

Donkey anaphora: the view from sign language (ASL and LSF)

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Abstract There are two main approaches to the problem of donkey anaphora (e.g. *If John owns a donkey, he beats it*). Proponents of dynamic approaches take the pronoun to be a logical variable, but they revise the semantics of quantifiers so as to allow them to bind variables that are not within their syntactic scope. *Older dynamic approaches* took this measure to apply solely to existential quantifiers; *recent dynamic approaches* have extended it to all quantifiers. By contrast, proponents of *E-type analyses* take the pronoun to have the semantics of a definite description (with *it* \approx *the donkey*, or *the donkey that John owns*). While competing accounts make very different claims about the patterns of coindexation that are found in the syntax, these are not morphologically realized in spoken languages. But they *are* in sign language, namely through locus assignment and pointing. We make two main claims on the basis of ASL and LSF data. First, sign language data favor *dynamic over E-type theories*: in those cases in which the two approaches make conflicting predictions about possible patterns of coindexation, dynamic analyses are at an advantage. Second, among dynamic theories, sign language data favor *recent ones* because the very same formal mechanism is used irrespective of the indefinite or non-indefinite nature of the antecedent. Going beyond this debate, we argue that dynamic theories should allow pronouns to be bound across negative expressions, as long as the pronoun is presupposed to have a non-empty denotation. Finally, an appendix displays and explains subtle differences between overt sign language pronouns and all other pronouns in examples involving ‘disjunctive antecedents’, and suggests that counterparts of sign language loci might be found in spoken language.

Earlier versions of this work appear in the *Proceedings of the Amsterdam Colloquium 2009* (Springer Lecture Notes in Computer Science—roughly, Sects. 1–3 of the present article) and in the *Proceedings of the NELS 2009, Special Session on Pronouns* (roughly, Sects. 5–6 and Appendix 2 of this work). A summary of some of these results, intended for an audience of non-specialists, can be found in Schlenker, (to appear b).

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The problem of donkey anaphora (Geach 1962) is illustrated in (1) and (2).

(1) **Indefinites**¹

- a. John owns a donkey. He beats it.
- b. If John owns a donkey, he beats it.

(2) **Non-Indefinites**

- a. John owns fewer than 5 donkeys. He beats them.
- b. If John owns fewer than 5 donkeys, he beats them.

In each case, the underlined pronoun is semantically dependent on the underlined quantifier; but it is not c-commanded by it. This poses a problem if the following two standard assumptions are adopted:

- (i) Pronouns are logical variables.
- (ii) The semantics of quantifiers gives rise to a standard notion of scope, namely c-command.²

Dynamic approaches preserve (i) but revise (ii) (e.g. Kamp 1981; Heim 1982; Groenendijk and Stokhof 1991; Chierchia 1995). E-type approaches preserve a version of (ii) but revise (i), taking pronouns to have the meaning (and sometimes the syntax) of definite descriptions [e.g. *the donkey*, or *the donkey that John owns* (Karttunen 1969; Jacobson 1977; Cooper 1979; Evans 1980; Heim 1990; Ludlow 1994; Elbourne 2005)]. The debate revolves in part around the patterns of *coindexation* that are found in the syntax. But coindexation is not usually overt in spoken languages, which has made the debate hard to decide directly. By contrast,

¹ By ‘indefinites’, we mean NPs with the indefinite determiners *a* and *some*, as well NPs with unmodified numerals: *one*, *two*, *three*, etc.

² By ‘c-command’, we mean: c-command at the syntactic level at which semantic interpretation is performed (‘LF’). While there might be various views on the covert operations that give rise to this level, there is no plausible syntactic operation that would move the quantifiers in (1) and (2) to a position in which they could c-command the pronouns (in the a. examples of (1)–(2), the quantifiers would need to have scope over an entire discourse; in the b. examples, they would have to move out of a syntactic island). In addition, such an operation would yield the wrong truth conditions in some of these cases (Heim 1982). Consider (ia), analyzed as in (ib):

- (i) a. If John owns a donkey, he beats it.
- b. [a donkey] λi [if John owns t_i , he beats it_i]

(ib) is inadequate: it is made true by virtue of the existence of a donkey which John would beat if he owned it. This is compatible with a situation in which John owns many donkeys that he does not beat—which is intuitively precluded by (ia) (thanks to a referee for suggesting that this point be clarified).

coindexation *is* arguably realized overtly in sign language, namely through pointing (Lillo-Martin and Klima 1990; Sandler and Lillo-Martin 2006³; Sinha 2008). It is thus natural to see whether sign language data might shed new light on the debate. After introducing it (Sect. 1), we argue for the following claims on the basis of original fieldwork on American and French Sign Language (ASL and LSF):

1. First, in those cases in which E-type analyses and dynamic analyses make different predictions about the formal connection between a pronoun and its antecedent, dynamic analyses are at an advantage (Sects. 2–4).
2. Second, it appears that the same formal mechanism is used in sign language versions of (1) and (2), irrespective of the indefinite or non-indefinite nature of the antecedent; this turns out to provide an argument for recent dynamic approaches over older ones (Sect. 5)
3. Going beyond this debate, we suggest that apparent failure of dynamic binding across negative expressions is not due to formal considerations, but to the failure of a presupposition: the pronoun's denotation is not presupposed to be non-empty (Sect. 6). Finally, we discuss in an appendix some subtle differences between overt sign language pronouns and all other pronouns, and we propose an analysis of this contrast. We also suggest that the distinction can be reproduced internal to spoken language with some non-standard anaphoric devices—e.g. *the former... the latter* (Appendix 2).

There are several limitations to our enterprise. First, we are not concerned with the debate between variable-free versus variable-full semantics (see for instance Jacobson 1999)—though sign language data clearly *are* relevant given the common belief that loci (= the positions associated with noun phrases in signing space) are the morphological realization of indices. Second, we do not discuss the issue of ‘functional readings’ of pronouns [e.g. *The woman who deposited her paycheck in the bank was wiser than the woman who deposited it in the Brown University Employees' Credit Union* (Jacobson 2000; see Karttunen 1969)]; we leave this question for future research.

1 The debate

1.1 E-type approaches

E-type approaches give pronouns the semantics of definite descriptions. This result may be achieved in different ways: by purely semantic means, as in Cooper (1979);

³ Sandler and Lillo-Martin (2006) summarize Lillo-Martin and Klima's proposal as follows (p. 378): “Lillo-Martin and Klima (1990) (...) analyze ASL pronouns into two parts: one PRONOUN sign listed in the lexicon and a referential index. (...) Suppose NPs in ASL, like those of spoken languages, have assigned referential indices. Then, for ASL, unlike for spoken languages, the referential indices can be overtly realized, in the form of distinct locations in signing space.”

or by syntactic means, as in Elbourne (2005). E-type theories have three main ingredients.

- (i) *What pronouns are.* First, they treat pronouns as having the semantics of definite descriptions. There are two primary choice points: (a) is the desired result achieved by semantic or syntactic means—in the latter case by literally including a definite description in the position of the pronoun? (b) how large is the description which is (syntactically or semantically) recovered? Depending on the specific answer given to (b), *it* in (1)b could be treated as having the same meaning as *the donkey that he [= John] has*, as in (3)a; or simply as *the donkey*, as in (3)b (in a semantic account like Cooper (1979), the content of the description is semantically recovered, for instance by way of a higher-order variable whose denotation is provided contextually; we come back to this point in Sect. 4.2).
- (3) a. If John owns a donkey, he beats it ~~donkey he has~~
 b. If John owns a donkey, he beats it ~~donkey~~ (Elbourne 2005)
- (ii) *What quantifiers do.* Second, E-type approaches take Conditionals (and many other constructions) to quantify over very fine-grained situations (or events/states)—which is necessary to guarantee that the uniqueness presupposition of the definite description is satisfied. This is clearly needed if the description is just *the donkey*; but this is also the case if the description is *the donkey that John owns*: John might own several donkeys, and if so one wants the *if*-clause to quantify over situations that each contain just one donkey.
- (iii) *Formal link.* Third, E-type theories need to find a ‘formal link’ between the pronoun and its antecedent in order to explain why a noun phrase must usually be present to license the anaphora. Without this ingredient, E-type approaches could not account for the contrast between (4)a and (4)b.
- (4) a. Every man who has a wife is sitting next to her.
 b. ?* Every married man is sitting next to her (Heim 1990)

Elbourne (2005) takes the formal link to result, quite simply, from a syntactic ellipsis of the NP; a pronoun is just the form that a definite article takes when this ellipsis takes place—and this approach is applicable to all cases of anaphora (e.g. *her = the wife*; we come back below to the analysis of the formal link given by other E-type accounts).

We note for future reference that E-type accounts treat in a uniform fashion the case of indefinite and non-indefinite antecedents, as is illustrated in (5) within Elbourne’s framework; in all cases, the pronoun is analyzed as a definite description in disguise, and ellipsis provides a formal link between the pronoun and its antecedent. Although some of our data will be problematic for E-type approaches, the uniformity of its treatment of all instances of anaphora will turn out to be a positive feature of this approach.

- (5) a. If John owns a donkey, he beats it ~~donkey~~.
 b. If John owns fewer than 5 donkeys, he beats them ~~donkeys~~.

For ease of presentation, when we compare the predictions of dynamic and E-type accounts, we will initially take Elbourne's analysis as a representative of the latter. There are two reasons for this choice: first, his analysis is particularly detailed and sophisticated; second, unlike several other E-type approaches, it offers a simple and appealing solution to the problem of the formal link, which is at the very center of our enterprise (since we are concerned with the nature of the connection that pointing establishes between sign language pronouns and their antecedents). However, we do discuss the consequences of our data for other E-type approaches in Sect. 4.2 (see also Roberts 2010 for further discussion of Elbourne's theory).

1.2 Dynamic approaches

Dynamic approaches are defined by the following properties.

- (i) *What pronouns are.* Dynamic accounts treat pronouns as logical variables, which can be coindexed with non-c-commanding antecedents, as is illustrated in (6).
- (6) a. John owns [a donkey]_i. He beats it_i.
b. If John owns [a donkey]_i, he beats it_i.
- (ii) *What quantifiers do.* In order for these patterns of indexation to yield the intended truth conditions, dynamic semantics revises the foundations of quantification. This can be done in purely semantic terms, by way of a sophisticated mechanism of quantification over assignment functions⁴ (e.g. Kamp 1981; Heim 1982; Groenendijk and Stokhof 1991); or through syntactic stipulations such as those illustrated in (7), where \exists and \forall are unselective quantifiers, which bind all the variables that are within their scope (e.g. Heim 1982); in these implementations, indefinites are taken to introduce variables.
- (7) a. \exists [John owns [a donkey]_i. He beats it_i.]
b. \forall [John owns [a donkey]_i] [he beats it_i]
- (iii) *Formal link.* All dynamic approaches give a simple account of the formal link between a pronoun and its antecedent: it is, quite simply, co-indexation.

Dynamic approaches differ in their treatment of donkey pronouns that depend on quantifiers that are not indefinites. To see why there is an issue in the first place,

⁴ The semantics for quantifiers is often given by way of assignment functions, i.e. of functions that assign values to variables. For instance, within a standard (non-dynamic) semantics, the logical formula $\exists x_1 R x_1 x_2$ is taken to be true relative to an assignment function s just in case there is at least one object d for which the formula $R x_1 x_2$ is true relative to the assignment function $s[x_1 \rightarrow d]$ (where $s[x_1 \rightarrow d]$ is the function which is identical to s , except that $s[x_1 \rightarrow d]$ assigns the object d to the variable x_1). Note that an assignment function s can be thought of as a (possibly infinite) sequence of objects $\langle s(x_1), s(x_2), s(x_3), \dots \rangle$. This last point matters because some E-type theories posit situations that are so finely individuated that they may correspond to sequences of objects—which under certain conditions erases part of the differences between quantification over situations and quantification over assignment functions; see Dekker (2004) for discussion.

consider the—incorrect—truth conditions derived by a simple-minded extension of (7)a (≥ 2 -donkeys(X) and < 5 -donkeys(X) stand for: X contains at least two donkeys, X contains fewer than five donkeys).

- (8) a. John owns [at least 2 donkeys]. He beats them.
 a'. *Bad analysis*: $\exists X$ [John owns X & ≥ 2 -donkeys(X) & John beats X]
 b. John owns [fewer than 5 donkeys]. He beats them.
 b'. *Bad analysis*: $\exists X$ [John owns X & < 5 -donkeys(X) & John beats X]

It is immediate that the truth conditions predicted by (8) are inadequate:

- Intuitively, (8)a entails that John beats *all the donkeys that he has*. But this entailment is not captured by (8)a': the fact that the pronoun refers to the *maximal* group of donkeys that John owns is left unaccounted for.⁵
- The same problem arises in (8)b: the inference that John beats all the donkeys that he has is not captured by (8)b'. But in addition, the proposed truth conditions do not even entail that John owns fewer than five donkeys (all they entail is that one can find a group of fewer than five donkeys that John owns—which is far too weak).

There are two broad solutions to this problem. One is a mixed approach: for indefinite antecedents, the standard dynamic line is adopted; for other antecedents, a version of the E-type approach is posited, one in which the quantifier has its 'usual' meaning but the pronoun has the semantics of a definite description—which directly accounts for the maximality condition observed in (8)a.

- (9) **Mixed Solution** (simplified version of Kamp and Reyle 1993)
- a. Pronouns that depend on indefinites are treated in the dynamic way.
 - b. Pronouns that depend on other quantifiers are treated with some version of the E-type account.

⁵ As an anonymous referee points out, Evans (1980) argued that unmodified indefinites also give rise to maximal readings—which according to him explained the deviance of (i) (see also Schein 1993 p. 223 for discussion):

(i) #There is a doctor in London and he is Welsh.

Further controls would be needed to assess (i) (to determine what is the role of the *there*-construction, and of the implicature triggered by *a doctor* even without the anaphoric dependency created by the second conjunct). Be that as it may, other examples suggest that pronouns anaphoric to singular indefinites need not yield maximal readings; for instance, (ii) does not give rise to the inference that all (relevant) doctors being sued for malpractice drew screwdrivers into people's backs. (See for instance Brasoveanu 2008 for a recent discussion of maximal versus non-maximal readings depending on the nature of the antecedent.)

(ii) A doctor is being sued for malpractice. He inserted a screwdriver into a man's back.

One cautionary note is in order: this mixed approach is a *simplified* version of the analysis developed in Kamp and Reyle (1993). The authors' actual theory is more sophisticated: in addition to the mechanism in (9)b, specifically developed for proportional quantifiers (e.g. *most students*), they also allow cardinality quantifiers (e.g. *exactly two students*) to introduce discourse referents together with maximality conditions. In such instances, their proposal is similar to recent dynamic analyses such as van den Berg's, discussed in the next paragraph. Quantifiers like *fewer than five donkeys* could in principle be treated in either way within Kamp and Reyle's framework. We thus consider a simplified version of their analysis with the bipartition in (9), rather than the tripartition (with cardinality quantifiers) which they in fact argue for.

The alternative is a pure dynamic approach, one in which *all* quantifiers (not just indefinites) introduce discourse referents and can bind variables that they do not c-command. In order to address the problems illustrated in (8), non-indefinite quantifiers (e.g. *at least two*, *fewer than five*, *most*) are taken to introduce discourse referents *together with explicit maximality conditions*. As is illustrated in (10)a'–b', this measure makes it possible to derive the correct truth conditions within a pure dynamic system—and when the maximality operator is introduced in this way, the truth conditions can be further simplified, as shown in (10)a''–b''.

- (10) **Pure Solution** (e.g. van den Berg 1996a,b; Nouwen 2003; Brasoveanu 2006)
- a. John owns [at least 2 donkeys]. He beats them.
 - a'. $\exists X$ [John owns X & X = [Max Y: donkey(Y) & John owns Y] & ≥ 2 -donkeys(X) & John beats X]
 - a''. $\exists X$ [X = [Max Y: donkey(Y) & John owns Y] & ≥ 2 -donkeys(X) & John beats X]
 - b. John owns [fewer than 5 donkeys]. He beats them.
 - b'. $\exists X$ [John owns X & X = [Max Y: donkey(Y) & John owns Y] & < 5 -donkeys(X) & John beats X]
 - b''. $\exists X$ [X = [Max Y: donkey(Y) & John owns Y] & < 5 -donkeys(X) & John beats X]

Furthermore, this type of solution can be extended to all generalized quantifiers Q that satisfy conservativity (e.g. van den Berg 1996b). This is because in such cases a formula $Q(N)(V)$ with a nominal argument N and a verbal argument V is equivalent to $Q(N)(N \cap V)$, where $N \cap V$ is just the maximal set defined above. Sentences with generalized quantifiers can be analyzed as predicating something of this maximal set. An example is given in (11) for the quantifier (*exactly*) *half* (here $|X|$ refers to the size of X , and $\{z: \text{donkey}(z)\}$ refers to the group of all donkeys).

- (11) a. John owns half the donkeys. He beats them.
 b. $\exists X$ [X = [Max Y: donkeys(Y) & John owns Y] & $|X| = \frac{1}{2}$ $|\{z: \text{donkey}(z)\}|$ & John beats X]

Thus when Q is conservative, the equivalence between $Q(N)(V)$ and $Q(N)(N \cap V)$ makes it possible to state the semantics of Q entirely in terms of the restrictor set N , and the so-called 'maximal set' introduced in (10), which is just $(N \cap V)$.

1.3 The complexity of the debate

The debate between E-type and dynamic approaches is more subtle than it looks. Initially, it might seem that the opposing sides differ along the three dimensions we used in our initial characterization of each approach: 1. what they take pronouns to be; 2. what they take operators to quantify over; and 3. what the nature of the formal link is.

(12) E-type versus dynamic approaches

	E-type approaches	Dynamic approaches
1. Pronouns are	Concealed definite descriptions	Variables
2. Operators quantify over	Situations (or events/states)	Assignment functions
3. The formal link is given by	NP ellipsis (Elbourne 2005)	Coindexation

What complicates the debate is that some recalcitrant examples have forced the E-type approach to take situations to be *extremely* fine-grained; Dekker (2004) shows that under certain assumptions, they are *so* fine-grained that they are isomorphic to assignment functions or, equivalently, to sequences of individuals—which is precisely what dynamic semantics took dynamic operators to quantify over.

To see what the problem is, consider the sentences in (13):

- (13) a. A bishop met a bishop. He blessed him.
b. If a bishop meets a bishop, he blesses him.

The potential difficulty is immediate for Elbourne's theory: if *he* and *him* are both construed as *the bishop*, it is not clear how their uniqueness presuppositions can be satisfied. But versions of the E-type analysis that resort to a longer descriptive content are not better off: resolving *he* as *the bishop that met a bishop* and *him* as *the bishop that a bishop met* won't help a bit, since these two descriptions are synonymous. The difficulty is that the two 'bishops' of the antecedent clause play entirely symmetric semantic roles, which makes it difficult to distinguish them.

How can the symmetry be broken? There are in fact two difficulties, which we illustrate on the example of (13)b (discussed in detail in Elbourne 2005).

- (i) First, situations must be made fine-grained enough that the 'symmetry' between the bishops mentioned in the antecedent can in principle be broken. An old insight, called 'Chierchia's Conjecture' in Dekker (2004), is that in the end situation-theoretic analyses might have to make situations as fine-grained as assignment functions. As mentioned, Dekker (2004) shows that with quite a few assumptions—which he takes to go against the spirit of the framework—situations are indeed isomorphic to assignment functions. One of these assumptions is that a situation in which *bishop B meets bishop B'* is different from a situation in which *bishop B' meets bishop B*. Importantly, this

assumption is embraced by Elbourne (2005), and it is an important ingredient of his solution (Schein 2002 provides independent evidence for positing, within a different framework, that *events* have to be extremely finely individuated). But a consequence of this situation is that the second line of the table in (12) (quantification over situations vs. quantification over assignment functions) might *not* clearly discriminate between E-type and dynamic approaches.

- (ii) Second, even if situations are extremely fine-grained, the situation-theoretic analysis must endow the pronouns that appear in the consequent clause of (13)b with enough descriptive content to pick out different individuals. Suppose for instance that we took *if*-clauses to quantify over situations that are sequences of individuals—thus accepting Dekker’s isomorphism between situations and assignment functions (since the latter are in essence sequences of objects). We would *still* have to explain how the pronouns *he* and *him* manage to pick out different individuals in the same situation (i.e. in the same sequence). One way to do so would be to stipulate that they come with some equivalent of indices, so that for instance he_1 evaluated with respect to a situation s with $s = \langle B, B' \rangle$ denotes B , while in the same situation he_2 denotes B' . This step would make the situation-theoretic analysis come one step closer to its dynamic competitors. Now if situations are just as fine-grained as sequences of individuals, and if in addition pronouns can carry information about which position of the sequence they index, then the *first* line of the table in (12) (‘what pronouns are’) might also fail to be discriminating: on both theories, pronouns have an index-like content that makes it possible to retrieve the object found in a particular position of a sequence of individuals.

When the E-type theory is refined in this way, it becomes quite close to a dynamic analysis. But there is still one important difference, represented in the third line of the table in (12): according to the E-type analysis under consideration, the formal link only yields an uninterpreted syntactic expression; by contrast, for the dynamic analysis it provides a semantic index which, by its very nature, has a direct interpretation, since it picks out a particular coordinate of a sequence (or equivalently, the value assigned to an index by an assignment function). We will show below that this small difference is sufficient to distinguish some E-type approaches from their dynamic competitors on the basis of sign language data. On the other hand, if this last difference is removed, the empirical predictions of the two theories might be very hard or impossible to distinguish. For this reason, it seems unreasonable to aim for a vindication of dynamic theories over *all* E-type theories, since some of the latter might be notational variants of the former; the best we can hope for is to find empirical arguments against specific E-type accounts.

Our methodology primarily involved elicitation with two native consultants over numerous contact hours and hundreds of videos. Our ASL consultant, Inf I, was a deaf child of deaf ASL signers⁶; our main LSF consultant, Inf F, was a hard-of-hearing child of deaf LSF signers. Videos whose number starts with *i* were elicited on iChat, usually to complete paradigms that had been obtained in face-to-face interaction.

⁶ While he has been using ASL throughout his life, he also went to a school in which interpreters used signed English.

Data from other native LSF consultants are also mentioned. All examples were videotaped. When judgments were not trivial, we asked the consultants to watch themselves sign the sentence in a video before providing a judgment. When possible, we constructed *minimal pairs* so as to obtain contrastive judgments, and to control for the various biases that are inevitably introduced in the first stage of the elicitation process. When more fine-grained judgments were necessary, we used scale-based judgments (on a 7-point scale) with our ASL consultant (unless otherwise noted, judgments were binary).

In the following, sign language sentences are glossed in capital letters. Non-manual markings are omitted because they do not play a role in the present discussion (although they are definitely crucial to a proper understanding of meaning in sign language). Subscripts correspond to the establishment of positions ('loci') in signing space. In some cases, this is done by signing an expression in the relevant location—for instance *_aONE* is the word 'one' signed in locus *a*. It must be emphasized, however, that there are multiple ways to establish loci—sometimes gazing at a location while producing a sign is enough; and sometimes pointing is used to establish a locus. In the former case, we use subscripts; in the latter case, we use *IX-a* to make clear that a pointing sign ('index') is associated with locus *a*. Pronouns are usually realized through pointing towards a locus, and they are also glossed as *IX-a*, *IX-b*, etc. Letters corresponding to loci are assigned in alphabetical order from right to left from the signer's perspective; the numbers 1 and 2 correspond to the position of the signer and to that of the addressee respectively.

2 Predictions for sign language

2.1 Pronouns in sign language

In the sign languages that have been described, the relation between a pronoun and its antecedent is often mediated by *loci*, which are positions in signing space that are usually associated with nominal elements (e.g. Sandler and Lillo-Martin 2006). A pronoun that depends on a noun phrase will thus point towards (or 'index') the locus that was introduced by that noun phrase. We see in (14) examples of locus assignment to proper names, definite descriptions and indefinite descriptions (in general, only meaning can distinguish between the latter two).

(14) ASL

- a. IX-1 KNOW _aBUSH IX-1 KNOW _bOBAMA. IX-b SMART BUT IX-a NOT SMART.
'I know Bush and I know Obama. He [= Obama] is smart but he [= Bush] is not smart.' (Inf 1, 4, 179)
- b. IX-1 KNOW PAST PRESIDENT IX-a IX-1 KNOW NOW PRESIDENT IX-b. IX-b SMART BUT IX-a NOT SMART.
'I know the former President and I know the current President. He [= the current President] is smart but he [=the former President] is not smart.' (Inf 1, 4, 179)
- c. IX-1 KNOW PAST SENATOR PERSON IX-a IX-1 KNOW NOW SENATOR PERSON IX-b. IX-b SMART BUT IX-a NOT SMART.
'I know a former senator and I know a current senator. He [= the current senator] is smart but he [= the former senator] is not smart.' (Inf 1, 4, 179)

Since there appears to be an arbitrary number of possible loci, it was suggested that the latter do not spell out morpho-syntactic features, but rather are the overt realization of indices (Lillo-Martin and Klima 1990; Sandler and Lillo-Martin 2006). This makes it particularly interesting to use sign language evidence to revisit the debate about donkey anaphora, since it crucially hinges on the nature of coindexation.

Importantly, we do not claim that *all* uses of pointing in sign language are pronominal in nature, only that pronouns (with the exception of null pronouns) involve pointing. There are at least four additional uses of pointing which have been discussed in the literature.

- (i) As was indicated above in our glossing conventions, pointing can be used to *establish* a locus (e.g. Sandler and Lillo-Martin 2006, p. 297). Usually each NP establishes its own locus, but there are cases in which distinct NPs make use of the same default locus (this point is further discussed in Appendix 2).
- (ii) Bahan et al. (1995) argue that in some cases an index plays the role of a definite determiner.
- (iii) It has sometimes been claimed that pointing can be used solely for purposes of ‘comparing’ two situations (e.g. in Winston 1995). It is currently unclear what this precisely amounts to in formal semantic terms.
- (iv) In addition, pointing signs can have locative uses, with a meaning akin to *there*, as is for instance discussed in Bahan et al. (1995) (who note some phonological differences between locative and determiner uses).

While we will have to keep these various uses in mind, we will generally assume that when pointing is involved *and* gives rise to a pronominal-like interpretation, it does indeed correspond to a pronoun.

But even if we restrict attention to pronominal uses, what do sign language indexes tell us about universal properties of anaphora? In principle, it could be that the anaphoric system of sign languages is entirely different from that found in spoken languages. If so, we would be getting from sign languages morphological evidence about a *different* system from the one that had prompted the donkey anaphora debate. This is unlikely, however, because there are in fact some striking similarities between sign language pronouns and their spoken counterparts.

- (i) First, in simple cases, the same ambiguity between strict and bound variable readings is found in both modalities, as is illustrated in (15) and (16) (see Lillo-Martin 1995; Lillo-Martin and Sandler 2006).

(15) **ASL**

IX-1 POSS-1 MOTHER LIKE. IX-a SAME-1,a⁷. (Inf 1, 1, 108)

*Ambiguous*⁸: I like my mother. He does too [= like my / like his mother]

⁷ The sign for *same* connects the loci *I* (= speaker) and *a* (= the other person under discussion).

⁸ Our consultant explicitly stated that the sentence is ambiguous and can have the two readings.

(16) **LSF⁹**

Context: There is a lottery.

_bPIERRE IX-_b THINK WIN. _aJEAN SAME. (Inf H, 17, 12; 13)

Ambiguous: Pierre thinks that he will win. Jean does too [= think that Jean/Pierre will win].

- (ii) Second, sign language pronouns obey at least some of the syntactic constraints on binding studied in syntax. For instance, versions of the following rules have been described for ASL (Lilla-Martin 1995; Sandler and Lillo-Martin 2006; Koulidobrova 2011): Condition A; Condition B; Strong Crossover.¹⁰

Still, it would be an overstatement to claim that *all* the features of sign language pronouns are analogous to those of their spoken language counterparts. Restricting attention to pronominal uses of pointing, there are instances of ‘locative agreement’ that do not have clear counterparts in spoken language; in such cases, a personal pronoun denoting a certain person can index the locus corresponding to the *location* of that individual (e.g. Emmorey 2002; see also Schlenker to appear a).¹¹ Similarly, sign language pronouns and agreement markers have iconic properties which are not found in their spoken language counterparts (e.g. Liddell 2003; Lillo-Martin and Meier, to appear; Schlenker, to appear c). All we seek to establish here is that for purposes of anaphora resolution, *sign language indexing must, among others, play the role of formal indices in dynamic semantics*. In particular, nothing in what we say precludes the possibility that sign language pronouns have a descriptive component *in addition* to their role as dynamic indices. Thus when we speak of the ‘E-type analysis’, our target will always be an E-type theory *without* any mechanism of dynamic binding.

2.2 The importance of Bishop sentences

The simplest donkey sentences may seem to provide initial evidence in favor of dynamic accounts because pronouns can index antecedents that do not c-command them.

(17) **LSF**

- a. _bSTUDENT _aPRIEST BOTH-_{a,b} DISCUSS. IX-_a KNOW BIBLE, IX-_b NOT-KNOW.

‘I talked to a student and a priest. He [= the priest] knew the Bible but he [= the student] didn’t know it’. (Inf E, 2, 62)

- b. EACH-TIME _aLINGUIST _bPSYCHOLOGIST ALL-THREE-_{b,a,1} TOGETHER WORK, IX-_a HAPPY BUT IX-_b HAPPY NOT.

‘Whenever I work with a linguist and a psychologist, the linguist is happy but the psychologist is not happy.’ (Inf E, 2, 63)

⁹ This example involves a null subject pronoun, but other LSF examples gave rise to similar ambiguities with overt pronouns (it is possible, however, that eye gaze can sometimes disambiguate).

¹⁰ In recent work, Gaurav Mathur and I have started to extend existing results on Strong Crossover (Lillo-Martin 1995) to Weak Crossover effects in ASL (paper presented at *TISLR 2010*).

¹¹ Thanks to K. von Stechow for raising this issue in comments he gave on a version of this paper at NELS 2009.

While these examples could be taken to display coindexing without c-command, they are not decisive. The E-type approach could account for them as follows:

- (i) In sign language, a pronoun indexes the Noun Phrase that provides its descriptive content. In the implementation of Elbourne (2005), we may simply posit that a pronoun points towards the locus introduced by the NP that provides its antecedent under ellipsis. Since we already know from spoken languages that some formal link must be provided between the pronoun and its antecedent, it comes as no particular surprise that the same phenomenon can be observed in sign language. Admittedly, it is very unclear that there is any independent motivation for positing that pointing can serve to resolve ellipsis in sign language. But the E-type approach could postulate that it is only in case of E-type reference that the phenomenon occurs. A similar stipulation is already needed for English pronouns: on the ellipsis-based version of the E-type analysis, something must be said to explain why *it* is not pronounced as *the*, since the underlying form is, for instance, *the donkey* (other E-type theories give a different analysis of the formal link between a pronoun and its antecedent; we return to this point in Sect. 4.2).
- (ii) In cases such as (17), pronouns index exactly the syntactic element that they should—in particular under Elbourne’s approach. Therefore (some) E-type approaches make exactly the same predictions as standard dynamic approaches.

But when it comes to bishop sentences such as (13), things can be different. In my understanding of Elbourne (2005), this analysis posits that *extra-linguistic material* is used to enrich the descriptive content of the pronouns to allow them to pick out different bishops.¹²

¹² Elbourne (2005) sketches a solution based on context change. He writes on p. 152 (my emphasis added):

“... it is not unreasonable to suggest that the consequent of (35) [= If a bishop meets a bishop, he blesses him] has the LF *[[he bishop] blesses [him bishop]]*, as required by the NP-deletion theory (...). Note that the solution (or outline of a solution) suggested here relies on our being able to make a swift change from understanding [he bishop] one way to understanding [him bishop] another, *despite the fact that the latter phrase seems like it should be synonymous with the former*. I do not think that there is a problem here, however, since there are already examples of this phenomenon in the literature, admittedly in milder versions. One relevant example is the following (Heim 1991):

(39) The table is wobbly. We should have kept Aunt Lida’s oak table.

One strategy for dealing with this would say that during the first sentence Aunt Lida’s oak table is not salient enough to be the referent of ‘the table’, which picks out the most salient table, presumably the one at which the speaker is sitting. The mention of Aunt Lida’s oak table makes that table salient during the second sentence, but by this time the phrase ‘the table’ of the first sentence has already done its job (...). (...) So something very [much] like the strategy suggested for (39) can probably go on (...) .”

Elbourne 2010 also appeals to context:

“How does the content ‘distinguished’ or ‘nondistinguished’ enter the semantics? Here I do not need to commit to any particular theory, in fact. We can just imagine that the content accrues by whatever mechanism is used to supply content in other cases of incomplete definite descriptions.”

To be more specific, let us follow Elbourne (2005) in introducing some additional material *D* and *N* to refer to the ‘distinguished’ and ‘non-distinguished’ bishop in a situation (one would need to say more about the *semantics* of *D* and *N*; but we assume, following Elbourne, that situations are fine-grained enough that the two bishops can indeed play asymmetric roles).

(18) If a bishop meets a bishop, he *D* ~~bishop~~ blesses him *N* ~~bishop~~.

As was mentioned at the outset, the formal link between a pronoun and its antecedent is provided in this analysis by syntactic ellipsis. But in the case of (18), the very same results are obtained no matter which antecedent is used, since all that is elided is the NP *bishop*. For this reason, both pronouns could in principle take the same NP as their antecedent under ellipsis. There certainly are other cases in which two elided NPs can have the same antecedent, as is shown in (19); so this possibility should be open in (18) as well.

(19) If two bishops meet, one ~~bishop~~ blesses the other ~~bishop~~.

In fact, for the E-type analysis under consideration, (18) is should have roughly the same theoretical status as (20) (assuming for the sake of argument that *the first* and *the second* involve NP ellipsis).

(20) If a bishop meets a bishop, the first ~~bishop~~ blesses the second ~~bishop~~.

Importantly, if the sole role of ellipsis is to recover the ‘right’ NP, as is the case in (19), any distribution of antecedents should be acceptable in (18) and (20) *while still giving rise to the intended truth conditions* (since what is responsible for ‘distinguishing’ the denotation of the two pronouns is not the NP *bishop*, but rather the additional material provided by *N*, *D*, *first* and *second*).

Thus we end up with the predictions in (21). Importantly, they are obtained *with the interpretation of bishop sentences held constant*, i.e. without introducing the possibility of a meaning akin to *if a bishop meets a bishop, he blesses himself* (self-blessings are completely implausible given the sentence, and we entirely disregard this possibility).

- (21) a. E-type theories in which the denotations of the pronouns in (18) are distinguished by extra-linguistic material allow both pronouns to have the same antecedent under ellipsis. Thus if pointing in sign language realizes ellipsis resolution (as is suggested by the spirit of Elbourne 2005), both pronouns should be allowed to index the locus introduced by the same antecedent (while still denoting different individuals).
- b. For dynamic analyses, by contrast, coindexing is semantically interpreted, and thus the two pronouns cannot index the same locus given the intended truth conditions.

Let us now turn to the facts of LSF and ASL (see Sinha 2008 for early work on anaphora in Indian Sign Language within a dynamic framework; Lillo-Martin and Klima 1990 also make reference to dynamic notions in their DRT guise).

3 Bishop sentences in ASL and LSF

3.1 Standard cases

The patterns of indexing found in standard bishop sentences in ASL and LSF are in agreement with the predictions of dynamic analyses, and contradict the E-type analysis discussed above: we find the two patterns of indexing predicted by dynamic theories, and no other patterns (note that for our ASL consultant, the pattern exemplified in (22)a is sometimes preferred to that in (22)b; we come back to this point in Sect 4.2 and in Appendix 1; the only point that matters for the moment is that other patterns of indexing are not found with the intended interpretation).

(22) ASL

WHEN _aSOMEONE LIVE WITH _bSOMEONE,
 ‘When someone lives with someone,’

- a. IX-a LOVE IX-b
 ‘the former loves the latter.’
- b. ?¹³ IX-b LOVE IX-a
 ‘the latter loves the former.’
- c. # IX-a LOVE IX-a
- d. # IX-b LOVE IX-b
 (Inf 1 i P1040962; i P1040963, i P1040972)

(23) LSF

- a. EACH-TIME IX-a _aSTUDENT a,b-MEET IX-b _bSTUDENT, a-GIVE-b CIGARETTE.
 ‘Each time a student meets a student, he [= the former] gives him [= the latter] a cigarette.’
- b. EACH-TIME IX-a _aSTUDENT a,b-MEET IX-b _bSTUDENT, IX-b b-GIVE-a CIGARETTE.
 ‘Each time a student meets a student, he [= the latter] gives him [= the former] a cigarette.’
- c. No other patterns are exemplified.
 (consultant F, 3, 35)

As it happens, ASL and LSF both have reflexive pronouns, and thus one could be tempted to appeal to a potential competition between the reflexive and the non-reflexive pronoun to account for these data. The idea could be developed along the following lines:

- (i) Following Reinhart and Reuland (1993), we posit that a reflexive (*SELF* in ASL and LSF) is preferred to a non-reflexive pronoun if (a) the reflexive is possible and (b) the two options yield the same truth conditions.

¹³ We summarize here the judgment obtained on a 7-point scale rather than the judgment obtained in a binary task (this sentence was taken to be ‘unacceptable’ in the binary task, and was assessed as 5 and then 6 on the 7-point scale; see Appendix 1 for further details).

- (ii) We then posit that in (22) and (23) the case in which the two (non-reflexive) pronouns index the same locus is ruled out by the competition principle in (i): a reflexive should have been used to express the resulting reading.

This reasoning is mistaken, however. The step that fails is (i)b: with a reflexive pronoun, the meaning obtained would be very different from the intended one; it would correspond to the English sentences *When someone lives with someone, he loves himself*, and *Each time a student meets a student, he gives himself a cigarette*. These are entirely implausible readings, and they are clearly different from the intended meanings of (22)–(23), which do *not* involve any reflexive action. Importantly, the *plausible* readings (which do not require that anyone love *oneself* or give *oneself* a cigarette) are predicted to be possible by the E-type theory under consideration *even when the two pronouns have the same antecedent* (just as is the case in (19)). And certainly there is nothing in the competition-based analysis that would allow a reflexive that yields a certain reading (the implausible one) to block an indexing possibility that produces a completely different reading (the plausible one). Therefore the competition-based analysis cannot explain why we do not find the patterns in (22)c-d and (23)c.

Lest any worry remains that Condition B might be involved in our simple examples, we note that exactly the same generalizations hold in (24), where the locality requirements for Condition B are not met anyway (see Appendix 1, (71) for an example with *LIVE* instead of *MEET*¹⁴).

(24) **ASL**

WHEN _a[FRENCH MAN] a,b-MEET _b[FRENCH MAN],

‘When a Frenchman meets a Frenchman,’

- a. IX-a WONDER WHO IX-b LIVE WITH.

‘the former wonders who the latter lives with.’

- b. ? IX-b WONDER WHO IX-a LIVE WITH.

‘the latter wonders who the former lives with.’

- c. # IX-a WONDER WHO IX-a LIVE WITH.

‘the former wonders who the former lives with.’

- d. # IX-b WONDER WHO IX-b LIVE WITH.

‘the latter wonders who the latter lives with.’

(Inf 1, i P1040945; i P1040946, i P1040955, i P1040968)

3.2 Intransitive cases

Elbourne (2005) suggests that in some cases a ‘symmetry problem’ does in fact arise in bishop sentences—but only when the NP antecedents are conjoined:

- (25) a. If a bishop meets a bishop, he greets him.
b. #If a bishop and a bishop meet, he greets him.

¹⁴ As our consultant noted, the status of *MEET* as a ‘plain verb’ or ‘agreement verb’ is not always clear from the videos.

Elbourne argues that the contrast in (25) is predicted by his E-type analysis, but not by its dynamic competitors. We show below that the contrast in (25) does not extend to ASL and LSF; and we tentatively suggest, on the basis of new data due to Salvador Mascarenhas, that the source of the English contrast is syntactic, not semantic.

3.2.1 Intransitive cases in ASL and LSF

Intransitive bishop sentences such as (25)b seem to be unproblematic in ASL and LSF; and as before we get exactly the indexing possibilities predicted by dynamic analyses (we also fail to find cases in which pronouns that have different denotations do not index the same locus).

(26) ASL

WHEN _aSOMEONE AND _bSOMEONE LIVE TOGETHER,

‘When someone and someone live together,

a. IX-a LOVE IX-b
the former loves the latter.’

b. IX-b LOVE IX-a
the latter loves the former.’

c. # IX-a LOVE IX-a

d. # IX-b LOVE IX-b

(Inf 1, i P1040966; i P1040967, i P1040973 [= scale-based judgment])

Similar data can be found in LSF:

(27) LSF¹⁵

a. EACH-TIME IX-a _aSTUDENT _bSTUDENT a,b-BOTH a,b-MEET,
CL-b a-GIVE-b CIGARETTE.

‘Each time a student and a student meet, he [= the former] gives him
[= the latter] a cigarette.’ (Inf F, 3, 39)

¹⁵ The two descriptions could potentially be interpreted as demonstrative: *each time this student and that student meet*, etc.; consultant I noted that the presence of *both* in the example could favor this reading. But the same consultant found that the indefinite interpretation was clear in (i). Consultant H produced and accepted (ii).

(i) LSF

EACH-TIME _aAMERICAN _bAMERICAN LIVE TOGETHER, IX-a LIKE IX-b
(Inf I, 15, 18; 19)

‘When an American and an American live together, he [= the former] likes him
[= the latter].’

(ii) LSF

a. EACH-TIME _bAMERICAN _aAMERICAN a,b-TOGETHER, IX-b LIKE IX-a

b. EACH-TIME _bAMERICAN _aAMERICAN a,b-TOGETHER, IX-b LIKE IX-a
(Inf H, 17, 17; 18)

- b. EACH-TIME IX-a _aSTUDENT _bSTUDENT IX-b a,b-BOTH
a,b-MEET, CL-b IX-b b-GIVE-a CIGARETTE.
'Each time a student and a student meet, he [= the latter] gives him
[= the former] a cigarette.' (Inf F, 3, 39)

These patterns extend to cases in which several semantically parallel propositions are conjoined:

(28) **ASL**

- a. IF _a[FRENCH PERSON HERE] a-OTHER-b _b[FRENCH PERSON
HERE] IX-a WILL a-GREET-b IX-b
'If a Frenchman were here and another Frenchman were here, he
[= the former] would greet him [= the latter].' (Inf 1, 2, 114; see
also Inf 1, 2, 113–114; Inf 1, 2, 153–154)
- b. IF _a[FRENCH PERSON HERE] a-OTHER-c _c[FRENCH PERSON
HERE] c-OTHER-b _b[FRENCH PERSON HERE] IX-a a-GREET-b,c
THE-TWO-b,c
'If a Frenchman were here and another Frenchman were here and
another Frenchman were here, he [= the first] would greet them
[= the second and the third].' (Inf 1, 2, 115)

(29) **LSF**

- _bPRIEST 1,b-DISCUSS. SAME OTHER-a _aPRIEST 1,a-DISCUSS. [BOOK
BIBLE] POSS-b b-GIVE-a.
'I talked to a priest. I also talked to another priest. He [= the former]
gave his Bible to him [= the latter].' (Inf E, 2, 69)

It has sometimes been suggested within event semantics that the thematic roles corresponding to the subject versus object of *meet* are crucial to break the symmetry between the indefinite antecedents in examples such as (25)a (Ludlow 1994). It does not seem that this strategy can extend to the intransitive cases discussed here: the antecedents bear exactly the same thematic role—but they can still be distinguished by pointing.

3.2.2 Mascarenhas's argument

There remains an important question: why is (25)b (= *#If a bishop and a bishop meet, he greets him*) deviant? One possibility is that this is an area of deep difference between spoken and sign languages. It might even be that Elbourne's analysis is applicable to English, while dynamic accounts are more correct for sign languages. Here we will outline a more conservative analysis, which builds on an important observation due to Mascarenhas (p.c.).

In brief, we will assume that the symmetry problem is real, but that it has a morpho-syntactic rather than a semantic source. Specifically:

- (i) ASL, LSF and English use the same abstract anaphoric system, at least with respect to the data under discussion here (but see Appendix 2 for some qualifications).

- (ii) There is indeed a symmetry problem in Elbourne's intransitive example, but it is *morpho-syntactic* in nature: the two antecedents are *formally* so similar that one has difficulty distinguishing them for purposes of anaphora resolution.
- (iii) The symmetry is broken in sign language by virtue of locus assignment, which makes the two antecedents very clearly distinct.
- (iv) In spoken language, modifications of Elbourne's intransitive example can be found in which the antecedents are (a) semantically symmetric and (b) morpho-syntactically asymmetric, and where anaphora becomes more acceptable again.

The crucial empirical point lies in (iv). Following Mascarenhas, we note that (30)b appears to be more acceptable than Elbourne's intransitive bishop sentences—exemplified here by (30)a.¹⁶

- (30) a. #Whenever a woman and a woman meet, she hugs her.
- b. (?) Whenever a woman and a childhood girlfriend of hers meet, she hugs her.¹⁷

It is clear that if *y* is a childhood girlfriend of woman *x*, it is also the case that *x* is a childhood girlfriend of woman *y*. So *semantically* the example in (30)b appears to be symmetric, although *syntactically* they are sharply distinct—which seems sufficient to break the symmetry that caused the problem in (30)a. Why syntactic symmetry causes this difficulty remains to be investigated, of course.¹⁸

As M. Gagnon notes (p.c.), Elbourne's view could be defended by noting that in (30)b the *whenever*-clause quantifies over minimal situations that contain an individual *x* with the property of being a woman, and an individual *y* with the property of being a friend of *x*. Now for Elbourne 'a situation can [...] omit some of the properties of an individual who is in it' (Elbourne 2005), and hence the situations that are quantified over might just include *x* and *y* and these two properties—with the effect that the implicit descriptions *the woman* and *the childhood friend of hers*

¹⁶ Mascarenhas's example was something like (i); due to the presence of a possessive description, it triggers additional presuppositions which are immaterial to the present discussion.

(i) ? Whenever a man and his boyfriend meet, he hugs him.

¹⁷ Two native English speakers found precisely the contrast we have in (30). A third one, however, had judgments that support Elbourne's theory, with the interesting observation that (among others) (30)b is 'less obviously bad' than (30)a, but 'once you try to figure out what they mean they become just as bad'. This is a domain in which experimental methods would be helpful to obtain more reliable data.

I provide similar data from French in (i); while (ib) is not perfect, it is to my ear better than (ia); the latter is just hard to understand.

(i) a. #Quand une femme et une femme se rencontrent, elle lui fait la bise.
 When a woman and a woman SE meet, she to-her does a kiss
 'When a-fem woman and a-fem woman meet, she gives her a kiss.'

 b. ?Quand une femme et une amie d'enfance à elle se rencontrent, elle lui fait la bise.
 When a-fem woman and a-fem friend of childhood SE meet, she to-her does a kiss
 'When a woman and a childhood friend of hers meet, she gives her a kiss.'

¹⁸ See Koralus (2010) for an analysis in terms of topic/focus structure.

might still pick out different individuals in the relevant situations. But this line of argument won't easily extend to the French examples in (31)b, where synonymous expressions with different grammatical genders are used to create the desired asymmetry (making use of the fact that *personne* is grammatically feminine, even when it refers to a man).¹⁹

- (31) a. #?Quand un homme et une femme se rencontrent, il la salue. Mais quand un homme et un homme se rencontrent, il ne le salue pas.
When a man and a woman SE meet, he her greets. But when a man and a man SE meet, he NE her greet not
 'When a woman and a man meet, she greets him. But when a woman and a woman meet, she doesn't greet her.'
- b. ? Quand un homme et une personne de sexe féminin se rencontrent, il la salue. Mais quand un homme et une personne de sexe masculin se rencontrent, il ne la salue pas.
When a man and a-fem person of gender feminine SE meet, he her greets. But when a man and a-fem person of gender masculine SE meet, il NE her greet not
 'When a woman and a male person meet, she greets him. But when a woman and a female person meet, she doesn't greet her.'

We conclude, following Mascarenhas, that Elbourne's symmetry problem is real, but that it probably has a morpho-syntactic rather than semantic source. Since sign language can 'break' the symmetry between the conjoined antecedents by assigning different loci to them, it is unsurprising that we find a difference between the English and ASL and LSF data in this domain.²⁰

¹⁹ P. Koralus (p.c.) finds that an appropriate use of contrastive focus can yield the same result:

- (i) If a bishop and an atheist meet, the bishop pretends he does not see the atheist. However,
 If a bishop and a bishop meet, he greets him.

²⁰ We argue in Appendix 2 that spoken language sentences makes limited use of loci when they include meta-linguistic expressions such as *the former*, *the latter*, or *the first*, *the second*, *the third*, which index noun phrases by virtue of their linear position in a discourse. We might expect that intransitive examples with symmetric antecedents become more acceptable when the pronouns are replaced with such meta-linguistic expressions. Thus we predict that (ib) should be better than (ia).

- (i) a. When a bishop and bishop meet, he blesses him.
 b. When a bishop and bishop meet, the former blesses the latter.

The data are not clear: some speakers find the expected improvement, others don't. I believe that French examples involving *Celui-ci* and *Celui-là* (= the proximal and distal demonstratives, which can have meta-linguistic uses) give rise to the expected improvement; but here too more work is needed to establish reliable data.

- (ii) a. #Quand un prêtre et un prêtre se rencontrent, il le bénit.
When a priest and a priest SE meet, he him blesses.
 b. (?) Quand un prêtre et un prêtre se rencontrent, celui-ci bénit celui-là.
When a priest and a priest SE meet, this-one blesses that-one

4 Consequences for E-type approaches

Let us now step back to consider the consequences of sign language data for E-type approaches.

4.1 Consequences for Elbourne's NP ellipsis analysis

So far, we have shown that (our understanding of) Elbourne's analysis, based on NP-ellipsis, makes incorrect predictions for ASL and LSF, while dynamic analyses appear to be adequate. The crucial difficulty was that the E-type analysis we assumed took the elided NPs to have *the very same meaning* no matter which antecedent they had. This, in turn, followed because the material that was taken to break the symmetry in the transitive cases (i.e. those examples that were acceptable) was provided by the context rather than by the antecedents: the covert symbols *D* (for 'distinguished') and *N* (for 'non-distinguished') which broke the symmetry between the 'bishop' antecedents in (18) *did not come from the antecedents themselves*.

Could a system be devised in which the choice of the antecedent had direct interpretive consequences?²¹ We could explore an analysis in which the additional material that serves to pick out different bishops in the consequent *is inherited from the process of ellipsis resolution*; this, in turn, would presumably require that this material be already present in the antecedent. Since the examples we discussed in (28)b seem to suggest that an arbitrary number of parallel antecedents can be distinguished, we will introduce the unpronounced symbols *#1*, *#2*, etc. to help in the process of anaphora resolution (the notation *#i* indicates that the symbol *#1* is unpronounced):

(32) If a [bishop *#1*] meets a [bishop *#2*], he ~~bishop *#1*~~ blesses him ~~bishop *#2*~~.

The idea could be that different antecedents under ellipsis give rise to different interpretations because of the presence of these unpronounced symbols in the *if*-clause. But this solution raises two issues. First, how are these symbols interpreted? It does not seem that they correspond to absolute properties of individuals, because if they did the two existential quantifiers would fail to range over the same individuals, which seems to be undesirable. Second, how does this solution differ from a dynamic semantics to which one has *added* an analysis of pronouns as elided descriptions? For the symbols *#1* and *#2* we have introduced in (32) seem to play *exactly* the role of indices in dynamic semantics.

The E-type analysis we discussed is thus faced with a dilemma: it must either make wrong predictions about the sign language data we considered; or it must become so similar to dynamic semantics that the debate might lose any substance. It might be that subtle differences will remain; but in order to prove this, this E-type analysis would need to be developed with the same rigor and generality as existing dynamic theories. In particular, one would need to see fully explicit fragments that make the same kind of predictions as dynamic theories (this would require that a

²¹ This possibility was suggested by an anonymous NELS reviewer. In our reading of Elbourne (2005, 2010), his analysis corresponds to (18), where *D* and *N* are *not* products of the resolution of ellipsis, but of context. See fn. 12 for relevant citations.

formal elucidation of the notion of ‘situation’ be given); and a general analysis of the cases in which the resulting system is or isn’t equivalent to existing dynamic systems.

4.2 Consequences for other E-type approaches

What do our data suggest for other E-type theories? Three empirical points are essential.

- (i) First, anaphora in sign language can be mediated by formal objects, loci, which are introduced by an antecedent and retrieved by a pronoun. Locus retrieval is normally effected by pointing, while loci themselves can be established by various means, including pointing.
- (ii) Second, in donkey sentences a quantificational antecedent can establish a locus which is retrieved by a pronoun in the absence of any c-command relation between the two.
- (iii) Third, when two donkey pronouns have two antecedents that have parallel semantic (and sometimes syntactic) contributions, very different readings are obtained depending on whether the two pronouns are formally connected (via loci) to the same or to different antecedents. This suggests that the formal connection between pronouns and their antecedents has a direct semantic reflex.

On the positive side, these findings provide some overt motivation for three ingredients of the dynamic analysis of anaphora:

- (i') A sign language locus appears to play very much the role of a formal index, which is carried by a pronoun *and* by the antecedent it is anaphoric to.
- (ii') Just as is the case with loci, the formal relation which is mediated by dynamic indices is not constrained by c-command.
- (iii') The semantics of indices and quantifiers guarantees that two indices introduced by different quantifiers can ‘refer’ (under an assignment function) to different individuals; the fact that two pronouns carry the same or different variables will thus have a direct semantic reflex, as is desired.

These findings raise difficulties for E-type accounts in general—except ones that might come so close to their dynamic competitors that the difference might in the end be notational.

Let us now consider the specific problems that are encountered by E-type accounts other than Elbourne’s. For clarity, we will distinguish between analyses that do and analyses that don’t make provisions for a formal link between the pronoun and its (non-c-commanding) antecedent.

4.2.1 Theories without a formal link: Cooper 1979 and Heim 1990 (first part)²²

Cooper (1979) and the first theory developed in Heim (1990) suggest that the meaning of donkey pronouns is resolved contextually, by way of a functional

²² We particularly focus on Heim’s theories because they are technically explicit with respect to the situation-theoretic assumptions and the indexing mechanism.

variable such as f^n_i , whose value is provided by an assignment function (how the assignment function comes to reflect the contribution of the linguistic environment is not made explicit). In Heim's words, "the semantics of pronouns consists of one stipulation only: A pronoun is represented at LF as a term of the form $f^n_i(v_1, \dots, v_n)$, where $n = 0$ and v_1, \dots, v_n are variables of the appropriate type (i.e., individual, world, or time variables). Interpretation is straightforward, with the proviso that free variables refer to contextually salient entities of the appropriate type".²³ In particular, the functional f^n_i has its value provided by the context—which means that there is no formal connection between the pronoun and its antecedent (the idea is that the antecedent makes a certain function 'salient', but there is nothing in the syntax to establish a link between the pronoun and its antecedent). To be concrete, here is an example from Heim (1990), where f is intended to refer to a function from individuals who own exactly one donkey to the donkey that they own.²⁴

- (33) a. Every man who owns exactly one donkey beats it.
 b. $[\text{every}_x \text{ man}(x) \text{ who } [\text{exactly-one}_y \text{ donkey}(y)] \text{ } x \text{ owns } y] \text{ } x \text{ beats } f(x)$

Importantly, some steps must be taken to ensure that there are natural functions (corresponding to some plausible notion of 'salience') that recover the desired denotation for the E-type pronouns. In 'bishop' examples, the desired result is achieved because adverbs quantify over minimal situations, while determiners induce simultaneous quantification over extensions of certain situations, and over individuals. Since this framework is also assumed in Heim's second E-type theory (which unlike the present one does provide a formal link between the pronoun and its antecedent), it is worth discussing in some detail. We give in (34)b an example of the kind of Logical Form that Heim posits for (34)a, with the intended interpretation in (34)c.

- (34) a. If a man shares an apartment with another man, he shares the housework with him.
 b. $\text{always}_{s_1} \text{ if } [[a_x \text{ man}(s_1)(x)] \text{ }_{s_1} [[a_y \text{ [man}(s_1)(y) \ \& \ y \neq x]] \text{ } [x \text{ shares-an-apartment-with}(s_1) \ y]]] \text{ }_{s_2} [f^1(s_1) \text{ helps}(s_2) \ f^2(s_1)]$
 c. Intended interpretation
 Every minimal situation s_1 which contains a man x and can be extended to a situation that contains another man y that shares an apartment with x can be extended to a situation s_2 such that $f^1(s_1) \text{ helps } f^2(s_1)$

The desired results are obtained thanks in part to the following rules, which guarantee that *always* quantifies over minimal situations, and that a subscript s_i that appears on a clause $_{s_i}F$ triggers existential quantification over situations that extend the situation denoted by s_i .

²³ In the analysis of Cooper (1979), E-type pronouns have the semantics of Russellian definite descriptions, which leads to undesirable predictions that are avoided by Heim's implementation. See Heim (1990) for discussion.

²⁴ For the analysis to deliver the desired result, $\text{man}(x) \text{ who } [\text{exactly-one}_y \text{ donkey}(y)] \text{ } x \text{ owns } y$ must be interpreted as the conjunction of $\text{man}(x)$ and of $[\text{exactly-one}_y \text{ donkey}(y)] \text{ } x \text{ owns } y$.

- (35) a. *always_{si} if F, G* has roughly the semantics: every minimal situation s_i that satisfies F satisfies G .
 $[[\text{always}_{s_i} \text{ if } F, G]]^g = \text{true}$ if and only if every minimal situation s such that $[[F]]^{g[s_i \rightarrow s]} = \text{true}$ is such that $[[G]]^{g[s_i \rightarrow s]} = \text{true}$.
- b. $[[s_i F]]^g = \text{true}$ if and only if for some situation s , $g(s_i) = s$ and $[[F]]^{g[s_i \rightarrow s]} = \text{true}$.

With these measures, it is possible to define natural functions that deliver the desired values for the E-type pronouns, as follows:

- (36) a. Value of f^1 : that function which associates
to every minimal situation s
which contains a man x and is contained in a larger situation where x
lives with another man
the unique man in s .
- b. Value of f^2 : that function which associates
to every minimal situation s
which contains a man x and is contained in a larger situation where x
lives with another man
the unique man that the
unique man in s lives with.

Note, however, that no mechanism is provided to determine how the values of f^1 and f^2 are deduced from the form of the sentence: context is supposed to do all the work.

For obvious reasons, this theory fails to solve the problem of the formal link, i.e. the contrast between (4)a and (4)b, repeated here as (37)a–b:

- (37) a. Every man who has a wife is sitting next to her.
b. ?* Every married man is sitting next to her (Heim 1990)

If a certain function is made salient by the subject noun phrase in (37)a, why isn't the same function also made salient by the synonymous noun phrase in (37)b? The problem is particularly severe in the case of sign language: donkey anaphora makes use of the same formal means as other types of anaphora; but there is nothing in this E-type analysis to explain what the nature of the formal link is in the case of donkey anaphora (whereas under standard binding coindexation could be appealed to).

4.2.2 Theories with a formal link: Heim 1990 (second part); Neale 1990

□ Heim 1990 (second part)

In the second part of her paper, Heim (1990) develops a theory that addresses the problem of the formal link. In a nutshell, she assumes that pronouns and their antecedents are connected by indices. She further postulates that a syntactic procedure is responsible for extracting from the antecedent the content of the E-type pronoun. An example is given in (38), where a. is turned into b. by a syntactic transformation, which copies the expression in bold from the subject noun phrase.

- (38) a. $[\text{every}_{x_1} [\text{man}(x_1) \text{ that } [[a_{x_2} \text{ donkey}(x_2)]_2 x_1 \text{ owns } x_2]]]_1 x_1 \text{ beats } it_2$
 b. $[\text{every}_{x_1} [\text{man}(x_1) \text{ that } [[a_{x_2} \text{ donkey}(x_2)]_2 x_1 \text{ owns } x_2]]]_1 x_1 \text{ beats } it_2$
 $[[a_{x_2} \text{ donkey}(x_2)]_2 x_1 \text{ owns } x_2]$

Heim sets up a semantic rule that guarantees that the interpretation of it_2 $[[a_{x_2} \text{ donkey}(x_2)]_2 x_1 \text{ owns } x_2]$ is just: *the donkey that x_1 owns*.²⁵ The natural suggestion, then, is that the formal connection made explicit in sign language between pronouns and their antecedents is an overt manifestation of Heim's mechanism of coindexation without c-command. This raises immediate questions. First, the syntactic transformation posited to resolve the pronoun is unmotivated and entirely stipulative. Second, E-type coindexation has a completely different semantics from normal binding, it is mysterious why sign language should use the same formal mechanism in both cases (from the perspective of dynamic semantics, coindexation has the same meaning in both cases, and it is thus unsurprising that sign language should use the same mechanism for both). In this respect, Elbourne's theory offers a much more compelling solution to the problem of the formal link.

Let us consider in greater detail how Heim's analysis can deal with bishop sentences. While the second part of Heim (1990) does not specifically address this issue, it is clear that her analysis can handle some simple cases. For instance, we obtain a result that is arguably correct in (39). (39)b is the initial Logical Form of (39)a; (39)c is obtained after Heim's syntactic transformation has been applied to recover the content the pronouns in bold.

- (39) a. If $[a \text{ man}]_1$ shares an apartment with $[another \text{ man}]_2$, he₁ shares the housework with him₂.
 b. $\text{always}_{s_1} \text{ if } [[a_{x_1} \text{ man}(s_1)(x_1)]_1 s_1 [[a_{x_2} [\text{man}(\underline{s_1})(x_2) \ \& \ x_2 \neq x_1]]_2$
 $[x_1 \text{ shares-an-apt-with}(s_1) \ x_2]]] s_2 [\text{he}_1 \ \underline{\lambda x_1} \ x_1 \text{ helps}(s_2) \ \text{him}_2]$
 c. $\text{always}_{s_1} \text{ if } [[a_{x_1} \text{ man}(s_1)(x_1)]_1 s_1 [[a_{x_2} [\text{man}(s_1)(x_2) \ \& \ x_2 \neq x_1]]_2$
 $[x_1 \text{ shares-an-apt-with}(s_1) \ x_2]]] s_2 [\text{he}_1 [a_{x_1} \text{ man}(s_1)(x_1)]_1 s_2 [[a_{x_2} [\text{man}(s_1)(x_2) \ \& \ x_2 \neq x_1]]$
 $[x_1 \text{ shares-an-apt-with}(s_1) \ x_2]]$
 $\underline{\lambda x_1} \ x_1 \text{ helps}(s_2)$
 $\text{him}_2 [[a_{x_2} [\text{man}(\underline{s_2})(x_2) \ \& \ x_2 \neq x_1]]_2 [x_1 \text{ shares-an-apt-with}(\underline{s_2}) \ x_2]]]$

We have underlined material that requires special attention if the correct results are to be obtained. Specifically:

- (i) we must change the situation variable s_1 into a variable s_2 when we resolve the syntactic content of *him*₂ (this is essential to guarantee that the definite

²⁵ Her rule is given in (i) for the case of the pronoun *it*:

(i) $[[[it \ [[\text{Det}_x \ F] \ G]]]^g] = \text{the unique } d \text{ such that } [[F]]^{g[x \rightarrow d]} = [[G]]^{g[x \rightarrow d]} = 1; \text{ undefined if there is no unique such individual.}$

descriptions are evaluated with respect to *different* situations—which in turn is necessary to satisfy their uniqueness presuppositions²⁶;

- (ii) we must introduce in (39)b a λ -abductor under he_1 in order to bind the variable x_1 that appears in the second E-type pronoun.

The intended interpretation is similar to (34)b, except that the functional term $f^1(s_1)$ is replaced with a syntactically complex description $D^1(s_1)$, and $f^2(\underline{s}_1)$ is replaced with a description $D^2(s_2)$. The latter replacement is important: the two descriptions must be evaluated with respect to different situations in order for their uniqueness presuppositions to be satisfied. The intended interpretation is given in (40).

(40) *Intended interpretation:*

Every minimal situation s_1 which contains a man x and can be extended to a situation that contains another man y that shares an apartment with x

can be extended to a situation s_2 in which such that $g^1(s_1)$ helps $g^2(s_2)$ with

$D^1(s_1)$ = the man x_1 in s_1 such that in some extension of s_1 , another man x_2 shares an apartment with x_1 .

$D^2(s_2)$ = the man x_2 in s_2 who is different from x_1 and who x_1 shares an apartment with in s_2 .

The results are arguably adequate.²⁷ But how did we obtain them? There are two questions to answer, which we illustrate on the example of (39)b.

- (i) First, how did we recover the denotation of the subject E-type pronoun he_1 ? The bound situation variable s_1 is the only formal connection between the *if*-clause and the main clause. But s_1 ranges over minimal situations that contain just one man x_1 , namely a man that satisfies the restrictor and nuclear scope of the first quantifier. When this descriptive content is copied in the main clause, it will thus pick out the same man.
- (ii) Second, how did we recover the denotation of the object E-type pronoun him_2 ? Through changes of variables, we get plausible results because:
- (a) in the *if*-clause, we existentially quantify over individuals x_2 and situations s_2 which are forced to stand in a certain relation R to x_1 and s_1 ;

²⁶ Contrary to what one might initially think, it won't do to solve the problem by modifying the names of variables in the *if*-clause, replacing (ia) with (ib) (the modifications are in boxes):

(i) a. always s_{s_1} if $[[a_x \text{ man}(s_1)(x)] \text{ } s_1 [[a_y \text{ } [\text{man}(s_1)(y) \text{ \& } y \neq x]] \text{ } [x \text{ shares-an-apt-with}(s_1) \text{ } y]]]$
 b. always s_{s_1} if $[[a_x \text{ man}(s_1)(x)] \text{ } \underline{s_2} [[a_y \text{ } [\text{man}(\underline{s_2})(y) \text{ \& } y \neq x]] \text{ } [x \text{ shares-an-apt-with}(\underline{s_2}) \text{ } y]]]$

The problem is that given the rule in (35)b, the choice of the variable name matters: the constituent in bold existentially quantifies over situations that extend the value of s_1 in (ia), but of s_2 in (ib).

²⁷ One complicated issue concerns the interaction between the uniqueness presuppositions of E-type pronouns and existential quantifiers. But since there is no consensus in the presupposition on how existential quantifiers project presuppositions, we leave this issue out of the present discussion.

- (b) we can reconstruct an analogous quantification over situations in the main clause, and make use of the information provided by the subject E-type pronoun he_I and the situation variable s_I to allow the descriptive content inherited from the object quantifier to denote the desired individual.

This analysis works in the case of (39) because (i) the two quantifiers are in a scopal relation relative to each other; and (ii) the corresponding E-type pronouns are in the *same* scopal relation. When either condition fails, further measures are needed. Let us first consider what happens when the pattern of antecedence of (39)a is reversed, as is shown in (41): now the matrix subject is anaphoric to the embedded object, while the matrix object is anaphoric to the embedded subject.

- (41) If [a man]₁ shares an apartment with [another man]₂, he₂ shares the housework with him₁.

When we apply Heim's algorithm to this inverse pattern, the subject pronoun ends up containing a variable x_I which is free, as shown in the boxed material in (42):

- (42) $s_2[he_1 [[a_{x_2} [man(s_2)(x_2) \ \& \ x_2 \neq \boxed{x_1}]]_2 [\boxed{x_1} \text{ shares-an-apt-with}(s_2) \ x_2]]$
 $\underline{\lambda x_1} \ x_1 \text{ helps}(s_2)$
 $him_2 [a_{x_1} [man(s_1)(x_1)]]_1 \ s_2[[a_{x_2} [man(s_1)(x_2) \ \& \ x_2 \neq x_1]] [x_1 \text{ shares-an-apt-with}(s_1) \ x_2]]$

To avoid this problem, we would need to assume an alternative Logical Form for (39)a, one in which the object pronoun has moved beyond the subject pronoun, as is represented in (43).²⁸

- (43) $always_{s_1} \text{ if } [[a_{x_1} [man(s_1)(x_1)]]_1 \ s_1[[a_{x_2} [man(s_1)(x_2) \ \& \ x_2 \neq x_1]]_2$
 $[x_1 \text{ shares-an-apt-with}(s_1) \ x_2]]] \ s_2[\text{him}_1 \ \underline{\lambda x_1} \ \text{he}_2 \text{ helps}(s_2) \ \underline{x_1}]$

In the LSF data we have discussed, the pattern of indexing illustrated in (41) appears to be acceptable. Our ASL consultant's judgments are rather subtle and are discussed in Appendix 1. They could be taken to provide initial *support* for the analysis under discussion, for the following reason: (a) the pattern in which the object pronoun is predicted to scope over the subject pronoun is slightly degraded; (b) things are sometimes worse if the object is separated from the subject by an island (though judgments are not fully stable). Problematically, however, in situation (b) the inverse anaphoric connection is still much more acceptable than a case in which a *wh*-word is extracted out of a syntactic island—an unexpected result if covert movement of the object pronoun out of the island is necessary for interpretive reasons. Furthermore, there are alternative explanations for the fact that the inverse

²⁸ Alternatively, we could leave the pronouns in their base position but posit that an operation of Quantifier Raising applies in the antecedent clause. But this won't do, because the bound variable x_I in the second quantifier $[a_{x_2} [man(s_I)(x_2) \ \& \ x_2 \neq x_I]]$ would become unbound in the process. Furthermore, in Heim's particular semantics it probably won't do to eliminate the conjunct $x_2 \neq x_I$ from this quantifier. The problem is that in her system the consequent clause quantifies over extensions s_2 of the situations s_1 that satisfy the antecedent clause; some of these situations s_2 will contain two symmetric bishops; thanks to the variable s_I , one bishop b can be characterized as 'the only bishop ... in s_1 ', but the other bishop must be characterized as 'the bishop ... in s_2 who is different from b '.

pattern of indexing illustrated in (41) is dispreferred. It is well established in the processing literature that there is a strong default preference for interpreting a subject pronoun as anaphoric to a subject antecedent in sentences such as (44)—a preference which is so strong that the sentence is anomalous because the feminine pronoun *she* is resolved to the subject *William* (this preference can be overridden if *she* is stressed; Smyth 1994).

(44) ? William bumped Bonnie and she poked Rod. (*she* = *William*)

Our ASL consultant's subtle judgments might be a reflection of this general processing strategy (yet another possibility is that the preference is simply for the first pronoun in linear order to be anaphoric to the first antecedent; we come back to this point below).

Heim's analysis encounters more serious difficulties with intransitive examples. As we noted, it was thanks to the syntactic asymmetry between the subject and the object quantifiers that we obtained plausible results in (40). But in our 'intransitive examples', we find syntactically parallel and conjoined quantifiers, which are presumably not in a scopal relation (covert movement of one quantifier would be blocked by the coordinate island constraint). Both binary and scale-based judgments show that these examples are acceptable for our consultant, as long as the two pronouns are anaphoric to different antecedents (when the two pronouns index the same antecedent, we obtain an odd meaning in both (45)c–d and (46)c–d; in addition, (45)c–d gives rise to a Condition B violation; note that ratings are on a 7-point scale).

(45) **ASL**

WHEN _aSOMEONE AND _bSOMEONE LIVE TOGETHER,

'When someone and someone live together,

a. IX-a LOVE IX-b

the former loves the latter.'

Rating: 7 ('good')

b. IX-b LOVE IX-a

the latter loves the former.'

Rating: 6 ('ok')

c. # IX-a LOVE IX-a

the former loves the former.'

Rating: 3 ('borderline unacceptable')

d. # IX-b LOVE IX-b

the latter loves the latter.'

Rating: 3 ('borderline unacceptable')

(Inf 1, i P1040966; i P1040967, i P1040973 [= scale-based judgment])

(46) **ASL**WHEN _aFRENCHMAN AND _bFRENCHMAN MEET²⁹,

'When a Frenchman and a Frenchman meet,

- a. IX-a WONDER WHO IX-b LIVE WITH.

the former wonders who the latter lives with.'

Rating: 7 ('good')

- b. IX-b WONDER WHO IX-a LIVE WITH.

the latter wonders who the former lives with.'

Rating: 5 ('soso')

- c. # IX-a WONDER WHO IX-a LIVE WITH.

the former wonders who the former lives with.'

Rating: 2 ('unacceptable')

- d. # IX-b WONDER WHO IX-b LIVE WITH.

the latter wonders who the latter lives with.'

Rating: 2 ('unacceptable')

(Inf 1, i P1040947; i P1040948, i P1040969 [= scale-based judgment])

While Heim does not discuss such examples, it would seem that her algorithm is not in a position to distinguish in the appropriate way the two 'bishop' antecedents, which now play entirely symmetric roles (because they are not in a scopal relation). For this reason, the uniqueness presuppositions of the pronouns should fail to be satisfied. As we mentioned in Sect. 3.2, following Elbourne, this might be a good result for English (though we sketched an alternative analysis of the English data). But for ASL, this prediction is problematic.

□ **Neale 1990**

Like the second part of Heim (1990), Neale (1990) offers a resolution algorithm for E-type pronouns which can in principle provide a solution to the problem of the formal link. But his analysis differs from Heim's in one major respect: whereas Heim preserves the uniqueness presuppositions of (singular) E-type pronouns and guarantees that they are satisfied thanks to quantification over fine-grained situations, Neale posits that E-type pronouns are number-neutral. In his representation of the truth conditions, he writes [*wh* *x*: *F*] for a definite description [*the* *x*: *F*] which is devoid of any number features. Interestingly, Neale argues that this analysis yields exactly the right result for bishop sentences—even without quantification over fine-grained situations or events. His theory is summarized in (47).

- (47) a. "The *antecedent clause* for a pronoun *P* that is anaphoric on a quantifier *Q* occurring in a sentence *F* is the smallest well-formed subformula of *F* that contains *Q* as a constituent."
- b. "If *x* is a pronoun that is anaphoric on, but no c-commanded by, a quantifier [*Dx*: *Fx*](*Gx*), then *x* is interpreted as the most 'impoverished' definite description directly recoverable from the antecedent clause that denotes everything that is both *F* and *G*."

²⁹ Here *MEET* appears to be signed in neutral position.

It is immediate that the kind of resolution posited in (47)b is *ad hoc*; furthermore, as was the case of Heim's second theory, it raises the question why sign language should use the same formal mechanism for 'standard' and 'E-type' anaphora, which are not treated in homogeneous fashion in Neale's analysis. Still, the latter yields adequate results in simple bishop sentences, as is illustrated in (48)–(49). Following the spirit of Neale's proposal, we give in (49)a–a' a representation with coindexing between the E-type pronoun and its antecedent, and show in (49)b–b' how Neale's procedure resolves it (note that Neale's definite descriptions appear in quantifier position because for independent reasons he wants them to have a Russellian analysis—a point which will not matter in the present discussion).

- (48) If a man shares an apartment with another man, he shares the housework with him.
- (49) a. if $[\text{an } x: \text{man}(x)]_1 [\text{a } y: \text{man}(y) \ \& \ y \neq x]_2 (x \text{ shares-an-apt-withs } y)$,
 he₁ helps **him**₂
 b. if $[\text{an } x: \text{man}(x)]_1 [\text{a } y: \text{man}(y) \ \& \ y \neq x]_2 (x \text{ shares-an-apt-withs } y)$,
 $[\text{whe } x: \text{man}(x) \ \& \ [\text{a } y: \text{man}(y) \ \& \ y \neq x] \ (x \text{ shares-an-apt-withs } y)]$
 $[\text{whe } y: \text{man}(y) \ \& \ y \neq x]_2 (x \text{ shares-an-apt-withs } y)]$
 x helps y
 a'. if $[\text{an } x: \text{man}(x)]_1 [\text{a } y: \text{man}(y) \ \& \ y \neq x]_2 (x \text{ shares-an-apt-withs } y)$,
 he₂ helps **him**₁
 b'. if $[\text{an } x: \text{man}(x)]_1 [\text{a } y: \text{man}(y) \ \& \ y \neq x]_2 (x \text{ shares-an-apt-withs } y)$,
 $[\text{whe } y: \text{man}(y) \ \& \ y \neq \underline{x}] \ (\underline{x} \text{ shares-an-apt-with } y)]$
 $[\text{whe } x: \text{man}(x) \ \& \ [\text{a } y: \text{man}(y) \ \& \ y \neq x] \ (x \text{ shares-an-apt-with } y)]$
 x helps y

When (48) receives the indexing in (49)a, it gets interpreted as (49)b, which means in essence: *if a man shares an apartment with another man, each man who shares an apartment with another man shares the housework with each man who share an apartment with him*—convoluted, no doubt, but arguably correct. The inverse indexing, represented in (49)a', yields an incorrect resolution because the underlined variable is free. But as was the case for Heim's second theory, we could solve the problem by positing that in this case the object pronoun scopes over the subject pronoun.

Despite this initial success, Neale's analysis encounters numerous problems, summarized in Kanazawa (2001). The heart of the matter is that Neale treats as number-neutral a pronoun which is intuitively singular. Kanazawa mentions, among others, the following difficulties.

- (i) The number-neutral theory fails to explain why *them* is more natural than *it* in (50).
- (50) Every farmer who owns at least one donkey beats them.
- (ii) It also fails to account for the semantic contrast between (51)a, which has an existential reading (*beat it* \approx *beat a donkey that they have*), and (51)b, which has a universal reading (*beat them* \approx *beat all the donkeys that they have*).

- (51) a. At least two farmers who own a donkey beat it.
 b. At least two farmers who own some donkeys beat them.
- (iii) Quite generally, singular donkey pronouns lack interpretations typically associated with plurals. In particular, they have no collective interpretation, as shown by the deviance of (52)b.
- (52) a. Every farmer who owns one or more donkeys rounds them up at night.
 b. #Every farmer who owns more than one donkey rounds it up at night.

This raises two questions. First, where does the obligatory distributivity come from? Second, if distributivity is obligatory with all donkey pronouns (irrespective of number), why is (53)a interpreted as (53)b (= the meaning obtained if *them* is read collectively) rather than (53)c (= the meaning obtained if *them* is read distributively)? It seems that one must stipulate that morphologically singular donkey pronouns are distributive, while plural donkey pronouns need not be.

- (53) a. Every man who bought two beers bought four others along with them.
 b. Everyman who bought at least two beers bought at least six beers.
 c. Every man who bought at least two beers bought at least five beers.

Unsurprisingly, Neale's analysis encounters related difficulties with sign language data. Let us just consider one example from ASL.

(54) **ASL**

Context: In chess, at most one person can win. So...

- a. WHEN _aSOMEONE PLAY WITH _bSOMEONE, IMPOSSIBLE IX-a WIN
 'When someone plays with someone, it's impossible that the former wins.'
 Follow-up: What is impossible? Answer: 'that player A can beat player B.'
- b. WHEN _aSOMEONE PLAY WITH _bSOMEONE, IMPOSSIBLE
 THE-TWO-a,b WIN
 'When someone plays with someone, it's impossible that both win.'
 Follow-up: What is impossible? Answer: 'that both A and B will win.'
 (Inf 1, i P1040987; i P1040991)

As in Kanazawa's English examples, Neale's analysis predicts that singular donkey pronouns should have the same readings as plural distributive pronouns. Specifically, the meaning that Neale would predict for (54)a is represented in (55), where the number-neutral description has scope under *impossible* (and is read distributively):

- (55) when [an x : human(x)]₁[a y : human(y) & $y \neq x$]₂(x plays-with y),
 impossible [whe x : human(x) & [a y : human(y) & $y \neq x$]
 (x plays-with y)] x wins.

This predicts a reading which is always true given the rules of chess: in any given game, it's impossible for the players to both win. This *is* the reading obtained in

(54)b, where a dual pronoun indexes both antecedents; but this is definitely not the reading obtained in (54)a.

Unlike Elbourne (2005), the E-type accounts we discussed in this section do not have a particularly compelling solution to the problem of the formal link, since they require quite complicated stipulations. But even if we grant their analysis of the formal link, these accounts face significant empirical difficulties with respect to our sign language data. We conclude that dynamic approaches are to be preferred over E-type approaches (unless the latter come extremely close to their dynamic competitors).

5 Anaphora to generalized quantifiers

It remains to see whether sign language data can be used to distinguish between the two main dynamic accounts. Let us remind ourselves of their main properties:

- (56) a. **Mixed Solution** (simplified version of Kamp and Reyle 1993)
- Donkey pronouns with indefinite antecedents are treated as variables which are dynamically bound.
 - Donkey pronouns with non-indefinite antecedents are treated as E-type pronouns.
- b. **Pure Solution** (e.g. van den Berg 1996a,b; Nouwen 2003; Brasoveanu 2006)
- All donkey pronouns are treated as variables which are dynamically bound.
 - Non-indefinite quantifiers introduce not just discourse referents, but also maximality conditions.

Thus the prediction of pure dynamic accounts is that the formal link between a donkey pronoun and its antecedent should be the same when the latter is indefinite as when it is non-indefinite. Mixed dynamic accounts make no such prediction. We will now show that the same formal link is used whether the antecedent is indefinite or not. This does not strictly refute the mixed account—it could be that both types of anaphoric links are realized in the same way; but it makes this account less plausible.

The striking fact, then, is that in all the following examples the very same mechanism is used for non-indefinite antecedents as for indefinite antecedents: in both cases, a locus is established by the antecedent, and the pronoun then points towards that locus. The data in (57)–(58) pertain to negative quantifiers; the data in (59)–(60) show that a variety of generalized quantifiers behave in similar fashion—including proportional quantifiers, which in the framework of Kamp and Reyle (1993) are crucially handled by an E-type-like mechanism (specifically, for them a

donkey pronoun anaphoric to a proportional quantifier cannot be handled in terms of dynamic binding, and it must be given the semantics of an E-type pronoun³⁰).

(57) **ASL**

- a. IF _a[LESS FOUR STUDENT] a-COME PARTY, IX-arc-a WILL BORED.
Follow-up question: Who would get bored? Answer: ‘all student partygoers’.
‘If fewer than four students come to the party, they [= the students that come] will get bored.’ (Inf 1, i P1040994; P1040995; see also i, 1)
- b. IF LESS _a[THREE FRENCH PERSON HERE] AND LESS _b[FIVE AMERICAN PERSON HERE], IX-arc-a WILL GREET-b IX-arc-b
‘If less than three Frenchmen were here and less than five Americans were here, they [= the Frenchmen] would greet them [= the Americans].’
(Inf 1, 2, 117)

(58) **LSF**

- a. IF STUDENT _aIX-open-hand³¹ FIVE LESS SICK FALL, IX-arc-a BORED.
‘If fewer than five students fall sick, they will be bored.’ (Inf H, 17, 30; 31)
- b. HERE IF PEOPLE _a[FRENCH THREE LESS] _b[AMERICAN FIVE LESS], IX-a a-GREET-b.
‘If fewer than three Frenchmen were here and fewer than five Americans were here, they [= the Frenchmen] would greet them [= the Americans].’
(Inf I 16, 40; 41)

(59) **ASL**

- a. IF _a[HALF STUDENT] a-COME PARTY, IX-arc-a WILL BORED.
Follow-up question: Who would get bored? Answer: ‘all student partygoers’.
‘If half the students come to the party, they [= the students that come] will get bored.’ (Inf 1, i P1040994; P1040995)
- b. IF _a[MOST STUDENT] a-COME PARTY, IX-arc-a WILL BORED.
Follow-up question: Who would get bored? Answer: ‘all student partygoers’.
‘If most students come to the party, they [= the students that come] will get bored.’ (Inf 1, i P1040994; P1040995)
- c. IF _a[20 % STUDENT] IX-arc-a a-COME PARTY, IX-arc-a WILL BORED.
Follow-up question: Who would get bored? Answer: ‘all student partygoers’.
‘If 20% of the students come to the party, they [= the students that come] will get bored.’ (Inf 1, i P1040994; P1040995)

³⁰ As was mentioned in Sect. 1.2, cardinal quantifiers—including negative ones—can be given two treatments in Kamp and Reyle’s analysis: using the same E-type strategy as for proportional quantifiers; or with dynamic binding combined with maximality conditions, essentially along the lines of van den Berg’s account.

³¹ What I transcribe as *aIX-open-hand* is not a pointing sign, but a circular motion of the open hand in a particular locus (here locus *a*).

(60) **LSF**

Note: in example b., locus b seems to be a subpart of the larger area corresponding to locus a; similarly, in example c., locus a seems to be a subpart of the larger area corresponding to locus b.

- a. IF STUDENT _aIX-open-hand HALF SICK FALL, IX-a BORED.
'If half the students fall sick, they [= the students who are sick] will be bored.'
(Inf H, 17, 24a; 25; cf. also Inf I, 16, 43; 44)
- b. IF STUDENT _aIX-open-hand _bMOST IX-b SICK FALL, IX-arc-b BORED.
'If most of the students fall sick, they [= the students who are sick] will be bored.'
(Inf H, 17, 26; 27; cf. also Inf I, 16, 43; 44)
- c. IF STUDENT _bIX-open-hand _aGROUP IX-a 20 % SICK FALL, IX-a BORED.
'If 20% of the students fall sick, they [= they students who are sick] will be bored.'
(Inf H, 17, 24c; 25; cf. also Inf I, 16, 43; 44)

These data suggest that the same anaphoric mechanism is used irrespective of the quantificational nature of the antecedent. This fact is of course compatible with the E-type analysis, but we saw in our discussion of bishop sentences that it faced other problems in bishop sentences. Within dynamic analyses, these data provide some support for the 'pure solutions' developed by van den Berg and others. Mixed solutions could account for them, but at the price of positing that indexing in sign language corresponds to two rather different formal mechanisms: dynamic binding for indefinite quantifiers, and an E-type mechanism for other antecedents.

We conclude that, among dynamic approaches, sign language data favor uniform accounts according to which *all* quantifiers (not just indefinites) introduce discourse referents and can bind pronouns that are outside of their c-command domain.

6 Binding across negation

Even if it is granted that quantifiers can bind pronouns outside of their syntactic scope, it remains to ask what conditions, if any, constrain this non-standard binding. Early dynamic approaches (be it DRT or dynamic logic) posited that negation—and many other operators—'break' the formal connection between a pronoun and its antecedent (e.g. Kamp 1981; Heim 1982; Kamp and Reyle 1993; Groenendijk and Stokhof 1991). One might initially think that such a measure is justified by the deviance of (61)b:³²

- (61) a. John has an umbrella. It is red.
- b. #John doesn't have an umbrella. It is red.

On closer inspection, however, there are two ways in which one could account for the deviance of (61)b:

³² Note that although (61)b could potentially involve a wide scope reading for the existential quantifier relative to negation, this is extremely unlikely, as it would make the first sentence trivially true. The natural reading is one on which the sentence means that *John doesn't have any umbrella*.

Theory I: Dynamic binding is impossible across negative expressions.

Theory II: Dynamic binding is possible across negative expressions, but pronouns come with a presupposition that they should have a non-empty denotation.³³

A version Theory I is implemented in standard dynamic accounts. Theory II is motivated by the intuition that the first sentence in (61)b *fails to have existential import*, in the sense that one cannot infer from it that the maximal set of umbrellas that John has is non-empty (note that this analysis is also compatible with standard E-type accounts; it is for other reasons that these were dismissed in Sect. 4). The idea is that it is this failure of existential import, rather than the presence of negation *per se*, which is responsible for the deviance of the sentence: if *it* in (61) comes with a presupposition that its denotation (the maximal set of umbrellas that John bought) is non-empty, we have a straightforward explanation of the contrast between (61)a and (61)b (we come back in Appendix 2 to some technical consequences of this presuppositional treatment).

The natural way to decide between Theory I and Theory II is to add a further negation on top of (61)b: if negations always block dynamic binding, the resulting anaphoric link should be just as impossible with two negations as it is with one; on the other hand, if the problem in our initial example was caused by existential import, it should be solved when a second negation is added, since semantically the two negations ‘cancel each other out’. English data might initially seem to favor Theory II (but see Krahmer 1998 for discussion):

(62) It is not true that John doesn’t have an umbrella. I have just seen it: it is red.

There is a difficulty, however: as was mentioned at the outset, some dynamic theories (e.g. Kamp and Reyle 1993) allow for an E-type mechanism of anaphora *in addition to* dynamic binding. If so, it might be that in (62) dynamic binding is indeed blocked by the negations, but that *it* is really an E-type pronoun with the meaning: *the umbrella*, or *John’s umbrella*.

6.1 Double negatives

Sign language has the advantage of making anaphoric relations overt. Since we argued in Sect. 4 that an E-type approach cannot deal with some of the crucial data, we will take pointing to represent some version of (dynamic) binding. The key question, then, is whether examples such as (62) are realized by pointing towards the locus introduced by *an umbrella*, *despite* the intervention of two negative expressions.

The following examples suggest that such an indexing is in fact possible. (63)a involves dynamic binding in a simple assertive environment. (63)b displays a deviance which is expected under both Theory I and Theory II: *some Republican* is in the scope of the single negative expression *no Democrat*, and as a result the

³³ The view that rules of presupposition projection might on their own play a crucial role in the resolution of anaphora within dynamic systems was first mentioned to me by Sam Cumming, who in turn made reference to Brasoveanu (2006).

pronoun cannot index *some Republican*. The crucial data are in (63)c, where we see that adding a negation—which has the effect of re-establishing the existential import found in (63)a—makes the anaphoric link possible again (a follow-up question was also used to make sure that the pronoun was indeed understood to refer to *the Democrat who cosponsors the bill with a Republican*).

(63) ASL

- a. IX-1 THINK _a[SOMEONE DEMOCRAT PERSON] WILL MATCH SUPPORT HEALTH CARE BILL WITH _b[SOMEONE REPUBLICAN PERSON]. IX-1 THINK IX-a WILL a-GIVE-b A-LOT MONEY.
‘I think that a Democrat will co-sponsor the healthcare bill with a Republican. I think he [= the Democrat] will give him [= the Republican] a lot of money.’
(Inf 1, 2, 228a; i P1040976)³⁴
- b. # IX-1 THINK NO _a[DEMOCRAT PERSON] WILL MATCH SUPPORT HEALTH CARE BILL WITH _b[REPUBLICAN CL]. IX-1 THINK IX-a WILL a-GIVE-b A-LOT MONEY. (Inf 1, 2, 228b; i, P1040976)³⁵
- c. IX-1 DOUBT _a[NO DEMOCRAT PERSON _aIX-open-hand] WILL MATCH SUPPORT HEALTH CARE BILL WITH _b[REPUBLICAN CL]. IX-1 THINK IX-a WILL a-GIVE-b A-LOT MONEY. (Inf 1, 2, 229 (see also 228c); i, P1040976)
‘I don’t think no Democrat will cosponsor the healthcare bill with a Republican. I think he [= the Democrat] will give him [= the Republican] a lot of money.’
Follow-up: Who will give money? Answer: ‘the person who cosponsors’ (2, 229)/‘the Democrat who cosponsors the bill’ (i, P1040976)

In the preceding examples, we took pains to include several antecedents in order to force assignment of clear non-default loci. But this also means that pointing might conceivably have some other function; for instance, it has been suggested that loci can somehow be licensed whenever two things or situations are in a vague sense

³⁴ Two additional remarks about (63)a.

- (i) In i P1040976, Inf 1 also answered the question: ‘Who will give the money?’ and answered: ‘the Democrat who cosponsors the bill’.
- (ii) We included *THINK* in this example to obtain a complete paradigm that allowed for embedding of *no democrat* under a negative expression. But the same pattern holds with indefinites that are not embedded under an attitude verb:
 - (i) _a[SOMEONE DEMOCRAT CL] WILL MATCH SUPPORT HEALTH CARE BILL WITH _b[SOMEONE REPUBLICAN CL] BUT IX-a WILL a-GIVE-b A-LOT MONEY. (Inf 1, 2, 225)
‘Some Democrat will cosponsor the healthcare bill with some Republican, but he [= the Democrat] will give him [= the Republican] a lot of money.’

³⁵ In P1040976, Inf 1 says that the sentence is acceptable but that its meaning is odd (and he writes that it’s ‘illogical but not impossible’). To the question ‘Who will give the money?’, he answers: ‘all the Democrats’ (rather than: ‘the Democrat who cosponsors the bill’, as in (63)a–c). This suggests that in this case the pronoun is anaphoric to the Noun Phrase *DEMOCRAT* rather than to a quantifier.

being ‘compared’ (Winston 1995). In (64), a single antecedent was used, and indexing was clearly possible:

(64) **ASL**

- a. # IX-1 DOUBT _aSOMEONE WILL GO MARS. IX-a WILL FAMOUS
(Inf 1, i, P1040982; i, P1040983)
- b. IX-1 NOT DOUBT _aSOMEONE WILL GO MARS. IX-a WILL FAMOUS (Inf 1, i, P1040982; i, P1040983)
‘I don’t doubt that someone will go to Mars. He will be famous.’
Follow-up: Who will be famous? Answer: ‘the one who goes to Mars’.

It is also noteworthy that the same pattern arises with the quantifier *NO ONE*, which is literally composed of *NO* (or *NONE*) and *ONE*³⁶:

(65) **ASL**

- a. # IX-1 THINK NO _aONE WILL GO MARS. IX-a WILL FAMOUS.
(Inf 1, i, P1040980b; i, P1040981)
- b. IX-1 NOT THINK NO _aONE WILL GO MARS. IX-a WILL FAMOUS.
(Inf 1, i, P1040980c; i, P1040981)
‘I don’t think no one will go to Mars. He [= the person who goes to Mars] will be famous.’
Follow-up: Who will be famous? Answer: the one who goes to Mars
- c. IX-1 DOUBT NO _aONE WILL GO MARS. IX-a WILL FAMOUS.
(Inf 1, i, P1040980; i, P1040981)
‘I don’t think no one will go to Mars. He [= the person who goes to Mars] will be famous.’
Follow-up: Who will be famous? Answer: the one who goes to Mars.

The same facts hold in the examples we elicited in LSF, although the syntax of our consultant’s examples is quite different. Here two separate sentences are used to express the negation of the universal negative statement. Literally, it comes out as something like: *No member of UMP [= the right-wing party] will accept to write a bill with a member of PS [= the Socialist Party]—this is not true*. Despite this rather complex syntax, the initial position of the indefinite for *a member of PS* remains available for further anaphoric uptake.

(66) **LSF**

Note: UMP is the (right-wing) governing party in France; PS is the opposition socialist party

- c[PERSON UMP] IX-c ACCEPT WRITE LAW a-WITH _a[PERSON PS]—NONE; IX-b³⁷ TRUE NOT. BUT IX-c MONEY c-GIVE-a.

³⁶ We include both (65)b and (65)c because Inf 1 preferred to avoid *NOT THINK* + *negative expression*, and preferred *DOUBT* + *negative expression*.

³⁷ This pronoun is plausibly in a default locus, in front of the signer.

‘It is not true that no UMP member will accept to write a bill with a member of PS. But he [= the member of UMP] will give him [= the member of PS] money.’ (Inf F, 3, 107)

It should be noted that the data in (63)c (and possibly (65) and (66)) also make another point: the sign language analogues of the negative quantifier *no Republican* can also introduce a discourse referent which is in principle available for further anaphoric uptake. When the initial sentence is unembedded, this is not possible because the quantifier lacks existential import. But upon embedding under negation, the quantifier does acquire existential import (since *not [no P] Q* is equivalent to *[some P] Q*), and an anaphoric connection becomes possible again. This is expected under Theory II, but not under Theory I.

6.2 Disjunctions

Several theories of presupposition projection predict that a presupposition triggered in the second position of a disjunction can be justified if it is (contextually) entailed by the *negation* of the first disjunct, as illustrated in (67)a (e.g. Beaver 2001; Chemla 2009; George 2008a, b; Schlenker 2008, 2009).

- (67) a. Either there is no bathroom in this house or the bathroom is well hidden.
 b. Either there is no bathroom in this house or it is well hidden. (attributed to B. Partee; see also Geach 1962 and Evans 1977)

The same facts extend to anaphora resolution, as shown in (67)b, but as was the case for binding across negations, these facts are compatible with two theories: Theory I takes binding to be impossible, and the relevant pronoun to be E-type; Theory II takes these examples to involve genuine binding.

Our ASL data argue in favor of Theory ii: pointing towards the locus introduced by the negative quantifier appears to be possible in these examples (we have not tested such examples in LSF).

(68) ASL

- a. EITHER NO_a[DEMOCRAT_aIX-open-hand] WILL MATCH SUPPORT HEALTH CARE BILL WITH_b[REPUBLICAN CL] OR IX-a WILL a-GIVE-b A-LOT MONEY.
 ‘Either no Democrat will cosponsor the healthcare bill with a Republican, or he [=the Democrat] will give him [=the Republican] a lot of money. (Inf 1, 2, 230; P1040977; see also Inf 1, 2, 134; 136; 137; 138; 148)
 Follow-up: Who will give money? ‘one Democrat’ (2, 230) / ‘likely the democrat who cosponsors the bill’ (i, P1040977).
 b. NO_a[REPUBLICAN PERSON] WILL INTRODUCE_c[ANY INDEPENDENT] WITH_b[ANY DEMOCRAT] OR IX-a WILL a-TELL-c NOT TRUST IX-b.
 ‘No Republican will introduce any Independent to any Democrat, or else he will tell him not to trust him.’ (Inf 1, 2, 150; i, P1040979)

Here too, it is worth asking whether we can find examples that only involve a single potential antecedent. This is indeed the case (Inf 1 had a preference for the (69)b over (69)a, but he deemed both acceptable; the difference lies in the nature of the disjunction).

(69) **ASL**

- a. NO _aONE WILL GO MARS, OR IX-a WILL FAMOUS
 ‘No one will go to Mars, or he [= the person who goes to Mars] will be famous.’ (Inf 1, i P1040984; i P1040985)
 Follow-up: Who will be famous? Answer: ‘the one who goes to Mars’.
- b. EITHER NO _aONE WILL GO MARS, OR IX-a FAMOUS
 ‘No one will go to Mars, or he [= the person who goes to Mars] will be famous.’ (Inf 1, i P1040984; i P1040985)
 Follow-up: Who will be famous? Answer: ‘the one who goes to Mars’.

On the basis of our data involving double negations and negations within disjunctions, we conclude that negative expressions need not ‘break’ the anaphoric connection between a pronoun and its antecedent; in such cases, however, a presupposition that the pronoun denotes a non-empty group must always be satisfied.³⁸

7 Concluding remarks

We hope to have shown that sign language data can be of great relevance to address some foundational debates in formal semantics. Our current conclusions—which will no doubt have to be refined or corrected when more consultants and more sign languages are considered—can be summarized as follows.

- (i) To the extent that E-type approaches are distinct from dynamic approaches, sign language data favor the latter.
- (ii) Among dynamic analyses, sign language data favor recent approaches in which *all* quantifiers (rather than just indefinites) introduce discourse referents.
- (iii) Our data also suggest that negative expressions do not always disrupt the relation between a pronoun and its antecedent. Rather, two negative expressions can cancel each other out and thus ‘restore’ the anaphoric potential that is apparently destroyed by a single negation. This, in turn, suggests that blocking of anaphora by negative expressions results from a presuppositional problem (= the existential presupposition of the pronoun is not satisfied), rather than from a strictly formal one.

In Appendix 2, we consider rather subtle data involving disjunctive antecedents (e.g. *If Mary sees a donkey or a horse, she waves to it*). We argue that these cases give rise to subtle differences between overt sign language pronouns on the one

³⁸ Although we got clear judgments from our consultants, a referee notes that these data might be more controversial than others found in this paper; work with further consultants is necessary for all parts of this work, but particularly so for the present section.

hand, and null sign language pronouns and English pronouns on the other, and we offer a preliminary analysis of this modality-determined distinction. We also suggest that spoken language uses counterparts of loci when it employs expressions such as *the former... the latter*, which recover their antecedents by reference to their linear position in a sentence; and we speculate that in examples involving disjunctive antecedents, these expressions might obey the same conditions as overt sign language pronouns.³⁹

Appendix 1: Scale-based judgments on ASL bishop sentences

In transitive bishop sentences, our ASL consultant often displays a preference for the subject–subject/object–object connection found in (39) over the inverse pattern illustrated in (41). In fact, in a few cases he found the latter to be on the ‘unacceptable’ side in a binary judgment task. But a scale-based task reveals that his judgments are more subtle; the following scores are on a 7-point scale (7 = good; 1 = bad); they were repeated over a 9-day interval.

- (70) WHEN _aONE LIVE WITH _bONE,
 ‘When someone lives with someone,’
 a. IX-a LOVE IX-b
 Score: 7 ‘good’, 7 ‘good’
 ‘the former loves the latter.’
 b. IX-b LOVE IX-a
 Score: 5 ‘soso’, 6 ‘ok’
 ‘the latter loves the former.’

³⁹ Two important questions are left for future research.

(i) On an empirical level, sign language data could bring new light to two further issues.

—Functional readings of pronouns: pronouns can sometimes have functional readings when they have indefinite antecedents [e.g. *Three students (each) wrote a paper. They (each) sent it to L&P*, where *it* recovers a functional dependency between students and papers (Nouwen 2003; see also Brasoveanu 2006)]. Functional readings also arise with definite antecedents—notably in ‘paycheck sentences’ [e.g. *The woman who deposited her paycheck in the bank was wiser than the woman who deposited it in the Brown University Employees’ Credit Union* (Jacobson 2000)]. It is an open question if and how such readings can be realized with sign language pronouns.

—‘Complement set’ readings: under restricted conditions, a donkey pronoun can refer to the complement within the restrictor set of the witness of the antecedent sentence [e.g. *Few MPs attended the meeting. They stayed home instead.* (Nouwen 2003)]. Here too sign language data could prove useful.

(ii) On a theoretical level, we have solely considered the debate between *existing* theories of donkey anaphora. While we have argued that *within the debate between E-type accounts and dynamic accounts*, sign language data favor the latter, we have not tried to delineate *how much of the dynamic framework is actually needed*. This is important in view of a broader debate about dynamic semantics. Thus it was argued in Schlenker (2008, 2009), Chemla (2009), George (2008a, b), and Fox (2008) that dynamic semantics is not needed to account for presupposition projection. But these accounts did not consider arguments from anaphora resolution. The present article suggests that, at a very least, *some* mechanism should be devised to make binding possible without c-command; but it does not show that the entire dynamic framework is needed to obtain this result.

- c. IX-a LOVE IX-a
Score: 3 ‘borderline unacceptable’, 4 ‘borderline acceptable’
- d. IX-b LOVE IX-b
Score: 2 ‘unacceptable’, 3 ‘borderline unacceptable’
(Inf 1 i P1040962; i P1040963, i P1040972, i P1040996)

From the standpoint of Heim (1990), the fact that (70)b is slightly degraded might arguably be due to the fact that the object pronoun must be moved across the subject pronoun to be interpreted (see the discussion of (43) in Sect. 4.2.2). This makes a prediction: if the movement of the object pronoun is blocked by a syntactic island, the inverse pattern of antecedence should be entirely blocked. (71)c suggests that this is not clearly the case: while possible degraded (with an unstable judgment), (71)b is still better than a case of *wh*-extraction out of a syntactic island, illustrated in (72)d (see Lillo-Martin 1990 for a discussion of some island effects).

- (71) WHEN _a[FRENCH MAN] MEET _b[FRENCH MAN],
‘When a Frenchman meets a Frenchman,
- a. IX-a WONDER WHO IX-b LIVE WITH.
Score: 7 ‘good’, 7 ‘good’
the former wonders who the latter lives with.’
 - b. IX-b WONDER WHO IX-a LIVE WITH.
Score: 3 ‘borderline unacceptable’, 6 ‘ok’
the latter wonders who the former lives with.’
 - c. #IX-a WONDER WHO IX-a LIVE WITH.
Score: 2 ‘unacceptable’, 6 ‘ok’
the former wonders who he (himself) lives with.’
 - d. #IX-b WONDER WHO IX-b LIVE WITH.⁴⁰
Score: 1 ‘bad’, 5 ‘soso’
the latter wonders who he (himself) lives with.’
(Inf 1, i P1040945; i P1040946, i P1040955, i P1040968, i, P1040997)
- (72) a. IX-2 THINK IX-1 FINISH BUY BOOKS
‘You think I bought books.’
Score: 7 ‘good’, 7 ‘good’
- b. WHAT IX-2 THINK IX-1 FINISH BUY Q?
‘What do you think I bought ?’
Score: 7 ‘good’, 7 ‘good’
 - c. IX-2 WONDER WHAT IX-1 FINISH BUY
‘You wonder wht I bought.’
Score: 5 ‘soso’, 7 ‘good’

⁴⁰ Our consultant remarked that (71)c–d would make much more sense if we added *SHOULD* to obtain: *IX-a WONDER WHO IX-a SHOULD LIVE WITH*. This is of course expected, since the latter sentence makes perfect sense on a coreferential reading.

- d. WHAT IX-2 WONDER WHO FINISH BUY
 Intended: For which x do you wonder what x bought?
 Score: 1 ‘bad’, 1 ‘bad’
 (Inf 1, i P1040939; i P1040940, i, P1040974, P1040998)

Appendix 2: Overt sign language pronouns versus other pronouns: the case of disjunctive antecedents

In this appendix, we discuss puzzling cases in which a singular pronoun appears to have disjunctive antecedents, and we show that this environment gives rise to subtle contrasts between overt sign language pronouns and other pronouns. We offer an analysis that builds on earlier parts of this article: binding can arise without c-command; pronouns can simultaneously carry several indices; in addition, they are subject to presuppositions that depend in part on the presence of distinct loci and on the nature of the pronouns themselves. We suggest that the data found in spoken language can be replicated with null pronouns in sign language; and that the patterns peculiar to overt sign language pronouns can be reproduced with some non-standard anaphoric expressions in spoken language (specifically: *the former ... the latter* or *the first... the second... the third*).

□ *Disjunctive antecedents in English*

In English, a pronoun can have ‘disjunctive antecedents’:

(73) If Mary sees a donkey or a horse, she waves to it. (Elbourne 2005)

(74) If Mary catches a fish or John traps a rabbit, Bill cooks it. (Stone 1992)⁴¹

In these examples, *it* may denote *whichever donkey or horse Mary sees* (in (73)) or *whichever fish Mary catches and whichever rabbit John traps* (in (74)). Importantly, this pattern is also possible when a disjunction of full propositions is involved, as in (74).

Stone (1992) notes that these examples pose difficulties for standard dynamic semantics. Brasoveanu (2008, fn. 94) and Wang (2005, Sect. 7.5) develop dynamic frameworks that can deal with them. For instance, Brasoveanu postulates that a disjunction has the effect of making available a discourse referent that denotes the *sum* of the objects that witness the truth of the disjuncts. Here we will briefly sketch a slightly different solution, which is based on two simple assumptions (see Schlenker 2011 for discussion⁴²).

⁴¹ Thanks to an anonymous NELS reviewer for suggesting that we consider instances of propositional disjunction.

⁴² The following discussion borrows from the presentation in Schlenker (2011).

- (75) **Assumption 1: discourse referents** (van den Berg 1996 a, b; Nouwen 2003; Brasoveanu 2006)

All quantifiers (not just indefinites) introduce discourse referents, often with maximality conditions.

To give a simplified example, *fewer than five donkeys* in (76) is taken to introduce a discourse referent X in the Logical Form in (76)b, and it is specified that (i) X denotes the maximal group of donkeys that John owns, (ii) the denotation of X includes fewer than five objects, and (iii) John stands in the relation of *beating* to the denotation of X . The interpretive procedure should be set up so as to guarantee that the discourse referent X is given existential force.

- (76) a. John owns [fewer than five donkeys]_X. He beats them_X.
 b. $X = [\text{Max } X': \text{donkey}(X') \ \& \ \text{John owns } X'] \ \& \ <5(X) \ \& \ \text{John beats } X$
Paraphrase: 'The maximal group X of donkeys that John owns contains fewer than five individuals, and John beats X .'

As was shown in Sect. 5, this type of analysis has the advantage of accounting for non-trivial data in sign language, since all sorts generalized quantifiers—not just indefinites—can be indexed by ASL and LSF pronouns.

Our second assumption is that pronouns (in spoken language as well as in sign language) can carry several indices:

- (77) **Assumption 2: multiple indexing**

Pronouns can have split antecedents and simultaneously carry several indices.

This assumption is rather natural for sign language, since dual and plural pronouns in ASL and LSF can visibly index several loci at the same time. But this assumption is also uncontroversial for spoken language: in (78), multiple indexing is essential to account for the observed ambiguity (any multiple indexing is possible, as long as the indices taken together denote a plurality of individuals).

- (78) [Each boy]_i told [each girl]_k that [each teacher]_m thought they_{i+k / i+m / k+m / i+k+m} should work together.

With this background in mind, we analyze Stone's example as in (79), where X denotes the maximal group of fish that Mary catches, and Y denotes the maximal group of rabbits that John traps. As a result, it_{X+Y} denotes the sum of these two groups (and the fact that *it* carries singular features should yield a presupposition

that in each situation satisfying the antecedent, this sum contains exactly one object⁴³).

(79) If Mary catches [a fish]_X or John traps [a rabbit]_Y, Bill cooks it_{X+Y}.

For simplicity, we will treat all disjunctive examples discussed below as if they involved propositional disjunction (for reasons of naturalness of brevity, most involve disjunction of DPs; analyzing them without our simplification would require a longer discussion).

□ *Disjunctive antecedents in ASL and LSF: Generalizations*

ASL and LSF give rise to a complex pattern in such examples. For simplicity we will concentrate on sign language versions of the sentences in (80), and we will call the reading obtained in both cases (where the pronoun refers to *the winner(s)*) the ‘donkey reading’.

- (80) a. [An African-American male]_X or [an Asian-American male]_Y will win the next presidential election. He_{X+Y} will win by a landslide.
Salient reading: Whichever of the two candidates wins will do so by a landslide.
- b. *Context:* There is a competition by teams of three.
 If [three Frenchmen]_X or [three Germans]_Y win, they_{X+Y} will get a gold medal.
Salient reading: Whichever of the two teams wins will get a gold medal.

The pattern we obtained is complex because signers must make at least two choices when signing such sentences: (a) they may assign distinct positions to the disjuncts, or sign both within a default locus; (b) they can have an overt pronoun in the second clause, or no overt pronoun at all.

The possibility in (b) requires a comment. Lillo-Martin (1986) shows that null pronouns are systematically available with agreement verbs, and that under certain discourse conditions they can be found with plain verbs. The latter case is what matters for our disjunctive examples; it is illustrated with one of Lillo-Martin’s examples in (81):

- (81) _aJOHN _aFLY _bCALIFORNIA LAST-WEEK. ENJOY SUNBATHE[dur].
 ‘John flew to California last week. (He’s) enjoying a lot of sunbathing.’
 (Lillo-Martin 1986)

⁴³ This might predict presuppositions that are too strong. Specifically, we might predict a presupposition that *either* Mary catches a fish *or* John traps a rabbit, but not both—which is not clearly correct (nor clearly incorrect). In the case at hand, the presuppositions depend on the precise treatment we adopt for *if*-clauses, and on our ontology of situations. In case an *if*-clause only selects *minimal* situations (as is assumed by E-type accounts, which we do not otherwise follow), then these might never include both Mary catching a fish *and* John trapping a rabbit; and this, in turn, would guarantee that the presupposition of the consequent is satisfied *even if both propositions are simultaneously true*. In the general case, however, these examples should be analyzed in the context of the debate on maximal vs. non-maximal readings of donkey pronouns; see for instance Brasoveanu (2008) for a recent discussion.

Lillo-Martin's generalization and analysis is that null pronouns should be able to "occur in ASL with nonagreeing verbs in just the same places in which null pronouns occur in Chinese" according to the analysis of Huang (1984), based on licensing by null topics. Neidle et al. (2000) propose a different theory. According to them, "once the nonmanual realizations of syntactic agreement are recognized, a simple account of the distribution of *pro* emerges: *pro* in ASL is licensed by an appropriate (manual or nonmanual) expression of agreement". We will remain neutral among the two approaches, but one point is crucial for our analysis: in the case of disjunctive antecedents, the null pronouns should not *overtly* index the loci associated with their antecedents.⁴⁴

Our data suggest the following preliminary generalizations.

- (i) When separate loci are assigned to the two antecedents, ASL and LSF can use a null pronoun to obtain the donkey reading found in English in (80). When an overt pronoun is used, two cases arise.
 - (a) If the pronoun just indexes a 'default locus' (towards the center of the signing space), a donkey reading may or may not be obtained depending on the examples and on the language (more work is needed here).
 - (b) If the pronoun indexes the two antecedents, a donkey reading is impossible or very hard to obtain.
- (ii) In addition, it is possible in both ASL and LSF to assign *the same locus* to both antecedents (this appears to be a default position, in front of the signer—see for instance Neidle et al. 2000 for discussion). In such cases, both a null pronoun and an overt pronoun can be used to produce the meanings found in (80).

The pattern is summarized in (82) and immediately illustrated with ASL and LSF examples.

(82) Availability of the donkey reading of (80) in ASL and LSF

	Antecedents in different loci	Antecedents in the same (default) locus
Null Pronoun	A. possible	B. possible
Visible Pronoun	C1. variable if the pronoun indexes a default locus	
	C2. impossible or very hard if the pronoun indexes the loci of both antecedents	D. possible

We start by illustrating the patterns in A, B, C1 and D with singular examples. The pattern in C2 requires a discussion of plural examples, because for morphological reasons a singular pronoun couldn't simultaneously index several antecedents.

⁴⁴ A referee writes that 'it would seem that overt pronouns would be greatly preferred' in our examples. We can only say that both our ASL and our LSF consultants signed versions of (80) without an overt pronoun. But of course work with further consultants is needed to explore these data in greater depth.

• Singular examples

(83) Disjunctive antecedents in ASL

Note: *IX-m* points towards the middle [default] position *m*.

a. Overt [default] pronouns: ok same locus, ??? different loci

- a1. _mBLACK OR _mASIA WILL WIN NEXT PRESIDENT ELECTION.

IX-m WILL WIN AHEAD

(Inf 1, 2, 185a; 8, 74; 8, 152; cf. also 8, 67a, 68).

- a2. ? / ??⁴⁵ _aBLACK OR _bASIA WILL WIN NEXT PRESIDENT ELECTION.

IX-m WILL WIN AHEAD. (Inf 1, 2, 185b; 8, 74; 8, 152; cf. also 8, 81, 82, 83, 154).

b. Null pronouns: ok same locus, ok different loci

- b1. _mBLACK OR _mASIA WILL WIN NEXT PRESIDENT ELECTION.

WILL WIN AHEAD. (Inf 1, 8, 67b, 68)

- b2. _aBLACK OR _bASIA WILL WIN NEXT PRESIDENT ELECTION.

WILL WIN AHEAD. (Inf 1, 2, 184; cf. also 8, 81, 82, 83, 154).

‘An African-American or an Asian-American will win the next presidential election. He will win by a large margin.’

(84) Disjunctive antecedents in LSF

Note: Here too, *IX-m* points towards the middle [default] position *m*. PC is the acronym of the French Communist Party.

a. Overt [default] pronouns: ok same locus, ?? different loci

- a1. IF _m[PERSON GREEN] OR _m[PERSON PC] WIN, *IX-m* FIND

MINISTER (Inf F, 4, 58a; cf. Inf F, i, 23a)

- a2. ??IF _b[PERSON GREEN] OR _a[PERSON PC] WIN, *IX-m*⁴⁶

FIND MINISTER (Inf F, 4, 58b; cf. i, 23b)

b. Null pronouns: ok same locus, ok different loci

- b1. IF _m[PERSON GREEN] OR _m[PERSON PC] WIN, FIND

MINISTER (Inf F, 4, 59a)

- b2. IF _b[PERSON GREEN] OR _a[PERSON PC] WIN, FIND

MINISTER (Inf F, 4, 59b; cf. Inf F, i, 21a)

‘If a Green candidate or a communist candidate wins, he will find ministers’

Interestingly, an ASL counterpart of Stone’s example with full propositional disjuncts is possible. In this case, both a null pronoun and a full pronoun indexing a

⁴⁵ A binary task (‘acceptable/unacceptable’) proved insufficiently fine-grained in this case because the sentence has an intermediate status. Depending on the version (2, 185b or 8, 81) the ratings we obtained on a 7-point scale were 3, 3, 4, and 5. These data should be investigated with a more rigorous methodology in the future.

⁴⁶ The consultant seemed to hesitate a bit after *IX_m*.

default locus appear to be possible.⁴⁷ We do not know why the latter option is more readily available than in the preceding examples, and we leave this question for future research.⁴⁸

(85) **ASL**

- a. IF _aMARY FISH-CATCH _bFISH OR _dJOHN TRAP-CATCH
_cRABBIT, BILL WILL COOK. (Inf 1, 8, 69; 8, 70; 8, 164; 8, 181)
- b. IF _aMARY FISH-CATCH _bFISH OR _dJOHN TRAP-CATCH
_cRABBIT, BILL WILL COOK IX-m. (Inf 1, 8, 69; 8, 70; 8, 164; 8, 181)
 ‘If Mary catches a fish of John traps a rabbit, Bill will cook it.’

In our LSF data, a donkey reading is obtained with propositional disjuncts as well; as in our other LSF examples, pointing towards the default locus does not appear to be acceptable.⁴⁹

(86) **LSF**

Context: We are discussing the next presidential elections.

a. Overt pronouns: ok same locus, ??different loci

- a1. IF _m[PERSON CANDIDATE GREEN ELECTED] OR _m[PC ELECTED],
 IX-m FIND MINISTER. (Inf F, i, 26; also Inf F, i, 24)
- a2. ??IF _a[CANDIDATE GREEN ELECTED] OR _b[PC ELECTED], IX-m
 FIND MINISTER. (Inf F, i, 26; also Inf F, i, 24)
 ‘If a green candidate is elected or a communist candidate is elected,
 he will find ministers.’

b. Null pronouns: ok same locus, ok different loci [but in the ‘same locus’ condition, there is a preference for using a full pronoun]

- b1. IF _m[CANDIDATE GREEN ELECTED] OR _m[PC ELECTED], FIND
 MINISTER. (Inf F, i, 25)
 (ok for the consultant, but in this condition she prefers to use an index
 as in a. above).
- b2. IF _a[CANDIDATE GREEN] ELECTED OR _b[PC ELECTED], FIND
 MINISTER. (Inf F, i, 25)
 ‘If a green candidate is elected or a communist candidate is elected,
 he will find ministers.’

⁴⁷ Our consultant deemed the option with the full pronoun was deemed more precise than that with no overt pronoun. The former yields a clear donkey reading (= ‘Bill will cook the fish that Mary catches or the rabbit that John traps’); the version with no overt pronoun is deemed compatible with this reading, but without excluding that Bill will cook something else. More work is needed on this example: it might be that *COOK* is interpreted with no object at all, with a meaning akin to: *will do the cooking*.

⁴⁸ While our ASL consultant’s judgments have usually proven very stable, on the particular question of pronouns indexing a default locus he might have become more liberal over time. We note that a version of (83) with full propositional disjuncts, which was tested more recently than (83), was judged acceptable in *all* conditions, including that corresponding to (83)a2 (Inf 1, 8, 182–183). We leave this issue for future research.

⁴⁹ We found one possible exception to this generalization in LSF. One native informant, Informant F (and another informant, Informant A, who started learning the language when he was 6 years old) produced examples in which separate loci were introduced for the disjunctive antecedents, and the donkey pronoun was realized by pointing *in the middle* of the two loci. But when our native LSF informant watched herself signing this sentence (a routine procedure when judgments are subtle), she found the example to be deviant. As mentioned in the text, the ASL judgments we obtained on this particular question were not stable.

• Plural examples

As was noted at the outset, plural examples are crucial to establish the claim C2 in (82): for morphological reasons, singular pronouns cannot simultaneously index several loci, and thus plural pronouns are needed to determine whether donkey readings are possible with multiple indexing. The answer appears to be that they are not available.

Consider the following paradigms (here we do not include the conditions with a pronoun indexing a default location).⁵⁰

(87) ASL

Context: There is a race by teams of three.

- a. IF _a[THREE FRENCH MEN] EITHER-OR _b[THREE GERMAN MEN] WIN, WILL GET GOLD MEDAL (Inf 1, 8, 89b'; 8, 90; 8, 156; 8, 185; 8, 194; 8, 185)
'If three Frenchmen or three Germans win, they will get a gold medal.'
=> ambiguous; this could mean: *the winners* will get a gold medal.
- b. IF _a[THREE FRENCH MEN] EITHER-OR _b[THREE GERMAN MEN] WIN, IX-arc-a,b WILL WIN GOLD MEDAL (Inf 1, 8, 89c'; 8, 90; 8, 156; 8, 185; 8, 194; 8, 185)
'If three Frenchmen or three Germans win, they will get a gold medal.'
=> preferably means that both groups win a gold medal.⁵¹

(88) ASL

Context: There is a competition by teams of three.

- a. _a[JOHN MARY SALLY] EITHER-OR _b[BILL ANN TINA] WILL WIN. WILL PROUD. (Inf 1, 8, 93b'; 8, 94; 8, 157)
'[John and Mary and Sally] or [Bill and Ann and Tina] will win. They [= the winners] will be proud.'
- b. _a[JOHN MARY SALLY] EITHER-OR _b[BILL ANN TINA] WILL WIN. IX-arc-a,b WILL PROUD. (Inf 1, 8, 93c'; 8, 94; 8, 157)
'[John and Mary and Sally] or [Bill and Ann and Tina] will win. They [= all six] will be proud.'

A similar conclusion can be reached on the basis of the LSF data in (89).

⁵⁰ We used examples involving groups of three people to ensure that a plural pronoun would be acceptable on any reading. When referring to groups to just two individuals, dual pronouns are often preferred to plural pronouns.

⁵¹ Out of four iterations of the judgment task on different days, there was one in which our consultant mentioned that both options (the winner vs. both teams) were possible for b. On the three other occasions, he ruled out a reading on which IX-arc-a,b could just denote the three winners (though the large arc could be justified if a larger group was involved).

(89) **LSF**

Context: There is a race by teams of three.

- a. IF_b[THREE FRENCH] OR_a[THREE GERMAN] WIN, MEDAL GOLD.
'If three Frenchmen or three Germans win, they'll get a gold medal.'
(Inf F, 4, 63d-64)
- b. #IF_b[THREE PERSON FRENCH] OR_a[THREE GERMAN] WIN,
IX-arc-a,b MEDAL GOLD. (Inf F, 4, 67a-68)

Our consultant's reaction was that (89)b was odd because one understood that everybody (three Frenchmen and three Germans) would win a gold medal. Importantly, then, we *failed* to get a donkey reading on which the pronoun refers to *whoever wins*.

We tentatively conclude that when both antecedents are overtly indexed, a donkey reading becomes unavailable.

□ ***Disjunctive antecedents in ASL and LSF: Analysis***

We propose to derive this rather complex pattern from the two assumptions we used above to account for disjunctive antecedents in English (Assumptions 1 and 2, in (75) and (77)), together with a third assumption about the presupposition of pronouns and indexes.

(90) **Assumption 3: presuppositions of pronouns and indexes**

- (i) Each pronoun (of any kind) must denote something: the discourse referents it carries must, *taken together*, be presupposed to denote a non-empty group of individuals.
- (ii) In addition, the same condition applies separately to each overt index in sign language: whenever a locus is activated by an overt pronominal index, the discourse referents it carries must, at the point at which the index appears, be presupposed to denote a non-empty group of individuals.

Let us consider how Assumptions 1, 2 and 3 together account for our data.

–In the English sentence in (80), the only requirement is that $X+Y$ should denote something (by Assumption 3, (i))—a condition which is satisfied when the first sentence is true.

–A sign language sentence with a null pronoun is subject to the same condition, since it involves no pointing sign at all, i.e. it does not overtly index any locus. This accounts for Cells A and B of (82)).

–A sign language sentence with a pronoun that simultaneously indexes two loci comes with a presupposition that *each* of these loci denotes a non-empty group (by Assumption 3, (ii)). Together with the assumption that each quantifier introduces a maximal discourse referent (Assumption 1), this yields an undesirable presupposition in (87)b and (89)b, namely that there is a group of three Frenchmen who will

win *and* there is a group of three Germans who will win; this rules out a donkey reading, and accounts for Cell C2.⁵²

–A sign language sentence in which the disjunctive antecedents and the pronoun all make use of the default locus comes with a requirement that the sum of the discourse referents found in this locus—i.e. $X+Y$ —should denote a non-empty group (this is the same requirement as for the corresponding English sentence). This accounts for Cell D.

Note that we do not make predictions about the empirically unclear case in Cell C1 because further assumptions would be needed about the relation between the default locus indexed by the pronoun and the non-default loci introduced by the antecedents.

We add that Assumption 3 is compatible with the fact that negative quantifiers such as *NO DEMOCRAT* in (63)c *can* establish a locus which will be indexed by a later pronoun (as a reminder, (63)c meant: *I don't think no Democrat will cosponsor the healthcare bill with a Republican. I think he [= the Democrat] will give him [= the Republican] a lot of money*). The crux of the matter is that *NO DEMOCRAT* will have the effect of introducing a discourse referent that refers to the maximal set of Democrats who cosponsor the bill with a Republican. Due to the content of the first sentence (which is positive because of the double negative), when we reach the second sentence this set *is* presupposed to be non-empty. As a result, Assumption 3 (ii) is satisfied: at the point at which this locus is activated by the pronominal index that appears in the second sentence, the corresponding discourse referent is presupposed to denote a non-empty set of individuals.

□ *Loci in spoken language?*

We saw that the patterns we observed with disjunctive antecedents in English can be replicated in ASL and LSF, by either (i) assigning the same locus to both antecedents, or (ii) using a null pronoun. But can we replicate within English the pattern we saw in sign language with distinct loci and overt pronouns?

First, we should note that there are cases in which anaphoric expressions in English and French retrieve their antecedents by making explicit reference to their

⁵² It remains to explain which readings *do* obtain in that case. One possible reading ('all six will get a gold medal') might involve a specific use of the indefinites, which are thus given semantically wide scope. If so, the final truth conditions are: *there is a group X of three Frenchmen and there is a group Y of three Germans such that if X or Y will win, X+Y will get a gold medal* (note that this involves standard rather than donkey anaphora). The corresponding reading of (88)b is straightforward to explain: ${}_a$ [JOHN MARY SALLY] and ${}_b$ [BILL ANN TINA] can both be construed as individual-denoting expressions; standard anaphora yields the observed reading. What does require further explanation, however, is the donkey reading obtained in the English version of this sentence, where *they* can optionally denote *whichever of the two groups wins*. A natural assumption is that all noun phrases, including apparently non-quantificational ones, can introduce maximal discourse referents. In the case at hand, this would allow ${}_a$ [JOHN MARY SALLY] to introduce *the maximal group identical to [John and Mary and Sally] which wins*.

position in space—temporal space rather than signing space. A case in point is the expression *the former* or *the latter*.⁵³

- (91) Although treatment with the Sengstaken-Blakemore tube and intravenous vasopressin is usually effective initially, **the former** can be used for only 24–48 hours and **the latter** may have serious cardiac side-effects.⁵⁴

Second, we can find within this system an approximation—possibly with different grammatical means—of the sign language device by which two loci are simultaneously indexed by the same (dual or plural) pronoun. Thus in (92) it is rather clear that the writer intends *the latter two* to refer to Scotland and Korea, and *the former two* to refer to England and Japan (= the oppressive ‘bully’ neighbors).

- (92) If I could modify this analogy slightly, perhaps it’s more that England is like Japan, and Scotland is like Korea! Certainly **the latter two** have no great love for **the former two**, and have seen them as oppressive ‘bully’ neighbors.⁵⁵

Third, we note that this device can be used in cases in which all antecedents are plural (possibly with a slight deviance due to the fact that in such cases *two* refers to the number of pluralities rather than of individuals).

⁵³ The French expressions *le premier* (‘the first’) and *ce dernier* (‘this last’) can have a similar role.

- (i) a. Louis a téléphoné à Paul et ce dernier l’a rappelé une heure plus tard. (Charolles 1995)
Louis has phoned to Paul and this last him has called-back one hour more late.
 ‘Louis called Paul and the latter called him back an hour later.’
 b. On reçut le candidat local et une candidate de l’extérieur. Le premier recueillit évidemment tous les suffrages. (Corblin 1998)
One received the-masc candidate-masc local and a-fem candidate-fem from the exterior.
The first got of-course all the votes.
 ‘We interviewed the local applicant and an external applicant. Of course the former [‘first’] got all the votes.’

⁵⁴ From ‘Transection of the oesophagus for bleeding oesophageal varices’, via Google Scholar: http://scholar.google.com/scholar?q=%22the+former%22+%22the+latter%22&hl=en&btnG=Search&as_sdt=2001&as_sdt=on.

⁵⁵ Allen Yeh, [http://www.scriptoriumdaily.com/2010/05/08/why-japan-and-britain-are-alike/Similar French examples can be constructed, as is shown in \(i\):](http://www.scriptoriumdaily.com/2010/05/08/why-japan-and-britain-are-alike/Similar%20French%20examples%20can%20be%20constructed,%20as%20is%20shown%20in%20(i):)

- (i) L’Angleterre est comme le Japon, et l’Ecosse est comme la Corée. Mais les/ces deux dernières n’ont pas d’amour particulier pour les deux premiers.
The England is like the Japan, and the Scotland is like the Korea. But the-plural/these two last NE have no of love particular for the two first.
 ‘England is like Japan, and Scotland is like Korea. But the latter two have no particular love for the first two.’

- (93) Some Frenchmen and some Italians were eliminated from the competition. Some Englishmen and some Americans will reach the semi-final.
- [Ambiguous reference] **The latter** are delighted, while **the former** are heavily disappointed.
 - [Non-ambiguous reference] **The latter two** are delighted, while **the former two** are heavily disappointed.

Here *the latter two* refers unambiguously to the sum of the groups denoted by the last two antecedents; the expression indexes these antecedents by their position in the order of enumeration.⁵⁶

Finally, we can perform the crucial test we used in (87)–(89) argue that overtly activated loci are presupposed to denote a non-empty group.

- (94) Some Frenchmen and some Italians were eliminated from the competition. Some Englishmen or some Americans will win the final.
- [Ambiguous reference] **The latter** will be delighted, while **the former** (two) are heavily disappointed.
 - [Unambiguous reference] **#The latter two** will be delighted, while **the former two** are heavily disappointed.

It is rather clear that *the latter two* in (94)b *cannot* refer to whoever wins the final. *The latter* in (94)a might have such a reading (though the example is ambiguous enough that it is unnatural); and this donkey reading relative to the disjunctive antecedents is certainly available when *the latter* is replaced with *they*.⁵⁷

A possible explanation is that in (94)b the last two discourse referents, namely *Englishmen* and *Americans*, are explicitly referred to—which corresponds to the sign language case in which two loci are simultaneously indexed. The result is deviant, *despite the fact* that the sum of individuals denoted by the disjunctive antecedents is in all cases plural. So we can repeat in this case the analysis we gave

⁵⁶ One can find some naturally occurring examples; in (i), the writer takes issue with someone else's claims about how "an adjective can apply to more than one noun in a list", and goes on to write:

(i) He would maintain that in "screws, blue nails, bolts, and washers," **the latter three** are blue (I maintain that only the nails are blue in this example).

(<http://grammar.ccc.commnet.edu/grammar/grammarlogs2/grammarlogs344.htm>)

In this case, *the latter three* refers to nails, bolts and washers.

⁵⁷ Similar facts can be replicated in French.

- (i) Des Français et des Italiens ont été éliminés. Des Anglais ou des Américains vont gagner la finale. *Some French and some Italians have been eliminated. Some English or some Americans will win the final.*
- Ces derniers seront ravis. Les deux premiers sont très déçus.
These last-plural will-be delighted. The two first will-be very disappointed.
 - #Les / ces deux derniers seront ravis. Les deux premiers sont très déçus.
The-plural / these two last will-be delighted. The two first will-be very disappointed.
 - Ils seront ravis. Les deux premiers sont très déçus.
They will-be delighted. The two first will-be very disappointed.

for (87)–(89): some constraint appears to require that *each locus which is explicitly referred to should denote a non-empty group of individuals*. If so, the constraints we saw on locus activation in sign language might have a counterpart in spoken language.

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