend-1sg-ACC Urumchian C] think-IMP.F.3
'Ahmet think a friend of mine is from Urumchi.'

In order to capture the relevant reading of this sentence, the indefinite accusative subject *bir dostum-ni* 'a friend of mine' must take narrow scope with respect to *oyla-* 'think', as there is no particular friend of mine who Ahmet thinks is from Urumchi. This again shows that accusative subjects can remain stay under the scope of the attitude predicate.

15.4 Section Summary

To recapitulate the main finding of the present section, I have pointed out the following two peculiarities of Uyghur indexical shifting:

- Indexical shifting is obligatory in finite clausal complements, but unavailable in nominalized complements.
- Accusative subjects never undergo indexical shifting, while nominative subjects always do, despite the fact that accusative subjects originate from the embedded clause and can stay under the scope of the attitude predicate.

In the following section, I argue that neither of the two theories mentioned in Section 14.3 can adequately account for Uyghur indexical shifting.

16 Against the Two Theories of Indexical Shifting

I will argue in this section that neither the Ambiguity Theory nor Schlenker's theory with monsters adequately captures indexical shifting in Uyghur. The two properties of Uyghur indexical shifting mentioned above are crucial for my arguments.

16.1 Against the Ambiguity Theory

To review the Ambiguity Theory, languages with 'indexical shifting' have indexicals and logophors that are accidentally homophonous. Thus, this theory denies the existence of indexical shifting *per se*, and treats it as a result of lexical ambiguity, whereby keeping the Kaplanian conjecture intact. As explained in Section 14.3.1, this analysis captures optional indexical shifting in Amharic. However, it is problematic for Uyghur for the following three reasons.

Firstly, in Uyghur, indexical shifting is obligatory for nominative subjects. Thus, the Ambiguity Theory must make a stipulation to the effect that in finite complements, indexicals cannot appear and only logophors are licensed. However, no constraints are independently known that bans indexicals from appearing in attitude contexts. Rather, in many, and perhaps all languages known so far, indexicals may appear in attitude contexts in general.

Secondly, since accusative subjects never shift, it has to be assumed that whatever bans indexical nominative subjects in attitude contexts does not apply to accusative subjects, and in addition that logophors are prohibited to become an accusative subject. Especially, the latter constraint is semantically strange, since the accusative subject can stay in the scope of the attitude predicate where logophors should be licensed.

Thirdly, the Ambiguity Theory makes a false prediction that indexical shifting is available in nominalized clauses. Given that there is no noticeable semantic difference between nominalized and finite complement constructions, it is unclear why logophors are anti-licensed in nominalized clauses.

For these reasons, the Ambiguity Theory is inadequate as an analysis of Uyghur indexical shifting. This conclusion leads us to consider a theory with a monster. However, Schlenker's (2003b) theory does not aptly explain the Uyghur data either.

16.2 Against Schlenker's Theory

One of the distinctive facets of Schlenker's (2003b) theory is the assumption that attitude predicates in all languages are monsters, and the crosslinguistic variation stems from the difference in the presuppositional meanings of indexical items. As a consequence, in a language with Amharic type first and second person pronouns, indexical shifting is predicted.

Although the presuppositional treatment of person features is independently problematic, as pointed out in Section 7 in Part II, there is an independent problem for this account, i.e. intra-linguistic variation across attitude constructions. Recall that many attitude predicates including *de-* 'say' in Uyghur are compatible with both nominalized and finite complement clauses, but indexical shifting is strictly confined to the latter. This state of affairs is not compatible with Schlenker's (2003b) view that the shiftability depends solely

on the semantics of indexical items.

A second problem is that not all occurrences of indexical items shift in Uyghur. In particular, accusative subjects never shift, while nominative subjects obligatorily do, despite the fact one and the same indexical item is used.¹⁵⁰ This is quite puzzling under Schlenker’s account, since nothing in his theory refers to the morphosyntactic properties of indexicals. Crucially, it is not the case that the accusative subject is generated in the matrix clause, or always outscopes the attitude predicate.

For these reasons, I reject Schlenker’s theory, too.¹⁵¹ In the next section, I introduce an account with a monster that is syntactically independent from the attitude predicate, following the proposals by Anand & Nevins (2004) and Anand (2006). Moreover, in order to account for the shifting behavior of nominative and accusative subjects, I propose a complex clausal structure for finite complements where accusative and nominative subjects stand in different structural relations to the monstrous operator responsible for the shifting effect.

17 The Semantics of Indexicals and the Syntax of the Monster

Following Schlenker (1999, 2003b), I reject the Kaplanian conjecture, and propose that a monster does exist in languages like Uyghur. With Schlenker, I assume that attitude predicates and other modals are quantifiers over contexts across languages, but contrary to him, I deny the variation in the semantics of first and second person pronouns and claim that there is a separate operator that achieves indexical shifting. The proposed analysis is very similar to Anand & Nevins’s (2004) and Anand’s (2006), but in the subsequent sections, we will see some differences.

17.1 Basic Setup

For technical reasons, I will make several syntactic and semantic assumptions, some of which are mentioned already in 14.3.2 in connection with Schlenker’s (2003b) theory. The interpretation function is relativized to a context c and an assignment function g , and not to a possible world parameter w . The role of w is taken over by phonologically silent context pronouns represented in syntax (cf. situation pronouns of von Stechow & Heim 2007, Percus 2000, Keshet 2008, 2010, Schwarz to appear). I furthermore assume that the denotation of a clause is of type $\langle k, t \rangle$, and every clause is prefixed with a binder index λi_k that binds context pronouns via Generalized Predicate Abstraction:

- (625) *Generalized Predicate Abstraction*
 If α has i_τ and β as its daughters where $i \in \mathbb{N}$ and τ is some semantic type, then

$$\llbracket \alpha \rrbracket^{c,g} = \lambda x_\tau. \llbracket \beta \rrbracket^{c,g[i_\tau \mapsto x]}$$
.

Since a sentence always denotes a function of type $\langle k, t \rangle$, the notion of truth needs to be made explicit. I assume the following rule repeated from Section 14.3.2 (cf. Stalnaker 1978, Anand 2006).

¹⁵⁰In the simple examples above, there is a difference in shape between nominative and accusative indexical pronouns, but more complex examples we will look at in Section 17.5 below demonstrate that the exact same items receive shifted or non-shifted interpretations depending on the environment.

¹⁵¹The criticisms raised here apply to Maier’s theory of indexical shifting (Maier 2006, 2009b,a), where the difference between English and Amharic first person pronouns is located in their lexical specifications, just as in Schlenker’s theory, although the analysis of indexical shifting itself is quite different.

(597) Sentence S is true with respect to context c and assignment g if and only if $\llbracket S \rrbracket^{c,g}(c) = 1$.

This ensures that the context pronouns bound by the topmost λi_k all denote the current context of utterance.

For the sake of simplicity, I assume that each phrase takes a context pronoun, but in most cases, some or all of the information carried by the context pronouns are ignored. For example, a proper name like *John* does not refer to any parameter, while a predicate like *leave* is only sensitive to the world parameter.

(626)

a. $\llbracket \widehat{\text{John } i_k} \rrbracket^{c,g} = \text{John}$

b. $\llbracket \widehat{\text{leave } i_k} \rrbracket^{c,g} = \lambda x. x \text{ leaves in } w_{g(i_k)}$

This might look like overkill, but as we will see, this mechanism will be crucial for the analysis of indexical shifting.

For first and second person pronouns, I will assume for the moment the indexical semantics (I will give a reformulation with complex indices in Section 20.1). They are interpreted relative to c , and insensitive to the context pronoun i_k , just like proper names.

(627)

a. $\llbracket \widehat{\text{me } i_k} \rrbracket^{c,g} = a_c$

b. $\llbracket \widehat{\text{you } i_k} \rrbracket^{c,g} = h_c$

Below, for expository purposes, those context pronouns that are not relevant for the truth conditions will sometimes be omitted.

The above semantics captures the direct referentiality of first and second person pronouns, i.e. the insensitivity to modals. Modals are analyzed as quantifiers over contexts, but importantly, they do not affect the context index c . For example, the deontic necessity *must* can be analyzed as follows.

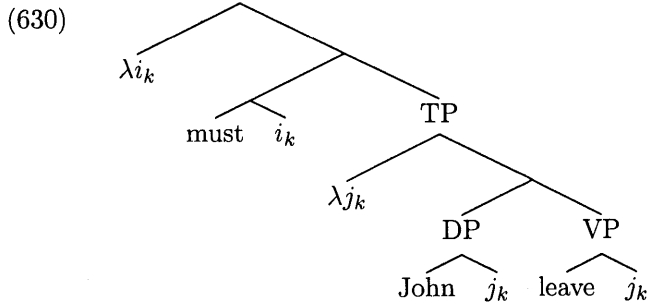
(628) $\llbracket \widehat{\text{must } i_k} \rrbracket^{c,g} = \lambda p_{\langle k,t \rangle}. \text{ for all worlds } w' \text{ that comply with the relevant rules in } w_{g(i_k)}, p(\langle a_{g(i_k)}, h_{g(i_k)}, w' \rangle) = 1$

Notice that it introduces a new context $\langle a_{g(i_k)}, h_{g(i_k)}, w' \rangle$ by changing the world parameter from $g(i_k)$. Notice also that the first two parameters are not altered from i_k , to which I will come back in Section 19.2.2. For the moment, what is important is that *must* quantifies over possible worlds, just as in the standard possible world semantics. Also since c is not changed by *must*, first and second person pronouns occurring in its scope will not be affected by it.

Let us illustrate how this works with the following example.

(629) John must leave.

The syntax is assumed to be (630).



Let us consider the evaluation of this sentence with respect to context c and assignment function g . By the rule (597), i_k denotes c . Also due to the semantics of the modal *must*, j_k ends up denoting $\langle a_c, h_c, w' \rangle$ where w' is a world that complies with the relevant rules in w_c . Since *leave* is only sensitive to the world coordinate of the context pronoun, it denotes the function $\lambda x. x$ left in w' . As a consequence, the reading predicted for (630) is that in all of the worlds w' that comply with the relevant rules, John leaves in w' .

Recall from Section 14, the denotations of first and second person pronouns are unaffected by modals in English. This is captured in the system so far, as their referents are solely dependent on the context parameter on the interpretation function, and modals do not affect it. That is, if *I* occurred in place of *John* above, it would denote a_c , the speaker of the current context of utterance.

17.2 The Monster

According to the indexical semantics of first and second person pronouns given in (627), their denotations are only sensitive to the context parameter of the interpretation function. Thus, in order to achieve indexical shifting in the present system, an operator that changes the context parameter on the interpretation function is necessary. To this end, I postulate the following operator, denoted by the symbol \mathfrak{M} and called the monster (cf. Anand and Nevins' OP_{\forall} and Stalnaker's \dagger -operator). Its function is to take a context pronoun i_k and substitutes its value with respect to g for the context parameter of the interpretation function.

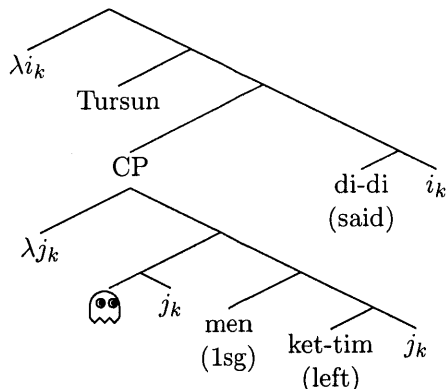
(631) $\left[\left[\mathfrak{M} \ i_k \ \varphi \right] \right]^{c,g} = \llbracket \varphi \rrbracket^{g(i_k),g}$

Indexical shifting is enabled by this operator in the following way. The monster changes the context index, so first and second person pronouns under its scope must refer to the new index which may be different from the original context index. Here is a simple illustration of how this works. Consider the following example with a shifted first person pronoun.

- (632) Tursun [**men** ket-tim] di-di.
 Tursun [1sg leave-PAST.1sg] say-PAST.3
 'Tursun said that he himself left.'

I assume that this sentence has the LF structure schematized in (633).

(633)



Here, the first pronoun *men* occurs under the scope of the monster, which changes the context index to $g(j_k)$, i.e. the context quantified over the modal denoted by *de-* ‘say’. Following Schlenker (1999, 2003b), I assume that attitude predicates are modals and quantify over contexts just like *must*. At this moment I postulate the following semantics of (the intransitive use of) *say*, which I will refine this semantics in the following sections.

$$(634) \quad \left[\left[\widehat{\text{say}} \ i_k \right] \right]^{c,g} = \lambda p_{\langle k,t \rangle} . \lambda x_e . \text{for all worlds } w' \text{ compatible with what } x \text{ says in } w_{g(i_k)}, p(\langle x, h_{g(i_k)}, w' \rangle).$$

Just as *must* introduces a new context, *say* also introduces a new context $\langle x, h_{g(i_k)}, w' \rangle$. This context is denoted by the context pronoun j_k in the structure (633). Just as in the case of *must*, *say* universally quantifies over possible worlds w' , and puts it in the third coordinate of the new context. Additionally, the first coordinate is changed to x , which is the subject of *say* (let us ignore $h_{g(i_k)}$ at this moment). The crucial step of the derivation of (634) is when the monster copies this context onto the interpretation function. As a consequence, *men* ends up denoting x , rather than a_c , which is a shifted interpretation.

17.3 Variation Within and Across Languages: When Is Shifting Possible?

I have just laid out the basic mechanism of indexical shifting. At this point, let us ask the following question: Why does indexical shifting not happen in English? My answer to this question is simply that the monster operator is not in the lexicon of English. Notice that the semantic computation would proceed without a problem even if the monster were absent in the above example, since the monster does not change the semantic type of its sister node. But in the absence of the monster, the context index c never gets overwritten, and a first person pronoun continue to refer to a_c no matter where it appears. In other words, this is just a special case of the insensitivity to modals, which we have seen with *must* in the previous subsection.

What this means is that in the present theory, indexical shifting is solely controlled by the present/absence of the monster. This is a fairly flexible system, but this degree of flexibility seems to be necessary to capture the variation within and across languages that we know exist in languages with indexical shifting (cf. Anand 2006). Let us discuss some concrete cases now.

Recall that indexical shifting in Uyghur is confined to finite complement clauses to attitude predicates and furthermore is obligatory there. To explain this, I simply assume that the monster appears only in finite complements and always does for morphosyntactic

reasons. Also that indexical shifting is never observed in nominalized complements can be captured by assuming that the monster cannot appear in this environment.¹⁵²

A different type of intra-linguistic variation regarding the availability of indexical shifting is known in Slave. As Anand (2006) discusses in detail, indexical shifting in Slave is documented under four attitude predicates: *hadi* ‘he says (intransitive)’, *yenjwε* ‘he thinks’, *hudeli* ‘he wants/thinks’ and *édedi* ‘he tells/asks’. Under *hadi*, shifting is obligatory, as in Uyghur, but under the other predicates, it is optional. This is partially shown in the following examples originally due to Rice (1986) cited in Anand (2006:78).

- (635) *Slave*
- a. John [beya ráwoie] yudeli.
John [1sg-son 3sg-will-hunt] 3sg-want-4sg
‘John wants {his, my} son to go hunting.’
 - b. Simon [rásereyineht’u] hadi.
Simon [2sg-hit-1sg] 3sg-say
‘Simon said that you hit {him, *me}.’

Our theory is again flexible enough to capture this difference among different attitude predicates. That is, *hadi* requires the presence of the monster in its complement clause, while the other three attitude predicates are only compatible with it.

Furthermore, a variation across attitude predicates is also observed in Amharic and Zazaki. Anand (2006) observes that indexical shifting is confined to complement clauses to the verb *say* in these languages and is not available under *think*, for example.^{153,154}

- (636) *Amharic*
- a. John jiægna n-ññ yiSəll yil-all.
John hero COP.PRES-1O says-3sm
‘John says that {I am, he is} a hero.’ (Schlenker 2003b:68)
 - b. John jiægna n-ññ yiSəll ig-all.
John hero COP.PRES-1O saying think.IMPERF-3sm

¹⁵² Although I do not commit myself to the precise categorial status of the monster here, one possibility is that the monster is the complementizer for finite clauses, although I do not have any conclusive evidence for or against this analysis. Also, the present analysis does not give a principled explanation as to why it is that finite but not nominalized complement clauses are monstrous, rather than the other way around, which might be a conceptual drawback, as indexical shifting seems to be found only in finite complements across languages. This issue is left open here.

¹⁵³ As noted in Anand (2006:18), Amharic has a construction with *believe* that uses the gerundive form of *say* as a sort of complementizer, where shifting is licensed (cf. Uyghur *dep* mentioned in fn.143). His data is reproduced below.

- (i) John jiægna n-ññ bilo y-amn-allə.
John hero COP.PRES-1o saying-3s 3ms-believe-be.3sm
‘John believes that he is a hero.’ (lit ‘John believes saying I am a hero.’)

In light of the discussion in Section 19 below, this fact raises an question as to how second person pronouns behave in this construction, but this is unfortunately not discussed in Anand (2006).

¹⁵⁴ Navajo seems to show inter-speaker variation in this respect, as noted by Anand (2006:p.75,fn.16). According to Schaubert (1979), *say*, *want* and *think* are compatible with indexical shifting, while Speas’s (1999) informants only accepted shifting with *say*. Also, Matses reported by Ludwig et al. (to appear) allows shifting under two attitude predicates, both of which are verbs of saying: *ke* ‘say (intransitive)’, *ka* ‘tell’ (and possibly *dan* ‘suppose incorrectly (saying)’). According to Deal (2011), indexical shifting in Nez Perce is found under *think* and *say/tell*.

‘John thinks that {I am, *he is} a hero.’ (Anand 2006:76)

(637) *Zazaki*

- a. Heseni (mi-ra) va ke ez dɛwletia.
 Hesen.OBL (1.OBL-to) said that I rich.be-PRES
 ‘Hesen said that {I am, Hesen is} rich.’ (Anand & Nevins 2004)
- b. Hesen termine ke no ke ez newesha.
 Hesen believe does that I sick.be-PRES
 ‘Hesen believes that {I am, *Hesen is} sick.’ (Anand 2006:77)

A way to capture this state of affairs is, again, to assume that the monster is only compatible with *say* in these languages.

Also, indexical shifting is generally optional in Amharic and Zazaki, unlike in Uyghur finite complements. The languages that are reported to have indexical shifting are categorized as follows.

- Optional: Amharic, Aghem, Navajo, Nez Perce, Zazaki, Slave with predicates other than *hadi*
- Obligaotry: Uyghur, Matses, Slave with *hadi*

The proposed analysis is flexible enough to capture this variation. That is, in Uyghur finite complements, the monster is required to be present, while in other languages like Amharic and Zazaki, the monster is optionally present in complements to (certain) attitude verbs.

17.4 Accusative Subjects are Structurally High

Having captured the obligatory indexical shifting in Uyghur finite complements, let us tackle the second feature of Uyghur indexical shifting, namely, the relevance of case. The pattern is that accusative subjects never undergo indexical shifting, while nominative subjects always do. I submit that this is because the accusative subject is located structurally above the monster. There are two pieces of evidence suggesting that the accusative subject is at least higher than the nominative subject.

Firstly, accusative subjects trigger Binding Condition effects with the matrix subject unlike nominative subjects.¹⁵⁵ (638) shows that accusative reflexive embedded subjects can be bound by the matrix subject, but not nominative reflexive embedded subjects. These examples contain *peqet ...-la* ‘only ...’ to prevent the embedded subjects from being phonologically null.

(638) *Condition A*

- a. men_i [peqet **öz_i-em-ni-la** nan ye-men] di-dim.
 1SG [only REFL-1SG-**acc**-only bread eat-IMP.F.1SG] say-PAST.1SG
 ‘I said that only I eat bread.’
- b. *?men_i [peqet **öz_i-em-Ø-la** nan ye-men] di-dim.
 1SG [only REFL-1SG-**nom**-only bread eat-IMP.F.1SG] say-PAST.1SG
 ‘I said that only I eat bread.’

¹⁵⁵This suggests that the accusative subject counts as a matrix material with respect to Binding Conditions A and B, but as an embedded material with respect to the *Double Accusative Constraint discussed in (619). I do not have an explanation of why these two constraints refer to different syntactic domains.

Likewise, accusative non-reflexive pronominal embedded subjects trigger a Binding Condition B violation with the matrix subject, unlike their nominative counterparts. For the same reason as above, the embedded subjects are focused in (639).

- (639) *Condition B*
- a. men_i [peqet **men_i-la** nan ye-men] di-dim.
 1SG [only 1SG.NOM-only bread eat-IMP.1SG] say-PAST.1SG
 ‘I said I eat bread.’
- b. * men_i [peqet **men_i-la** nan ye-men] di-dim.
 1SG [only 1SG.ACC-only bread eat-IMP.1SG] say-PAST.1SG
 (Intended) ‘I said I eat bread.’

(640) is a baseline showing that (639b) becomes fine when the matrix subject is not coreferential with the accusative subject, and thus its ungrammaticality is not due to the accusative subject *per se*.

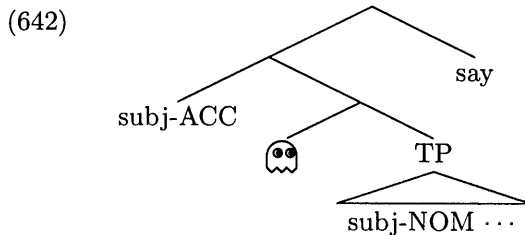
- (640) Ahmet [peqet **meni-la** nan ye-du] di-dim
 Ahmet [only 1SG.ACC-only bread eat-IMP.3] say-PAST.1SG
 ‘Ahmet said only I eat bread’

Secondly, accusative subjects but not nominative subjects can be scrambled in front of the matrix subject, as shown below.

- (641) Yasu [istakan(-ni) buz-ul-di] di-di.
 Yasu [cup(-ACC) break-PASS-PAST.3] say-PAST.3
 ‘Yasu said the cup broke.’
- a. *istakan Yasu [__ buz-ul-di] di-di.
 b. istakan-ni Yasu [__ buz-ul-di] di-di.

This is weaker as evidence than the previous data, as extractability might not be correlated with the structural height.

I take these data to be suggesting that the accusative subject is structurally high, and moreover I take one step further and argue that it is located higher than the monster. Thus clause structure of a finite complement clause looks schematically as follows.

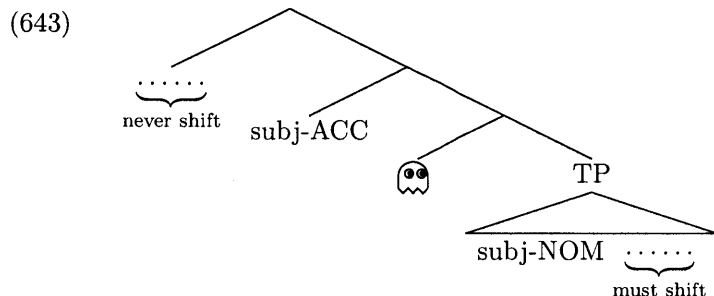


This structural relation makes a number of testable predictions which I examine in the next section.

17.5 Predictions

The accusative subject is assumed to be in a syntactic position that is higher than the monster, but still below the attitude verb. This makes a prediction that if an embedded

indexical appears above the accusative subject at LF, it never shifts, while if it appears below the nominative subject, it must shift. In other words, it is predicted that the embedded subject can be used as the benchmark for the monster’s scope. This situation is illustrated by the following schematic tree diagram.



The predictions can be tested in Uyghur, since it is a scrambling language where indirect and direct objects can move to various places.¹⁵⁶

Moreover, the flip side of this prediction is that when the subject is *pro*-dropped, a dative/object indexical becomes ambiguous between two readings provided that it can undergo string vacuous scrambling.

Furthermore, when a noun phrase contains more than one indexicals in it, there should be only two possible interpretations: either all of them shift or none of them do. Also this should depend on the syntactic position the whole noun phrase appears in. I call this phenomenon *Shift-Together Locally* (cf. *Shift-Together* of Anand & Nevins 2004, Anand 2006).

In the remainder of this section, I show that these predictions are all true.

17.5.1 Prediction 1: Subject as a Benchmark

Firstly, as shown in (644), objects and datives do shift in the canonical SOV order.

- (644) a. CONTEXT: I saw Ahmet tell Aygöl “I like you.” Now I am telling Mettursun what he said.
 Ahmet Aygöl-ge [men **seni** jaxshi kör-ymen] di-di.
 Ahmet Aygöl-DAT [1sg.NOM 2sg.ACC well see-IMPF.1sg] say-PAST.3
 ‘Ahmet told Aygöl that he likes her.’
- b. CONTEXT: Ahmet told me “I sent you a letter the other day.” Now I am telling you what he said.
 Ahmet manga [men **sanga** xet ewet-tim] di-di.
 Ahmet 1sg.DAT [1sg.NOM 2sg.DAT letter send-PAST.1sg] say-PAST.3
 ‘Ahmet told me that he sent a letter to me.’

The second person pronouns here are interpreted as the hearer in the respective reported contexts, i.e. Aygöl in (644a) and the current speaker in (644b). These are shifted readings.

Now it is shown that when preceded by a nominative subject, datives and objects must shift, not just they are allowed to shift, in accordance with our prediction. This

¹⁵⁶ Following Saito’s (1985) analysis of Japanese scrambling, I assume that nominative subject do not scramble. This assumption is crucial here, because otherwise nominative subjects would be wrongly expected to optionally unshift. However, I admit that I do not have conclusive evidence to buttress this assumption at this moment.

is demonstrated by the following examples where the contexts support only the non-shifted readings of the object and dative indexicals respectively. Thus the infelicity of the sentences proves that the non-shifted/actual context interpretation is unavailable.

- (645) a. CONTEXT: Ahmet told me “I like Aygül.” I am telling Aygül what he said.
 #Ahmet [men **seni** jaxshi kör-yemen] di-di.
 Ahmet [1sg.NOM you.ACC well see-IMPF.1sg] say-PAST
 ‘Ahmet said that he likes me.’
- b. CONTEXT: Muhemmet told me “I sent a letter to Aygül.” Now I am talking to Aygül.
 #Muhemmet manga [men **sanga** xet ewet-tim] di-di.
 Muhemmet 1sg.DAT [1sg.NOM 2sg.DAT letter send-PAST.1sg] say-PAST.3
 ‘Muhemmet told me that he sent a letter to me.’

It is also expected that when a dative phrase is scrambled in front of the accusative subject, it can no longer shift. This expectation is borne out as shown in (646). In the context in (646a) which supports the non-shifted interpretation of the dative second person pronoun *sanga*, the sentence is felicitous, suggesting it need not shift. Moreover, in the context in (646b) that supports the shifted interpretation of the same dative, the sentence is infelicitous, indicating that the dative cannot shift in this environment.

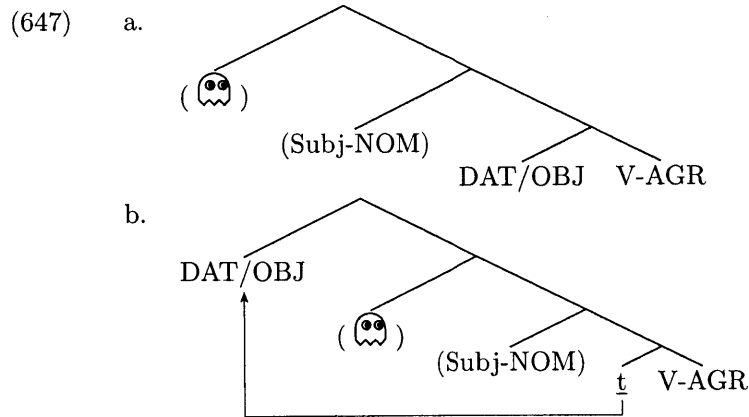
- (646) a. CONTEXT: Ahmet told Muhemmet “Yasu sent a letter to Aygül.” Muhemmet told me what Ahmet said, and I am telling Aygül about this.
 Ahmet [**sanga** meni xet ewet-ti] di-di.
 Ahmet [2sg.DAT 1.ACC letter send-PAST.3] say-PAST.3
 ‘Ahmet said that I sent a letter to you.’
- b. CONTEXT: Ahmet told Aygül “Yasu sent a letter to you.” Aygül in turn told me what Ahmet said. Now I am telling Muhemmet what I heard.
 #Ahmet Aygül-ge [**sanga** meni xet ewet-ti] di-di.
 Ahmet Aygül-DAT [2sg.DAT 1sg.ACC letter send-PAST.3] say-PAST.3
 ‘Ahmet said to Aygül that I sent a letter to Muhemmet.’

The comparable data involving direct objects is impossible to obtain due to the constraint banning two accusative phrases in the same clause mentioned in Section (619).

The above data demonstrate that the subject can be used as a benchmark for the monster’s scope, as predicted by the analysis proposed above. Also the data shows that not only accusative subjects, but also certain other embedded material can appear not shifted in finite clausal complements.

17.5.2 Prediction 2: When Subject is Covert

We just saw that the subject can be used to tell where the monster is, but when the subject is missing, we won’t be able to tell where it is. More concretely, when the subject is *pro*-dropped, there are two possible structures regarding the structural position of the dative/object, as depicted in the following tree diagrams. The items in parentheses are silent.



(647a) is the basic structure where the dative/object is under the monster's scope. (647b) is derived from it by scrambling the dative/object to a position higher than the monster. In (647a), the dative/object receives the shifted interpretation because it is below the monster, while in (647b) it receives the non-shifted interpretation because it is higher than the monster. Thus, it is predicted that when the subject is silent, datives and objects optionally shift. Below, this is shown to be correct with concrete data.

Firstly, when the context supports the non-shifted interpretation, dative and object indexicals are felicitous when the subject is covert, as demonstrated in (648).

- (648) a. CONTEXT: Ahmet told me "I like Aygül." I am telling Aygül what he said.
 Ahmet [**seni** jaxshi kör-ymen] di-di.
 Ahmet [2sg.ACC well see-IMPERF.1sg] say-PAST
 'Ahmet said that he likes you.'

- b. CONTEXT: Muhemmet told me "I sent a letter to Aygül." Now I am talking to Aygül.
 Muhemmet manga [**sanga** xet ewet-tim] di-di.
 Muhemmet 1sg.DAT [2sg.DAT letter send-PAST.1sg] say-PAST.3
 'Muhemmet told me that he sent a letter to you'

Secondly, when the context supports the shifted interpretation of the object and the dative indexicals, the exact same sentences are judged felicitous.

- (649) a. CONTEXT: I saw Ahmet say to Aygül "I like you." I am telling Mettursun what he said.
 Ahmet Aygül-ge [**seni** jaxshi kör-ymen] di-di.
 Ahmet Aygül-DAT [2sg.ACC well see-IMPERF.1sg] say-PAST.3
 'Ahmet said to Aygül that he likes her.'
- b. CONTEXT: Ahmet told me "I sent you a letter the other day." Now I am telling you what he said.
 Ahmet [**seni** jaxshi kör-ymen] di-di.
 Ahmet [2sg.ACC well see-IMPERF.1sg] say-PAST
 'Ahmet said that he likes you.'

17.5.3 Prediction 3: ‘Shift Together Locally’

The last prediction to verify here is *Shift Together Locally*, i.e. indexicals that occur within the same noun phrase must shift together or none of them shift, depending on the position where the entire noun phrase appears. (650) shows that no indexicals contained in an accusative subject can shift. That is, the second person pronoun in the relative clause and the first person possessive indexical in (650) must both be interpreted relative to the current context of utterance.

- (650) Ahmet Aygül-ge [[**sen** yaxshi kör-idi-ghan] oqughuchi-**m**-ni imtihan-din
Ahmet Aygül-DAT [[2sg well see-IMPF-REL] student-1SG-ACC test-from
öt-ti] di-di.
pass-PAST.3] say-PAST.3
‘Ahmet said that the student of mine that you like passed the test.’
*‘Ahmet said that the student of mine that Aygül likes passed the test.’
*‘Ahmet said that the student of his that you like passed the test.’
*‘Ahmet said that the student of his that Aygül likes passed the test.’

Furthermore, (651) shows that all the indexicals contained in a nominative subject must shift simultaneously.

- (651) Ahmet Aygül-ge [[**sen** yaxshi kör-idi-ghan] oqughuchi-**m** imtihan-din öt-ti
Ahmet Aygül-DAT [[1sg well see-IMPF-REL] student-1sg test-ABL pass-PAST.3
] di-di.
] say-PAST.3
*‘Ahmet said that the student of mine you like passed the test.’
*‘Ahmet said that the student of mine that Aygül likes passed the test.’
*‘Ahmet said that the student of his that you like passed the test.’
‘Ahmet said that the student of his that Aygül likes passed the test.’

18 Shifted Indexicals and *De Se* Construal

Having established the clausal architecture of Uyghur finite complement clauses, we are now in a position to delve into the semantics of shifted first and second person pronouns. In the present section, I observe that in Uyghur, shifted first person pronouns are obligatorily *de se*, while shifted second person pronouns do not have to be *de se* (or *de te*), in the sense made clear shortly. In this respect, Uyghur is different from other languages with indexical shifting, most notably Amharic and Zazaki, where both first and second person pronouns are obligatorily *de se* (Anand 2006). I propose that obligatory *de se* interpretation automatically follows from the semantics of attitude predicates, and the optional *de te* in Uyghur indicates that second person pronouns in Uyghur are not true indexicals, but disguised definite descriptions. Further support of this claim is presented in Section 19.

18.1 *De Se* and *De Te* Pronouns

Previous studies pointed out that shifted first and second person pronouns in languages like Amharic and Zazaki are obligatorily interpreted *de se* (Anand 2006, Anand & Nevins 2004, Deal 2011, Schlenker 1999, 2003b).

Under the *de se* reading, a pronoun denotes the individual that the attitude holder identifies as himself (Lewis 1979a). That this is a linguistically relevant semantic category is illustrated by the contrast between overt pronouns and PRO in English. It is widely known that English 3rd person pronouns are ambiguous between *de se* and non-*de se* readings, while PRO in obligatory control constructions is obligatorily *de se* (Chierchia 1989, Anand 2006, Maier 2006, 2009a, Pearson 2012). Consider the sentences in (652).

- (652) CONTEXT: John is so drunk that he has forgotten that he is a candidate in the election. He watches someone on TV and finds that that person is a terrific candidate, who should definitely be elected. Unbeknownst to John, the candidate he is watching on TV is John himself
- a. John_i hopes that **he_i** will be elected.
 b. #John hopes PRO to be elected. (Schlenker 2003b:61)

In the context given here, only the non-*de se* reading of the pronouns in question is felicitous, as John does not think that their referent is he himself. Thus, the infelicity of (652b) indicates that PRO cannot be read non-*de se*, unlike *he* in (652a).

There are similar readings for the hearer/addressee (second person *de se* or *de te*). That is, *de te* pronouns denote the individual that the attitude holder identifies as the person he is talking to. Again, third person pronouns and PRO in object control constructions contrast in whether they allow non-*de te* readings. Here is an example due to Anand (2006).¹⁵⁷

- (653) CONTEXT: John is hosting a party. He hears that a certain waiter named Bill is being a nuisance. John tells the nearest waiter, “Bill has to go.” Unbeknownst to him, he’s talking to Bill
- a. John told Bill_i that **he_i** had to leave.
 b. #John told Bill PRO to leave. (Anand 2006:16)

The logic of the argument is the same as above, and the context here only supports the non-*de te* reading of the pronoun, and the infelicity of (653b) indicates that the *de te* reading is obligatory for PRO.

Schlenker (1999) and Anand (2006) provide data showing that shifted first and second person pronouns in Amharic and Zazaki are obligatorily interpreted *de se*. Below are some examples due to these authors. The logic is the same as the examples above: the context only supports the non-*de se* interpretation, and the infelicity indicates that the sentence is incompatible with it, meaning it only admits the *de se* interpretation.¹⁵⁸

- (654) *Amharic First Person*
 CONTEXT: John, who is a candidate in the election, is so drunk he doesn’t remember who he is. He watches TV and sees a candidate he finds terrific, thinking that this guy must be a hero. This candidate happens to be John himself, though he doesn’t realize it.

¹⁵⁷I have encountered speakers who accept (653b). It seems that this is a locus of inter-speaker variation. On the other hand, the judgments for subject control in (652) seems to be unequivocal. As the semantics of PRO is not the main topic here, I will leave this for future research, but the interesting resonance with shifted first and second person pronouns in Uyghur discussed in Section 18 should be noted.

¹⁵⁸Anand (2006) also shows that shifted temporal and locative indexicals in Zazaki also receive *de se* interpretations.

$$(634) \quad \llbracket \widehat{\text{say}}_{i_k} \rrbracket^{c,g} = \lambda p_{\langle k,t \rangle} . \lambda x_e . \text{for all worlds } w' \text{ compatible with what } x \text{ says in } w_{g(i_k)}, p(\langle x, h_{g(i_k)}, w' \rangle).$$

According to this semantics, a shifted person pronoun simply refers to the denotation of the subject. However, this is compatible with a non-*de se* reading of a shifted first person pronoun, as it does not impose any restriction on how x thinks about the denotation of the shifted person pronoun. As Lewis (1979a) argues, what is needed to capture the *de se* reading is the notion of self-ascription: x self-ascribes what is described in the embedded clause. Lewis achieves this by making the denotation of the embedded clause a property, a function of type $\langle e, \langle s, t \rangle \rangle$. In our system, the same can be achieved, as the denotation of the embedded clause is a generalized version of such a function and properly more complex—a function of type $\langle k, t \rangle$, and k contains two individuals and a possible world. To see this more concretely, let us represent the meaning of *say* as follows.

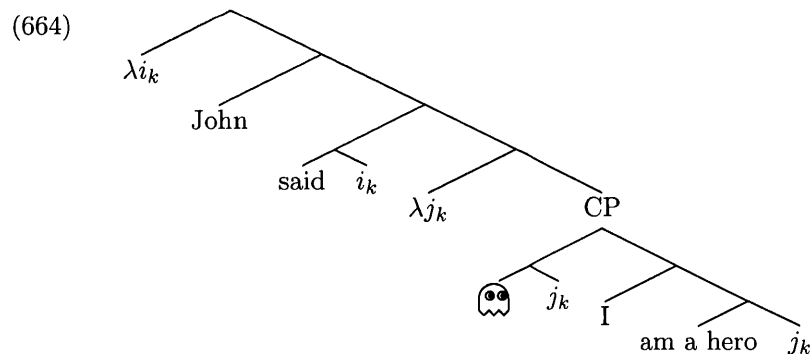
$$(662) \quad \llbracket \widehat{\text{say}}_{i_k} \rrbracket^{c,g} = \lambda p_{\langle k,t \rangle} . \lambda x_e . \text{for all } c' \in \text{SAY}_{x,g(i_k)}, p(c') = 1$$

The core meaning of an attitude verb is the restriction on the quantification, and in the case of *say*, it is $\text{SAY}_{x,g(i_k)}$ which is defined as follows (I will remark on $h_{c'}$ later.)

- (663) $c' \in \text{SAY}_{x,g(i_k)}$ iff
- a. $w_{c'}$ is compatible with what x says in $w_{g(i_k)}$
 - b. $a_{c'}$ is the individual in $w_{c'}$ that x identifies in $w_{g(i_k)}$ as himself

Notice here that the restriction on possible worlds in (663a) is the same as in the standard possible world semantics, but there one additional clause demanding that $a_{c'}$ be the *de se* individual, i.e. the individual that the attitude holder identifies as himself or herself. As a result, a shifted first person pronoun appearing in the scope of *say* denotes the individual that the sayer identifies as himself, which is the *de se* reading.

In order to see more concretely how the *de se* interpretation of a shifted first person pronoun is derived, let us consider the sentence *John said that I am a hero* in a language like Uyghur, whose LF is analyzed as (664).



According to the analysis above, (664) is true with respect to c and g just in case for all $c' \in \text{SAY}_{\text{John},c}$, $\llbracket \text{CP} \rrbracket^{c,g[j_k \mapsto c']} = 1$. Due to the monster, this is the case if and only if for all $c' \in \text{SAY}_{\text{John},c}$, the individual that John identifies as himself in $w_{c'}$ is a hero in $w_{c'}$. What is important here is that the first person pronoun in the embedded clause refers to $a_{c'}$, which is the *de se* individual that John identifies as himself in $w_{c'}$. Thus, the desired

de se interpretation obtains. I assume that this is the mechanism behind the obligatory *de se* interpretation of first person pronouns in Amharic, Zazaki and Uyghur.

18.4 Optional *De Te* and Crosslinguistic Variation

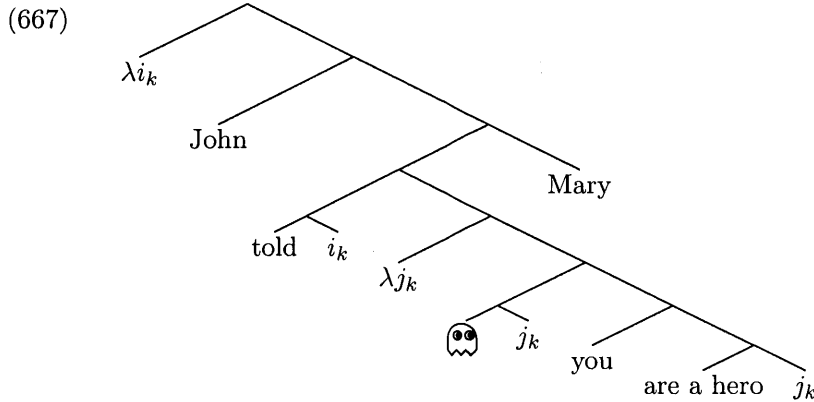
Now let us consider second person pronouns. As we saw above, shifted second person pronouns in Amharic and Zazaki are obligatorily *de te*, while those in Uyghur are only optionally so. I take the obligatory *de te* interpretation to be the norm, and claim that it follows from the meanings of attitude predicates and second person pronouns, just like obligatory *de se* readings of shifted first person pronouns are derived. For instance, I propose the following semantics for *tell*.

$$(665) \quad \left[\left[\widehat{\text{tell}} \ i_k \right] \right]^{c,g} = \lambda p_{\langle k,t \rangle} . \lambda y_e . \lambda x_e . \text{for all } c' \in \text{TELL}_{x,y,g(i_k)}, p(c') = 1$$

Again, the core of the meaning is the domain of quantification, $\text{TELL}_{x,y,g(i_k)}$, which is assumed to be the following set of contexts.

- (666) $c' \in \text{TELL}_{x,y,g(i_k)}$ if and only if
- $w_{c'}$ is compatible with what x told y in w_{i_k}
 - $a_{c'}$ is the individual in $w_{c'}$ who x identifies in $w_{g(i_k)}$ as himself
 - $h_{c'}$ is the individual in $w_{c'}$ who x identifies in $w_{g(i_k)}$ as his addressee

In addition to the *de se* individual in (666b), it also introduces the *de te* individual (666b), which a shifted second person pronoun will pick out. The mechanism is the same as in the case of a shifted first person pronoun we saw above. In order to see this with a concrete example, let us consider the meaning of *John told Mary that you are a hero*. The LF structure of this sentence is assumed to be the following.



According to our semantics, (667) is true with respect to c and g just in case, for all $c' \in \text{TELL}_{\text{John}, \text{Mary}, c}$, $h_{c'}$ is a hero in $w_{c'}$. Here $h_{c'}$ is the individual John identifies as his addressee, and as expected a *de te* interpretation obtains, which is correct for Amharic and Zazaki, as we saw above.

However, in Uyghur a shifted second person pronoun is not obligatorily *de te* unlike in Amharic and Zazaki. On the assumption that the meanings of attitude predicates are invariant across languages, the crosslinguistic difference needs to be located somewhere else. I propose that second person pronouns in Uyghur are disguised definite descriptions that

contain a first person pronoun, and are interpreted as follows.

$$(668) \quad \left[\left[\text{sen} \wedge i_k \right] \right]^{c,g} = \text{the individual that } a_c \text{ is talking to in } w_{g(i_k)}$$

In a non-intensional context, (668) refers to the current addressee, as desired, and furthermore, under the scope of an attitude predicate and the monster, it is predicted to shift, because a_c shifts. More concretely, consider the examples in (667) again. Let us assume that the context pronoun that *sen* takes is i_k , which is a *de re* interpretation. The predicted reading in this case is: for all $c' \in \text{TELL}_{\text{John}, \text{Mary}, c}$, the individual that $a_{c'}$ is talking to in w_c is a hero in $w_{c'}$. This captures the intended shifted interpretation, and it is not obligatorily *de te*.

It is in principle an option that *sen* combines with the context pronoun j_k instead of i_k in the above structure. However in that case, it results in a referential failure, as in this particular example, $a_{c'}$ is not assumed to be talking to anybody in w_{j_k} .¹⁵⁹ I assume that this blocks the *de dicto* reading. However, one can construct an example where the *de dicto* reading would be predicted to be felicitous, e.g. *John told Mary that I talked to you*, but fortunately, the *de dicto* reading here is truth conditionally indistinguishable from the *de re* reading. A potentially more problematic case of *de dicto* reading arises in non-attitude contexts such as *If you are French, I will speak French*. The *de dicto* reading is paraphrased as “In a situation where my addressee is French, I will speak French.” I grant that this is a prediction of my analysis, but I have not been able to verify it at this moment. It should be mentioned in this connection, however, that *de dicto* readings of certain types of definite descriptions are apparently more marked than one might expect (Nunberg 1993, Rothschild 2007, Sauerland 2007), and the judgments might not be as straightforward as would be predicted by the theory.

To summarize, I have proposed a cross-linguistic variation in the semantics of second person pronouns in order to account for the different interpretations of shifted second person pronouns in indexical shifting in Amharic, Zazaki and Uyghur. In Amharic and Zazaki, second person pronouns are real indexicals, directly referring to h_c , and as a consequence, their shifted interpretations are obligatorily *de te*. On other hand, second person pronouns in Uyghur are disguised definite description containing a first person pronoun, and are not obligatorily *de te*. In the next section, I will point out yet another difference between shifted first and second person pronouns in Uyghur indexical shifting that is explained by the analysis proposed here.

19 Indexical Shifting under Many Attitude Predicates

I mentioned in Section 17.3 some facts about variation in languages with indexical shifting. One locus of variation mentioned there is optionality, and largely following Anand & Nevins (2004) and Anand (2006), I suggested to capture this variation by morphosyntactically constraining the distribution of the monster so that it can be absent, optionally present, or obligatorily present in a given construction in a given language. Admittedly, this will put a heavy burden on the part of language acquisition, but given the arbitrariness of the observed variation, this seems to be reasonable.

¹⁵⁹Strictly speaking, this is not ensured for some of such possible worlds, but notice that in order for the reference to succeed, a_c needs to be talking to somebody in *each* of the worlds compatible with what John told Mary in w_c . In a neutral context, which I assume here, therefore, the sentence suffers referential failure.

Another kind of crosslinguistic variation in indexical shifting mentioned there has to do with different attitude predicates. As mentioned in 17.3, indexical shifting in Amharic and Zazaki is limited to complement clauses to the verb *say*.¹⁶⁰ Unlike in these languages, in Uyghur, a multitude of attitude predicates, in fact perhaps all attitude verbs compatible with finite complement clauses, license indexical shifting. This feature of Uyghur allows us to discern the semantics of various attitude predicates and how contexts are interpreted (Section 19.1). I also discuss crosslinguistic variation in the interpretation of second person pronouns under certain verbs by contrasting Uyghur with Slave, another language where the interpretation of second person pronouns under various verbs is documented (Section 19.2). I point out that the analysis of the semantics of second person pronouns proposed in the previous section accounts for the difference here as well. The proposed analysis is further tested with novel data from indexical shifting in Japanese (Section 19.3). Finally, I will critically evaluate a previous analysis that deals with shifting properties of various attitude predicates by Anand (2006) and Anand & Nevins (2004) (Section 19.4)

19.1 Uyghur

I will first show that multiple attitude predicates license indexical shifting in Uyghur, and moreover that some of them do not allow shifted second person pronouns under them, while all of them are fine with shifted first person pronouns. I observe that these two types of attitude predicates constitute semantic natural classes, as summarized in (669).

- (669) a. Predicates of communication involving two individuals where the subject is the speaker/language user in the reported context allow shifting of both first and second person pronouns.
- b. All the other predicates license shifted first person pronouns but not second person pronouns.

Interestingly, the latter class includes predicates of hearing that involve two individuals but the subject is not the speaker.

19.1.1 Predicates of Communication

Predicates of communication whose subject is the speaker and whose oblique argument is the hearer license shifting of both first and second person pronouns. Unsurprisingly, shifted first person pronouns under them refer to the speaker of the reported context, and second person pronouns refer to the hearer of the reported context. For example, as we have repeatedly seen in the first half of the present paper, the verb *de-* ‘tell’ shift both first and second person pronouns.¹⁶¹ Most of the examples below involve a *wh*-phrase taking matrix scope to force the embedded clause to be a non-quotation.

- (670) **de-** (say, tell)
- a. Ahmet [*pro* kim-ni jaxshi kör-imen] di-di?
 Ahmet [*pro* who-ACC well see-IMPERF.1sg] say-PAST.3
 ‘Who did Ahmet say that he likes?’

¹⁶⁰See fn.153 for a complication in Amharic.

¹⁶¹When the dative argument is absent on the surface, it is not clear whether *de-* is an intransitive verb similar to *utter* or a transitive verb similar to *tell*. It is conceivable it is ambiguous between these two meanings. A similar remark applies to *sözle-* ‘speak, talk’.

- b. Ahmet Aygül-ge [*pro* kim-ni jaxshi kör-**isen**] di-di? ‘Who
 Ahmet Aygül-DAT [*pro* who-ACC well see-IMPERF.2sg] say-PAST.3
 did Ahmet told Aygül that she likes?’

Similarly, both persons appear shifted under the following verbs: *sözle-* ‘speak, talk’, *maxtan-* ‘brag’, *qayil qil-* ‘persuade, convince’, *aghrin-* ‘complain’, and *wede qal-* ‘promise’.

(671) **sözle-** (speak, talk)

- a. Ahmet [*pro* kim-ni jaxshi kör-**imen** dep] sözli-di?
 Ahmet [*pro* who-ACC well see-IMPERF.1sg C] speak-PAST.3
 ‘Who did Ahmet say that he likes?’
- b. Ahmet Aygül-ge [*pro* kim-ni jaxshi kör-**isen** dep] sözli-di?
 Ahmet Aygül-DAT [*pro* who-ACC well see-IMPERF.2sg C] speak-PAST.3
 ‘Who did Ahmet told Aygül that she likes?’

(672) **maxtan-** (brag)

- a. Ahmet Aygül-ge [*pro* kim-ni kör-**dim** dep] maxtan-di?
 Ahmet Aygül-DAT [*pro* who-ACC saw C] brag-PAST.3
 ‘Who did Ahmet brag to Aygül that he met?’
- b. Ahmet Aygül-ge [**men sen-din** igiz dep] maxtan-di.
 Ahmet Aygül-DAT [1sg 2sg-from tall C] brag-PAST.3
 ‘Ahmet bragged that he is taller than Aygül.’

(673) **qayil qil-** (persuade, convince)

- a. Ahmet Aygül-ni [*pro* kim-ni kör-**imen** dep] qayil qil-di?
 Ahmet Aygül-ACC [*pro* who-ACC see-IMPERF.1sg C] convince do-PAST.3
 ‘Who did Ahmet convince Aygül that he should meet?’
- b. Ahmet Aygül-ni [*pro* kim-ni kör-**isen** dep] qayil qil-di?
 Ahmet Aygül-ACC [*pro* who-ACC see-IMPERF.2sg C] convince do-PAST.3
 ‘Who did Ahmet convince Aygül that she should meet?’

(674) **aghrin-** (complain)

- a. Ahmet Aygül-ge [*pro* kim-ni kör-**dim** dep] aghrin-di?
 Ahmet Aygül-DAT [*pro* who-ACC see-PAST.1sg C] complain-PAST.3
 ‘Who did Ahmet complain to Aygül that he met?’
- b. Ahmet Aygül-ge [*pro* kim-ni kör-**ding** dep] aghrin-di?
 Ahmet Aygül-DAT [*pro* who-ACC see-PAST.2sg C] complain-PAST.3
 ‘Who did Ahmet complain to Aygül that she met?’

(675) **wede qal-** (promise)

- a. Ahmet Aygül-ge [*pro* kim-ni söy-**imen** dep] wede qil-di?
 Ahmet Aygül-DAT [*pro* who-ACC kiss-IMPERF.1sg C] promise do-PAST.3
 ‘Who did Ahmet promise Aygül to kiss?’
- b. Ahmet Aygül-ge [*pro* qaysi imtahan-din öt-**isen** dep] wede
 Ahmet Aygül-DAT [*pro* which test-from pass-IMPERF.2sg C] promise
 qil-di?
 do-PAST.3
 ‘Which test did Ahmet promise Aygül that she would pass?’

19.1.2 Predicates of Thinking

Secondly, predicates that express an agent's mental state shift only first person pronouns, and second person pronouns under them give rise to infelicity, as shown by the following data with the verbs *bil-* 'believe, know', *oyla-* 'think', *ansir-* 'worry', *ümid qil-* 'hope' and *xejal qil-* 'dream'.

- (676) **bil-** (believe, know)
- a. Ahmet [*pro* kim-ni jaxshi kör-**imen** dep] bil-du?
 Ahmet [*pro* who-ACC well see-IMPERF.1sg C] believe-IMPERF.3
 'Who does Ahmet believe that he likes?'
- b. *Ahmet [*pro* kim-ni jaxshi kör-**isen** dep] bil-du?
 Ahmet [*pro* who-ACC well see-IMPERF.2sg C] believe-IMPERF.3
- (677) **oyla-** (think)
- a. Ahmet [*pro* kim-ni jaxshi kör-**imen** dep] oyla-du?
 Ahmet [*pro* who-ACC well see-IMPERF.1sg C] think-IMPERF.3
 'Who does Ahmet think he likes?'
- b. *Ahmet [*pro* kim-ni jaxshi kör-**isen** dep] oyla-du?
 Ahmet [*pro* who-ACC well see-IMPERF.2sg C] think-IMPERF.3
- (678) **ansir-** (worry)
- a. Ahmet [*pro* qaysi imitihan-din ötül-ma-**imen** dep] ansir-di?
 Ahmet [*pro* which test-from pass-NEG-IMPERF.1sg C] worry-PAST.3
 'Which test does Ahmet worry that he didn't pass?'
- b. *Ahmet [*pro* qaysi imitihan-din ötül-ma-**isen** dep] ansir-di?
 Ahmet [*pro* which test-from pass-NEG-IMPERF.2sg C] worry-PAST.3
- (679) **ümid qil-** (hope)
- a. Ahmet [*pro* kim-ni kör-**imen** dep] ümid qil-du?
 Ahmet [*pro* who-ACC see-IMPERF.1sg C] hope do-IMPERF.3
 'Who does Ahmet want to meet?'
- b. *Ahmet [*pro* kim-ni kör-**isen** dep] ümid qil-du?
 Ahmet [*pro* who-ACC see-IMPERF.2sg C] hope do-IMPERF.3
- (680) **xejal qil-** (dream)
- a. Ahmet [*pro* qaysi imtihan-din öt-**tim** dep] xejal qil-di?
 Ahmet [*pro* which test-from pass-PAST.1sg C] dream do-PAST.3
 'Which test did Ahmet dream about passing?'
- b. *Ahmet [*pro* qaysi imtihan-din öt-**ting** dep] xejal qil-di?
 Ahmet [*pro* which test-from pass-PAST.2sg C] dream do-PAST.3

It should be emphasized here that the second person pronouns in the (b) examples above are completely infelicitous/ungrammatical, and there is no felicitous interpretation where they are construed as the current hearer or somebody else. This point will be critical in the following discussion.

19.1.3 Predicates of Hearing

Quite interestingly, predicates that express acquisition of information via linguistic means also shift only first person pronouns, and shifted second person pronouns under them result in anomaly. This is illustrated with *angla-* ‘hear’ and *oqu-* ‘read’ below.

- (681) **angla-** (hear)
- a. Ahmet Aygül-din [*pro* qaysi imtihan-din öt-**tim** dep] angla-di?
 Ahmet Aygül-from [*pro* which test-from pass-PAST.1sg C] hear-PAST.3
 ‘Which test did Ahmet hear from Aygül that he passed?’
- b. *Ahmet Aygül-din [*pro* qaysi imtihan-din öt-**ting** dep] angla-di?
 Ahmet Aygül-from [*pro* which test-from pass-PAST.2sg C] hear-PAST.3
- (682) **oqu-** (read)
- a. Ahmet [*pro* qaysi imtihan-din öt-**tim** dep] oqu-di?
 Ahmet [*pro* which test-from pass-PAST.1sg C] read-PAST.3
 ‘Which test did Ahmet read that he passed?’
- b. *Ahmet [*pro* qaysi imtihan-din öt-**ting** dep] oqu-di?
 Ahmet [*pro* which test-from pass-PAST.2sg C] read-PAST.3

The data of *angla-* ‘hear’ in (681) is especially interesting in that the first person pronoun in (681a) still refers to the matrix subject, Ahmet, despite the fact that he is the hearer, rather than the speaker, of the reported context. Moreover, neither a first nor second person pronoun may refer to the the oblique argument, which is the speaker in the reported context.

19.1.4 Discussion: Ontology of Contexts and the Semantics of Attitude Predicates

The data above sheds light on the ontology of contexts in the linguistically relevant sense. First person pronouns are standardly taken to refer to the speaker of a given context, but this construal is evidently inadequate for shifted first person pronouns under predicates of thinking and predicates of hearing. Rather, the referent of a shifted first person pronoun in such a case is better characterized as the person whose mental state is reported, rather than the person who is speaking. The case of *hear* is rather striking in this respect, since the reported context includes a person who is speaking, but a first person pronoun cannot refer to him/her, and refers to the hearer, who is the attitude holder.

Generally, it is more appropriate to construe the denotation of a first person pronoun in a context *c* to be the *de se* individual in *c*, and to achieve this, I propose to reconceptualize what ‘contexts’ are. In Section 14, I introduced possible contexts *c* as consisting of two individuals, *a_c* and *h_c*, and a possible world *w_c*, and noted in passing that *c* models a conversational context where *a_c* is talking to *h_c* in *w_c*. However, this interpretation is no longer tenable in light of the discussion above. Instead, I assume that any triple consisting of two individuals and a possible world is a possible ‘context’. However, in practice, we only see a very specific subset of such triples. In particular the standard interpretation is appropriate for non-shifted contexts in general. I suggest that there are two factors relevant here that regulate the behavior of contexts: (i) a principle regarding how sentences are interpreted in a given context of utterance, and (ii) the semantics of attitude predicates. I assume that the former looks like (683), which replaces the earlier rule (597).

- (683) Sentence φ is true with respect to speaker x , assignment function g and possible world w if and only if $\llbracket \varphi \rrbracket^{c,g}(c)$ where $c = \langle a_c, h_c, w_c \rangle$ such that,
- a. x identifies a_c as himself in w
 - b. x identifies h_c as his addressee in w
 - c. $w = w_c$

According to this rule, non-shifted first person pronouns denote the speaker x himself, and non-shifted second person pronouns denote the *de te* individual in the current world, i.e. the hearer of the current context of utterance.

In an indexical shifting environment, the context is shifted to ones introduced by the attitude predicate with the aid of the monster. Such contexts are systematically created from the topmost context and the meanings of the attitude predicates and their arguments. For instance, the semantics of *tell*, repeated here from above, imposes what each coordinate of c' means, given the topmost context denoted by i_k :

$$(665) \quad \llbracket \widehat{\text{tell}}_{i_k} \rrbracket^{c,g} = \lambda p_{\langle k,t \rangle} . \lambda y_e . \lambda x_e . \text{ for all } c' \in \text{TELL}_{x,y,g(i_k)}, p(c') = 1$$

- (666) $c' \in \text{TELL}_{x,y,g(i_k)}$ if and only if
- a. $w_{c'}$ is compatible with what x told y in w_{i_k}
 - b. $a_{c'}$ is the individual in $w_{c'}$ who x identifies in $w_{g(i_k)}$ as himself
 - c. $h_{c'}$ is the individual in $w_{c'}$ who x identifies in $w_{g(i_k)}$ as his addressee

As explained above, this semantics forces shifted first person pronouns to be always *de se*, and shifted second person pronouns to be *de te* (in languages like Amharic and Zazaki). Similar semantics can be given to other predicates of communication, by simply tweaking the world coordinate (683a).

Now, we are in an appropriate position to ask what semantics we should give to attitude predicates other than predicates of communication. Notice in particular with predicates such as *think* and *want*, it does not make sense to talk about a *de te* individual, as the attitude holder is not talking to anybody in the events described by these predicates to begin with. I propose that for such predicates, the second coordinate of the context is inherited from i_k . Here is the case of *think*.

$$(684) \quad \llbracket \widehat{\text{think}}_{i_k} \rrbracket^{c,g} = \lambda p_{\langle k,t \rangle} . \lambda x_e . \text{ for all } c' \in \text{DOX}_{x,g(i_k)}, p(c') = 1$$

- (685) $c' \in \text{DOX}_{x,g(i_k)}$ iff
- a. $w_{c'}$ is compatible with what x thinks in $w_{g(i_k)}$
 - b. $a_{c'}$ is the individual in $w_{c'}$ that x identifies in $w_{g(i_k)}$ as himself
 - c. $h_{c'} = h_{g(i_k)}$

The Uyghur data above does not motivate this analysis, since it lacks ‘indexical second person pronouns’ that refer to $h_{c'}$. In fact, the anomaly of shifted second person pronouns under predicates of thinking and of hearing follows straightforwardly from the hypothesis that Uyghur second person pronouns are definite descriptions. That is, in such shifted environments, their denotation is the person that the attitude holder x is talking to, but such an individual does not exist as x is not talking to anybody when x is thinking or hearing.

On the other hand, the semantics in (685) makes some predictions for languages with second person pronouns that directly refer to h_c when interpreted relative to c . In the next

subsection, I claim that it makes correct predictions for the interpretation of second person pronouns under verbs of thinking in Slave.

19.2 Slave

Based on previous work by Rice (1986), Anand & Nevins (2004) and Anand (2006) observe that indexical shifting is licensed under several attitude predicates in Slave, just as in Uyghur. As we will see now, essentially the same semantic generalization in (669) that we saw with Uyghur holds among the four Slave predicates they discuss. That is, predicates of communication shift both first and second person pronouns, while the rest only shift first person pronouns. However there is one crucial difference between Uyghur and Slave: second person pronouns under the latter kind of predicates are licit and receive non-shifted interpretations.

19.2.1 The Data

Let us look at concrete examples. The verb *édedi* ‘tell, ask’ shift both first and second person pronouns, while *hadi* ‘say (intransitive)’, *yenjwę* ‘want, think’, and *hudeli* ‘want, think’ shift only first person pronouns. Below are examples from Anand (2006:78), which are originally due to Rice (1986).

- (686) **édedi** (tell, ask) shifts both first and second
 [*segha ráwqđí*] *sédjidi yjlé.*
 [1sg-for 2sg-will-buy] 2sg-tell-1sg PAST
 ‘You told me to buy it for you.’
- (687) **yenjwę** (want, think) shifts only first
 a. *sú* [*leshuyie k’eguhw’e*] *yerinewe?*
 Q [spoon 1sg-will-lick] 2sg-want
 ‘Do you want to lick the spoon?’
 b. *denexare* [*wqję*] *yenjwe.*
 sister [2sg-will-sing] 3sg-want
 ‘Sister wants you to sing.’
- (688) **hudeli** (want, think) shifts only first person
 John [*beya ráwozíe*] *hudeli.*
 John [1sg-son 3sg-will-hunt] 3sg-want-4sg
 ‘John wants his son to go hunting.’
 ‘John wants my son to go hunting.’
- (689) **hadi** (say, intransitive) shifts only first person
 Simon [*rásereyineht’u*] *hadi.*
 Simon [2sg-hit-1sg] 3sg-say
 ‘Simon said that you hit {him, *me}.’

19.2.2 The Difference between Uyghur and Slave

The crucial difference between Uyghur and Slave is that second person pronouns under predicates like *think*, *want* and intransitive *say* are not ungrammatical in Slave. The relevant Slave example is repeated here, where the attitude predicate is intransitive *say*.

- (689) Simon [rásereyineht'u] hadi.
 Simon [2sg-hit-1sg] 3sg-say
 'Simon said that you hit {him, *me}.'

Here the second person feature stays not shifted and refers to the current hearer, while the first person feature is shifted. Recall that analogous cases in Uyghur are all ungrammatical.

I claim that this difference between Uyghur and Slave is due to the different semantics of second person pronouns in those languages. I proposed in the previous section that Uyghur second person pronouns are definite descriptions and denote the individual that the referent of a first person pronouns is talking to in the given index. I claimed that this accounts for the optional *de te* reading, and also we saw above that it correctly predicts the infelicity as a reference failure when second person pronouns are embedded under predicates like *think* and *want*. On the other hand, shifted second person pronouns in Amharic and Zazaki are obligatorily *de te*, and I claimed that this is because they refer to h_c , unlike in Uyghur. The difference between second person pronouns in these languages are summarized in (690).

- (690) a. *Uyghur Second Person*
 $\left[\left[\widehat{\text{sen } i_k} \right]^{c,g} \right] = \text{the individual that } a_c \text{ is talking to in } w_{g(i_k)}$
 b. *Amharic/Zazaki-type Second Person*
 $\left[\left[\widehat{\text{you } i_k} \right]^{c,g} \right] = h_c$

I claim that Slave second person pronouns have the semantics in (690b), as in Amharic and Zazaki. Admittedly there is no direct evidence suggesting that shifted second person pronouns in Slave are obligatory *de te*, but there is no evidence to the contrary either, and I claim that this semantics together with the analysis of attitude predicates put forward above accounts for the data.

In Uyghur, as explained above, second person pronouns under predicates like *think* and *want* give rise to infelicity, because their referent does not exist in these cases. On the other hand, in Slave, second person pronouns still refer to the current hearer in the same environment. I submit that attitude predicates like *think* and *want* simply inherit the second individual coordinate from the context pronoun. Recall our semantics for *think* from above:

$$(684) \quad \left[\left[\widehat{\text{think } i_k} \right]^{c,g} \right] = \lambda p_{\langle k,t \rangle} \cdot \lambda x_e. \text{ for all } c' \in \text{DOX}_{x,g(i_k)}, p(c') = 1$$

- (685) $c' \in \text{DOX}_{x,g(i_k)}$ iff
 a. $w_{c'}$ is compatible with what x thinks in $w_{g(i_k)}$
 b. $a_{c'}$ is the individual in $w_{c'}$ that x identifies in $w_{g(i_k)}$ as himself
 c. $h_{c'} = h_{g(i_k)}$

The second person coordinate of c' is simply identified with that of $g(i_k)$. As a consequence, a shifted second person in Slave just refers to $h_{g(i_k)}$, which in this case is the hearer of the current context of utterance.

The rule of thumb seems to be that those coordinates that are irrelevant to the meaning of the modal remain unchanged. If this is on the right track, we can generalize this one step further to non-attitude modals such as *must*. In this case, both a_c and h_c are inherited from the context pronoun i_k .

$$(691) \quad \left[\left[\widehat{\text{must } i_k} \right]^{c,g} \right] = \lambda p_{\langle k,t \rangle} \cdot \forall c' \in \text{DEON}_{g(i_k)} p(c') = 1$$

- (692) $c' \in \text{DEON}_{g(i_k)}$ iff
- a. $w_{c'}$ satisfies the relevant rules in $w_{g(i_k)}$;
 - b. $a_{c'} = a_{g(i_k)}$;
 - c. $h_j = c'_{g(i_k)}$

Recall that indexical shifting reported so far is strictly confined to attitude constructions. Under the present account, this follows as a necessary consequence of the lexical semantics of modals. That is, only attitude modals shift the individual coordinates of the context by their semantic properties, and even if there is a monster under a non-attitude modal, its effects are impossible to detect.¹⁶²

To summarize, the analysis crosslinguistic variation among indexical shifting languages proposed here has two essential components: (i) the semantics of attitude predicates (and other modals) that quantify over contexts, and (ii) the semantics of second person pronouns. The former is universal and invariant across languages, but the latter is different in different languages. In particular, we make the following prediction: If a shifted second person pronoun is not obligatorily *de te* in a given language, it is prohibited from appearing under attitude predicates like *think* and *want*. The data from Slave presented above suggests this generalization, but it is not conclusive enough in that it is unclear whether shifted second person pronouns are obligatorily *de te* in this language. To buttress this hypothesis further, I will now discuss yet another language with indexical shifting, Japanese.

19.3 Japanese

19.3.1 Basic Observations

In this section, we will look at yet another language which I claim has indexical shifting. I will show that Japanese behaves like Uyghur and Slave in that many attitude predicates license indexical shifting, and furthermore that shifted second person pronouns are obligatorily *de te*, and they can occur under predicates like *think* and *want*, referring to the current hearer, as predicted by the present analysis.

It has been repeatedly observed in the literature that first and second person pronouns in attitude constructions in Japanese can optionally receive shifted interpretations (Coulmas 1985, Kuno 1988, Oshima 2006, Maier 2008). One such case is given in (693).

- (693) Mary-wa [John-ga watashi-o sukida to] itta.
 Mary-TOP [John-NOM me-ACC like C] said
 ‘Mary said that John likes {me, her}.’

In this example, the first person pronoun is ambiguous between the current speaker, which is the non-shifted interpretation, and the attitude holder Mary, which is the shifted interpretation. Although this particular example is in principle amenable to a direct quotation analysis, one can substitute a *wh*-phrase that takes a matrix scope for an embedded item as in (694).

¹⁶²Yet, the distribution of the monster operator needs to be constrained independently in morphosyntax, given the discussion in Section 17.3. For example, it is necessary to assume that the monster is somehow not licensed in nominalized complements in Uyghur. Thus, it might be that the monster is also prohibited in non-attitude contexts in general.

- (694) Mary-wa [dare-ga watashi-o sukida to] itta no?
 Mary-TOP [who-NOM me-ACC like C] said Q
 ‘Who did Mary say likes {me, her}?’

This example is still ambiguous between the shifted and non-shifted interpretations of the embedded first person pronoun *watashi*. Other long distance phenomena such as long distance licensed NPIs and *de re* phrases can also co-occur with shifted first person pronouns as shown in (695).

- (695) a. Mary-wa [daremo watashi-o sukida to] iw-anakat-ta.
 Mary-TOP [nobody me-ACC like C] say-NEG-PAST
 ‘Mary didn’t say that anyone likes {me, her}.’
 b. 20-nen-mae John-wa [ima-no daitooryoo-ga watashi-to shinyuu-da to
 20-year-ago John-TOP [now-GEN president-NOM me-with best.friend-is C
] itta.
] said
 ‘John said 20 years ago that the current president is best friends with {me, him}.’

Since the ambiguity persists, these data suggest that indexical shifting is taking place in these examples.

However, based on similar observations, Kuno (1988) and Maier (2008) among others proposed analyses without indexical shifting. According to them, shifted interpretations of first and second person pronouns in Japanese are due to partial quotations (cf. mixed quotations; cf. Geurts & Maier 2005). The idea is that the long distance phenomena in the above examples exclude the possibility that the entire embedded sentence is quoted, but is still compatible with an analysis that the first person pronoun is quoted to the exclusion of the rest of the embedded clause.

In fact, such a partial quotation containing an indexical item is known to be possible in English as well, as demonstrated by (696), taken from Cappelen & Lepore (1997:429), where *us* occurring in a partial quotation indicated by the quotation marks receives a shifted interpretation where the referent is Mr. Greenspan and R. B. Reich (see also Cumming 2005, Geurts & Maier 2005, Recanati 2000).

- (696) Mr. Greenspan said he agreed with Labor Secretary R. B. Reich ‘on quite a lot of things’. Their accord on this issue, he said, has proved ‘quite a surprise to both of us.’

Thus, the idea of the partial quotation account of shifted indexicals in Japanese is that such partial quotations containing first and second person pronouns are rampant in Japanese, creating an impression of indexical shifting. I will show, however, the partial quotation account fails to capture a morphological restriction on shifted indexicals in Japanese, which can be explained under an indexical shifting account.

19.3.2 Restrictions

There are restrictions on shifted interpretations of first and second person pronouns in attitude constructions in Japanese. In the following examples I use one of the anti-quotations tests above to eliminate the possibility of direct quotation readings.

Firstly, shifted interpretations of first and second person pronouns are unavailable in embedded questions.

- (697) a. Mary-wa [dare-ga watashi-o sukida to] itta no?
 Mary-TOP [who-NOM me-ACC like C] said Q?
 ‘Who did Mary say likes {me, her}?’
 b. Mary-wa [dare-ga watashi-o suki ka] kiita no?
 Mary-TOP [who-NOM me-ACC like Q] ask Q?
 ‘Who is the person that Mary ask whether they like me?’
 c. Mary-wa [dare-ga watashi-o suki ka] shitteiru no?
 Mary-TOP [who-NOM me-ACC like Q] know Q?
 ‘Who is the person that Mary knows whether they like me?’

Secondly, just as in Uyghur, Japanese has nominalized and finite embedded clauses, and shifted interpretations are only available in the latter. Again just as in Uyghur, certain attitude verbs, such as *kiduk-* ‘realize’, are compatible with both types of embedded clauses, and one can construct a minimal pair.

- (698) a. Mary-wa [dare-ga watashi-o sukida to] kidui-ta no?
 Mary-TOP [who-NOM me-ACC like C] realize-PAST Q
 ‘Who did Mary realize likes {me, her}?’
 b. Mary-wa [dare-ga watashi-o sukina koto]-ni kidui-ta no?
 Mary-TOP [who-NOM me-ACC like fact]-DAT realize-PAST Q
 ‘Who did Mary realize likes {me, *her}?’

Thirdly, clauses led by the complementizer *yooni*, which typically combine with non-realis attitude predicates such as bouletic predicates and predicates of commands, do not license shifted interpretations of first pronouns in them.

- (699) a. Mary-wa [dare-ga watashi-to kekkonsuru yooni] negatteiru no?
 Mary-TOP [who-NOM me-with marry C] hope Q
 ‘Who does Mary hope will marry {me, *her}?’
 b. Mary-wa John-ni [itsu watashi-ni au yooni] tanonda no?
 Mary-TOP John-DAT [when me-DAT meet C] asked Q
 ‘When did Mary ask John to meet {me, *her}?’

Fourthly, other attitude constructions that do not involve embedding under an attitude predicate do not license indexical shifting, e.g. a construction that makes use of a PP that corresponds to English *according to*.

- (700) Mary-niyoruto, dare-ga watashi-o sukina no?
 Mary-according.to, who-NOM I-ACC like Q
 ‘According to Mary, who likes me?’

Again, the first person pronoun cannot shift to Mary in this example.

Simply put, the generalization we can draw from the observations above is that shifted interpretations are only available in clauses whose complementizer is *to*. This restriction is unexpected under the partial quotation account, since partial quotations are fairly ubiquitous across constructions, and should not be constrained by morphological factors like this

restriction.

19.3.3 Indexical Shifting Account

I claim that Japanese is also a language that licenses indexical shifting, just as Uyghur and Amharic. As we have seen above, indexical shifting is confined to finite clauses where the complementizer is *to*. I assume that the monster operator is only licensed in this type of clause. This is quite similar to the situation in Uyghur. However, unlike in Uyghur but like Amharic and Zazaki, indexical shifting is optional in Japanese. Notice that because of the optionality, it is not possible to analyze *to* as the morphological realization of the monster: *to* is a necessary but not a sufficient condition for indexical shifting.

Just as in Uyghur and Slave, Japanese is a language where many attitude predicates license indexical shifting, and it can be used as a testing ground for our prediction: if a shifted second person pronoun is obligatorily *de te*, then it should be fine under predicates like *think*. I will show below that this prediction is borne out in Japanese.

19.3.4 Obligatory *De te* and Second Person Pronouns under *Think*

It is first shown that shifted second person pronouns are obligatorily *de te*. (701) shows that a second person pronoun shifts under *tell*. (701a) is a long distance wh-question and hence the embedded clause cannot be a direct quotation.

- (701) CONTEXT: Yesterday, John told Mary, "I will see you tomorrow at 3 pm."
a. John-wa Mary-ni [anata-ni itsu au to] itta no?
John-TOP Mary-DAT [you-DAT when meet C] said C
'When did John tell Mary that he will see {#you, her}?'
b. John-wa Mary-ni [anata-ni san-ji-ni au to] itta.
John-TOP Mary-DAT [you-DAT 3-o'clock-at meet C] said
'John told Mary that he will see {#you, her} at three o'clock.'

This question can be felicitously answered by *3pm*. If the context only supports a non-*de te* interpretation, the question becomes infelicitous, as shown in (702a). As shown in (702b), the declarative sentence is also anomalous.

- (702) CONTEXT: John is a prospective student, visiting our department. He is supposed to meet with one of our graduate students Mary at 3 pm, but he does not know her face. One graduate student came to him and asked about his schedule today, and he said, "I will see this student Mary at 3 pm." That student happened to be Mary.
a. #John-wa Mary-ni [anata-ni itsu au to] itta no?
John-TOP Mary-DAT [you-DAT when meet C] said C
'When did John tell Mary that he will see {you, her}?'
b. #John-wa Mary-ni [anata-ni san-ji-ni au to] itta.
John-TOP Mary-DAT [you-DAT 3-o'clock-at meet C] said
'John told Mary that he will see {you, her} at three o'clock.'

This indicates that shifted second person pronouns in Japanese are obligatorily *de te*.

Now let us check what happens under predicates of thinking. Firstly, first person pronouns can shift under *consider*, as demonstrated in (703).

- (703) Mary-wa [dare-ga watashi-o sukida to] kangaeteiru no?
 Mary-TOP [who-NOM me-ACC like C] consider Q
 ‘Who does Mary consider likes {me, her}?’

On the other hand, a second person pronoun cannot receive a shifted interpretation. Thus, (704) is unambiguous.

- (704) Mary-wa [dare-ga anata-o sukida to] kangaeteiru no?
 Mary-TOP [who-NOM you-ACC like C] consider Q
 ‘Who does Mary consider likes you?’

Now, (705) demonstrates that a shifted first person pronoun can co-occur with a non-shifted second person pronoun under *consider*.

- (705) Mary-wa [dare-ga watashi-ni anata-o shookaishita to] kangaeteiru no
 Mary-TOP [who-NOM me-DAT you-ACC introduced C] consider Q
 ‘Who does Mary consider introduced you to {me, her}?’

To summarize, in Japanese, a shifted second person pronoun is obligatorily *de te*, and can appear under predicates of thinking like *consider* and co-occur with a shifted first person pronoun. This state of affairs is expected under the proposed put forward here. That is, *consider* inherits the second person coordinate of the context index, and an Amharic-Zazaki-type second person pronoun refers to it, unlike in Uyghur.

19.4 A Previous Account

Anand & Nevins (2004) and Anand (2006) discuss indexical shifting under many attitude verbs, and propose an account that deploys several kinds of context shifting operators, in order to account for different shifting properties of different attitude predicates in Slave. Their inventory of monsters is the following. Notice that they assume an ontology of contexts that is more complex than I have been assuming so far. For them, contexts are n -tuples consisting of various parameters, such as the location l_c , the time t_c , etc., in addition to a_c , h_c and w_c .

- (706) a. OP_V : Monster that shifts all aspects of context

$$\left[\left[\begin{array}{c} \diagup \quad \diagdown \\ OP_V \quad \varphi \\ \diagdown \quad \diagup \\ i_k \end{array} \right]^{c,g} \right] = \llbracket \varphi \rrbracket^{g(i_k),g}$$
- b. OP_{per} : Monster that shifts both first and second persons

$$\left[\left[\begin{array}{c} \diagup \quad \diagdown \\ OP_{per} \quad \varphi \\ \diagdown \quad \diagup \\ i_k \end{array} \right]^{c,g} \right] = \llbracket \varphi \rrbracket^{\langle a_{g(i_k)}, h_{g(i_k)}, l_c, t_c, w_c, \dots \rangle, g}$$
- c. OP_{auth} : Monster shifts only first person

$$\left[\left[\begin{array}{c} \diagup \quad \diagdown \\ OP_{auth} \quad \varphi \\ \diagdown \quad \diagup \\ i_k \end{array} \right]^{c,g} \right] = \llbracket \varphi \rrbracket^{\langle a_{g(i_k)}, h_c, l_c, t_c, w_c, \dots \rangle, g}$$

As our main interest here is first and second person pronouns, the two operators in (706a) and (706b) make no difference. According to this account, certain attitude predicates select for (706c), in which case second person indexicals cannot shift as this monster only copies the first coordinate of the second index and all the other coordinates stay the same.

They do not specify what is relevant for the difference in the selection properties of different attitude predicates, but it should not be completely free, as suggested by the semantic naturalness of the present phenomenon alluded to in (669). That is, predicates of communication shift both first and second person pronouns, and all the other attitude predicates shift only first person pronouns. In fact, Anand (2006:110) shares this insight and remarks as follows.

“[I]t seems rather natural that ‘tell’ would shift second person while ‘want’ would not; indeed, what would such a shift mean, given that it is unclear how the ADDR coordinate would even be filled in such cases. My hope is to reduce this arbitrariness to principles of lexical semantics in the future.”

The conceptual weakness of their account is the following. It is in principle possible that a predicate of thinking takes (706b) rather than (706c) in which case both first and second person pronouns would shift under it. Also, there is no principled reason why a predicate of communication cannot take the monster (706c), in which case a second person pronoun would fail to shift under it. However, as we saw above, such shifting patterns are not observed in the three languages we examined above. Rather, the shifting property of a given attitude predicate seems to be crosslinguistically stable, and determined by its meaning.

The account put forward in this dissertation, on the other hand, postulates only one kind of monster, and attributes the shifting properties of different attitude predicates to their semantics. Predicates of communication quantify over contexts that involve both *de se* and *de te* individuals, and as a consequence, both first and second person pronouns shift under them. On the other hand, other predicates do not overwrite the second individual coordinate h_c , and inherit it from the context pronoun. Consequently, only first person pronouns shift under these predicates.

20 Summary and Further Issues

Let us summarize the main claims of this part. I have argued, following Anand & Nevins (2004) and Anand (2006), that indexical shifting is achieved by the interplay between the monster and an attitude predicate. The crosslinguistic variation regarding the availability and optionality of indexical shifting is attributed to the morphosyntactic property of the monster: When and only when it appears under an attitude predicate, indexical shifting takes place. I also claimed that whether a given attitude predicate shifts second person pronouns is determined by its meaning. More specifically, predicates of communication whose subject is a language user and whose other argument is a hearer, e.g. *tell*, shift both first and second person pronouns, while other predicates, e.g. *think* and *hear*, generally only shift first person pronouns. Based on the observation, I have also claimed that the denotations of first and second person pronouns should be understood as *de se* and *de te* individuals, rather than the speaker and the hearer of a given context.

20.1 Reformulation with Complex Indices

In Part II of the present dissertation, I proposed a novel semantics for first and second person pronouns where they are interpreted as variables that get values with respect to the assignment function g , just like third person pronouns. The central idea is that person features are part of the indices. In this setting, a context need not be represented as a separate parameter (although context pronouns in object language are kept). Pronouns of

all persons bear indices and interpreted via g in the following manner (I omit the context pronoun argument, as it is vacuous).

- (707) a. $\llbracket \text{me}_{i[\textcircled{1}]} \rrbracket^g = g(i[\textcircled{1}])$
 b. $\llbracket \text{you}_{i[\textcircled{2}]} \rrbracket^g = g(i[\textcircled{2}])$
 c. $\llbracket \text{him}_{i[\textcircled{3}]} \rrbracket^g = g(i[\textcircled{3}])$

The interpretive effects of person features are captured via the admissibility condition for assignment functions, which is assumed to apply to an utterance.

- (708) Assignment function g is admissible with respect to speaker x and possible world w only if
- $g(i[\textcircled{1}])$ contains the individual a_c that x identifies as himself in w ;
 - $g(i[\textcircled{2}])$ contains the individual h_c that x identifies as his addressee in w , but does not contain a_c ;
 - $g(i[\textcircled{3}])$ contains neither a_c nor h_c .

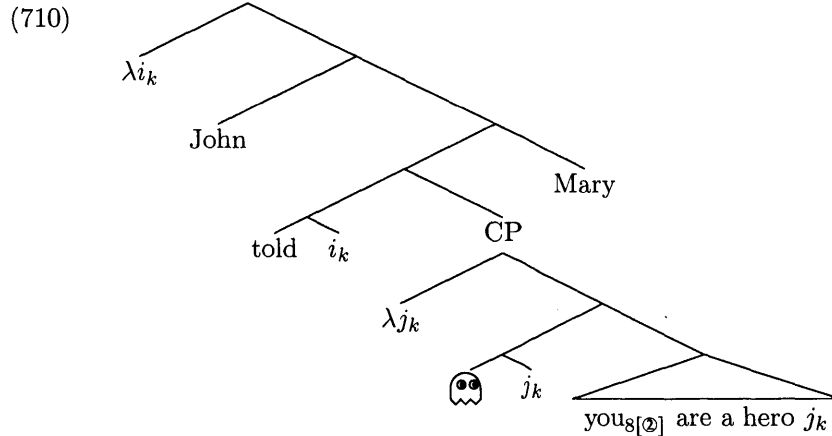
Assuming this semantics of first and second person pronouns, the monster has to be redefined as an operator that manipulates the assignment function g . Specifically, it replaces the values for $i[\textcircled{1}]$ and $i[\textcircled{2}]$ with the new *de se* and *de te* individuals.

(709) $\llbracket \begin{array}{c} \diagup \quad \diagdown \\ \text{☹} \quad i_k \quad \varphi \end{array} \rrbracket^g = \llbracket \varphi \rrbracket^{g'}$

where g' differs from g at most in that for all $i \in \mathbb{N}$,

- $g'(i[\textcircled{1}]) = a_{g(i_k)}$
- $g'(i[\textcircled{2}]) = h_{g(i_k)}$

This achieves indexical shifting. To illustrate let us look at the following schematic example.



We will evaluate this sentence with respect to a speaker x and an assignment function g and a possible world w . The attitude predicate *told* quantifies over c' such that (i) $a_{c'}$ is the individual that John identifies in w as himself, (ii) $h_{c'}$ is the individual that John identifies in w as his addressee, and (iii) $w_{c'}$ is a world compatible with what John told Mary in w . The monster manipulates g in such a way that all the first and second person pronouns in its scope refer to the *de se* and *de te* individuals so introduced. For instance, in the above

case, there is a second person pronoun with the index $8[\textcircled{2}]$, and it refers to $h_{c'}$, rather than h_c , which is a shifted interpretation.

An additional complication arises with respect to binding of a third person pronoun in an indexical shifting environment by a first or second person pronoun in the matrix context that is not an argument of the matrix predicate. For instance, it is conceivable that in an indexical shifting language, *he* in the embedded clause of (711) can be bound by *my* in the matrix clause, although I do not have a concrete example at this moment.¹⁶³

(711) Only my father told the police that he is missing.

The intended reading of (711) is paraphrase by (712).

(712) My father told the police that I am missing, John's father did not tell the police that he is missing, Mary's father did not tell the police that she is missing, etc.

Thus, *my* in the matrix clause binds *he*.

Generally binding by a first person pronoun is enabled by a first person binder index $\lambda i[\textcircled{1}]$, but according to the definition of the monster given in (709), the monster occurring between $\lambda i[\textcircled{1}]$ in the matrix clause and *he* in the embedded clause in (711) overwrites the binding information regarding $i[\textcircled{1}]$ and $i[\textcircled{2}]$, and hence it is predicted that *my* cannot directly bind any pronoun under the scope of the monster. In order to solve this undergeneration problem, we can also force the monster to preserve the relevant binding information in the following way.

The idea is to store the binding information regarding first and second person indices of the original assignment function g in third person indices of the new assignment function g' . In order to avoid accidental binding, the latter third person indices should be the ones that are not used to bind other pronouns elsewhere in the sentence. In order to achieve this, let us introduce the notion of maximal index. For any structure ϕ , $\text{max.bound.index}(\phi)$ denotes the number i such that there is a binder index $\lambda i[\textcircled{3}]$ c-commanding ϕ , and there is no number j such that $\lambda j[\textcircled{3}]$ c-commanding ϕ and $i < j$. Thus for any number above i , it is safe to put any value in the modified assignment function. If there is no such i , then $\text{max.bound.index}(\phi) = 0$. The idea is that when we apply the monster, we store the first and second person indices in the third person indices that are not used on bound pronouns in the shifted domain. This is achieved by the following monster.

$$(713) \quad \left[\left[\begin{array}{c} \text{ } \\ \text{ } \end{array} \right] \right]^g = \llbracket \varphi \rrbracket^{g'}$$

where g' differs from g at most in that for all $i \in \mathbb{N}$,

- $g'(i[\textcircled{1}]) = a_{g(i_k)}$
- $g'(i[\textcircled{2}]) = h_{g(i_k)}$
- $g(i[\textcircled{1}]) = g'((i + \text{max.bound.index}(\varphi))[\textcircled{3}])$
if $g'(i[\textcircled{1}]) \neq a_{g(i_k)}$ and $g'(i[\textcircled{1}]) \neq h_{g(i_k)}$
- $g(i[\textcircled{2}]) = g'((i + \text{max.bound.index}(\varphi))[\textcircled{3}])$
if $g'(i[\textcircled{2}]) \neq a_{g(i_k)}$ and $g'(i[\textcircled{2}]) \neq h_{g(i_k)}$

¹⁶³ A relevant example is hard to construct in Japanese, as indexical shifting is optional, and unambiguously third person pronouns are not easily bindable (cf. Hoji 1991, 1995). A clearer example should be available in Uyghur, but I leave this for another occasion.

The *if*-clauses here prevent overgeneration in cases where first or second person pronouns are arguments of the matrix attitude predicate. For instance, the following sentences presumably do not allow co-referential interpretations, when indexical shifting takes place.

- (714) a. I think that he is smart.
 b. John told you that she is beautiful.

20.2 Other Indexicals

In this dissertation, I exclusively looked at first and second person pronouns in shifting environments, but previous research has shown that indexical shifting is not limited to personal pronouns but locative and temporal indexicals like *here*, *now* and *today* can also shift. (715) illustrates this with Zazaki, which is drawn from Anand (2006:77).

- (715) *Zazaki*
- a. Waxto ke ma Diyarbekir-de bime, Heseni_i mi-ra va [ke o_{i/j} ita
 When that we Diyarbekir-at were, Heseni.obl me-at said [that he here
 ame dina].
 came world]
 ‘When we were in Diyarbekir, Heseni_i told me he_{i/j} was born {here, Di-
 yarbekir}.’
- b. Hefte nayeraraver, Heseni_i mi-ra va [ke o_{i/j} vizeri Rojda paci kerd
 week ago, Heseni.obl me-at said [that he yesterday Rojda kiss did
].
]
 ‘A week ago, Heseni_i told me that he_{i/j} kissed Rojda {8 days ago, #yester-
 day}.’

Unlike in Zazaki, Uyghur locative indexicals (*bu jer* ‘here’; *u jer* ‘there’) never shift even when they are to the right of the nominative subject as demonstrated by (716) and (717).

- (716) CONTEXT: This summer, I went to UCLA and met Muhemmet there. He told me “I’m going to study here from this September.” Now I’m back in Cambridge, MA, talking to Ahmet.
- men UCLA-gha bar-dim.
 1sg.NOM UCLA-to go-PAST.1sg.
 ‘I went to UCLA.’
- a. ... Muhemmet manga [toqquzinji ay-din başla-p (men) u jer-de
 Muhemmet 1sg.DAT [9th month-from start-ing 1sg.NOM there-LOC
 uqu-imen] di-di.
 study-IMPERF.1sg] say-PAST.3
 ‘... Muhemmet told me that he would study there from September.’
- b. #... Muhemmet manga [toqquzinji ay-din başla-p (men) bu jer-de
 Muhemmet 1sg.DAT [9th month-from start-ing 1sg.NOM here-LOC
 uqu-imen] di-di.
 study-IMPERF.1sg] say-PAST.3
 ‘... Muhemmet told me that he would study here from September.’

(717) CONTEXT: In Ürümchi, I told Ahmet “I am a student at MIT” (*men MITning oqughuchisi*). Then he said “Last year, I met Chomsky there” (*ötken yili, men u jerde Chomskyni kördim*). I am at MIT now telling you what happened in Ürümchi.

- a. Ahmet [(men) **bu jer**-de Chomsky-ni kör-dim] di-di.
 Ahmet [(1sg.NOM) here-LOC Chomsky-ACC see-PAST.1sg] say-PAST.3
 ‘Ahmet said that he met Chomsky here.’
- b. #Ahmet [(men) **u jer**-de Chomsky-ni kör-dim] di-di.
 Ahmet [(1sg.NOM) there-LOC Chomsky-ACC see-PAST.1sg] say-PAST.3
 ‘Ahmet said that he met Chomsky there.’

Thus, it seems that Uyghur and Zazaki locative indexicals seem to behave differently. A possible analysis of this crosslinguistic difference is suggested by the morphological shape of locative indexicals in Uyghur. That is, they are morphologically demonstratives. Interestingly demonstratives never shift either in Uyghur.

(718) CONTEXT: Yesterday, I showed Kirill a book. He said “I have read that book” (*men u kitapni uqudim*). Now, I tell Omer what happened yesterday. I am holding the book:

- a. Kirill [men **bu kitap**-ni uqu-dim] di-di.
 Kirill [1sg.NOM this book-ACC read-PAST.1sg] say-PAST.3
 ‘Kirill said that he read this book.’
- b. #Kirill [men **u kitap**-ni uqu-dim] di-di.
 Kirill [1sg.NOM that book-ACC read-PAST.1sg] say-PAST.3
 ‘Kirill said that he read that book.’

One possible analysis of this state of affairs is that the monster is fastidious, and does not alter the parameters responsible for the interpretation of demonstratives in the context index. As the interpretation of demonstratives in indexical shifting contexts is not well understood crosslinguistically, it is not clear what predictions this analysis would make. For this reason, I leave this open here.

As for temporal indexicals, preliminary data suggest that only a subset of them (e.g. *tünügün* ‘yesterday’; *ete* ‘tomorrow’) undergo indexical shifting, and the rest do not (e.g. *hazir* ‘now’; *bügün* ‘today’). However, I do not have comprehensive data at this moment and leave them entirely for future research.

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