

Weak Crossover and the Direct Association Hypothesis

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1 Weak Crossover

First introduced by Postal (1971), the phenomenon of weak crossover has figured prominently in the debate over the existence of traces, as it was thought to provide evidence for the necessity of traces to long-distance dependencies in *wh*-questions.

On a transformational theory, *wh*-questions are formed when a *wh*-operator moves from the position associated with its grammatical function to the head of a sentence. Weak crossover “violations” occur when the operator has to pass over a coreferential pronoun, and in particular a pronoun which does not c-command¹ the operator’s original position.²

- (1) a. His_{*i*} mother greeted him_{*i*}.
- b. *Who_{*i*} did his_{*i*} mother greet?

While the coreferenced reading of the pronouns in (1)a is available, this same reading is not possible in (1)b. This difference in acceptability only occurs when operator movement involves crossing the pronoun: both (2)a and (2)b are acceptable as indexed.

- (2) a. He_{*i*} greeted his_{*i*} mother.
- b. Who_{*i*} greeted his_{*i*} mother?

The difference between (1) and (2) suggests that important structural relationship of import for weak crossover is between the pronoun and the base position of the operator. Thus, it has been argued that there must be something left in this position that enters into a relationship with the pronoun – i.e. there must be a trace left behind by the operator.³ On this view, weak crossover seems to provide strong evidence for the existence of traces in *wh*-questions; thus, by extension, it provides motivation for traces in other long-distance dependency phenomena.

¹See Carnie (2007).

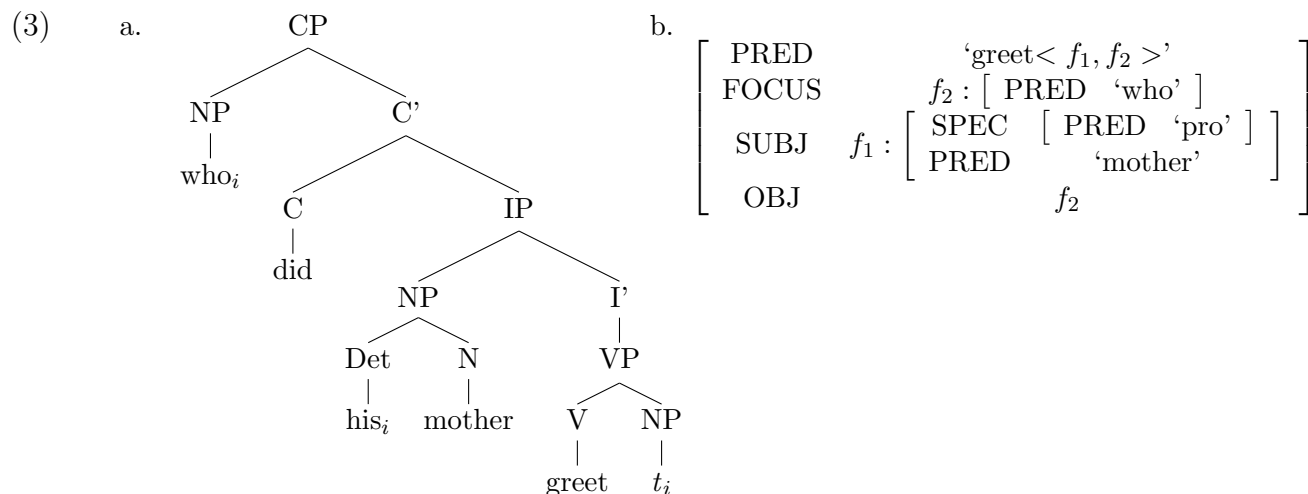
²When the pronoun *does* c-command the operator’s position, the phenomenon is known as strong crossover. This distinction is due to Wasow (1972).

³Chomsky (1976) and Reinhart (1983), among others.

2 Two LFG accounts of weak crossover

2.1 Bresnan (1995)

Traces, although originating in transformational theories of grammar, are up to a point compatible with non-configurational syntax as well.⁴ Kaplan & Bresnan (1982) provide an account of long-distance dependencies which adapts traces to the LFG framework (see pp.82-113). Crucially, the node filled by a trace is represented in the c-structure they propose – it thus corresponds to an f-structure, and in particular the same f-structure as the *wh*-operator. Example (1)b would have the following structure:



Bresnan’s (1995) account of weak crossover takes this structure as its starting point, and locates the principles governing the phenomena at the f-structure level. Coreference phenomena are broadly constrained by two principles: syntactic rank and linear order. Syntactic rank comes from the **functional hierarchy**⁵ (Keenan & Comrie 1977), while linear order is governed by **f-precedence**⁶ (Bresnan 1995).

To avoid a weak-crossover violation on Bresnan’s account, a *wh*-question with coreferenced operator and pronoun must obey the following “prominence” constraints.

- (4) **Syntactic prominence:** An f-structure containing the pronoun may not be higher in syntactic rank than an f-structure containing the operator.

⁴See Dalrymple, et al (2001) for some arguments against traces. See also evidence from Kaplan & Zaenen (1989) and Sag (1998).

⁵Bresnan provides the truncated hierarchy SUBJ > OBJ > OBL > COMP, and for the most part this is all we will need here. The hierarchy originates, however, with Keenan & Comrie (1977), who describe it as SUBJ > DOBJ > IOBJ > GEN > OCOMP (p.66). There is some debate as to the appropriate ranking of objects; in particular, whether or not direct objects outrank indirect objects, or if the correct distinction is actually between “primary” and “secondary” objects, are both open questions.

⁶There are several versions of f-precedence in the literature. I am only concerned here with $\forall \exists$ f-precedence, which is defined as follows: Let μ be the mapping from c-structure nodes to f-structures. Then an f-structure f f-precedes another f-structure g if and only if $\mu^{-1}(f)$ and $\mu^{-1}(g)$ are both nonempty, and all nodes in $\mu^{-1}(f)$ precede some node in $\mu^{-1}(g)$.

- (5) **Linear prominence:** The pronoun must not f-precede the operator.

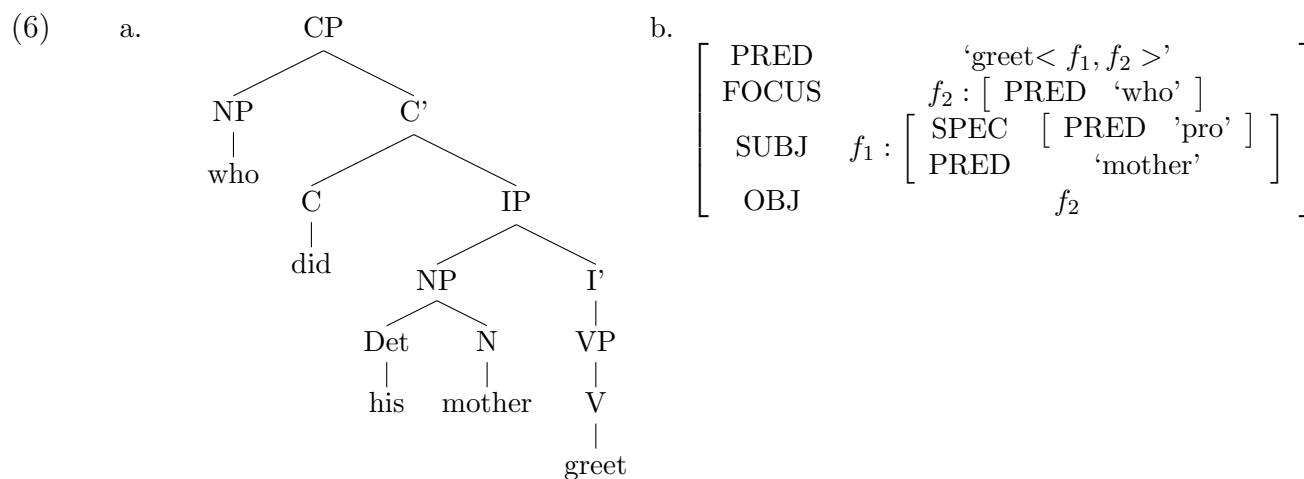
Example (3) is ungrammatical because it violates both prominence constraints. The f-structure containing the operator has rank OBJ, whereas the pronoun occurs within the SUBJ f-structure. Similarly, the pronoun f-precedes the operator because it appears before the trace.

On the other hand, (2)b is fine: the operator has rank SUBJ, while the pronoun appears in OBJ. Additionally, both operator and trace occur before the pronoun, thus obeying the linear prominence constraint as well.

Bresnan’s account makes the correct predictions for examples (2)b and (3). While both prominence constraints are significant in English, she argues that they vary in importance cross-linguistically, and this is supported by evidence from Palauan (an Austronesian language), Malayalam, and Hindi. See Bresnan (1995) for details.

2.2 Dalrymple, Kaplan & King (2001)

Dalrymple, Kaplan & King (2001) propose a revision of Bresnan’s account that maintains the intuitions about multidimensional prominence constraints, while eliminating the need for a trace. This is bolstered by Kaplan & Zaenan’s (1989) proposal to handle long-distance dependencies in LFG via *functional uncertainty*. Dalrymple et al have the following c- and f-structures for (3):



The idea underlying the revision is that “linear prominence requirements between an operator and a pronoun are determined by overt material which indicates the syntactic role of the displaced phrase,” rather than to the position of a covert trace. From (6), we can see that syntactic prominence is not affected by the revised structure, but that f-precedence relations are altered.

- (7) *Who_i did Sue talk about his_i mother to (t_i)?

In (7), the extracted element is an oblique, as is the element containing the pronoun. This means that (7) is permitted by syntactic prominence. On Bresnan’s account, the trace appears at the end of the sentence (as marked), so the operator is f-preceded by the pronoun. Dalrymple et al (2001) instead consider the overt preposition “to,” which indicates the status of the extracted element, to be the important piece of information. In essence, then, the revised account holds that it is the presence of the preposition after the pronoun that rules out (7).

Formalization of this requires the introduction of *coarguments*, or the set of arguments and adjuncts of a single predicate. Specifically, Dalrymple et al define *CoargOp* and *CoargPro*, the coargument f-structures containing operator and pronoun, respectively. This allows the prominence constraints to be reformulated:

(8) **Syntactic prominence:** CoargOp must be at least as high as CoargPro on the functional hierarchy.

(9) **Linear prominence:** CoargOp must f-precede the pronoun.

Consider the f-structure associated with (7):

$$(10) \left[\begin{array}{l} \text{PRED} \quad \text{'talk< SUBJ, OBL}_{to}, \text{OBL}_{about} >'} \\ \text{FOCUS} \quad f_1 : [\text{PRED} \quad \text{'who'}] \\ \text{SUBJ} \quad [\text{PRED} \quad \text{'Sue'}] \\ \text{OBL}_{to} \quad [\text{PRED} \quad \text{'to<OBJ>'} \\ \quad \text{OBJ} \quad f_1] \\ \text{OBL}_{about} \left[\text{PRED} \quad \text{'about<OBJ>'} \right. \\ \quad \left. \text{OBJ} \left[\text{SPEC} \quad [\text{PRED} \quad \text{'pro'}] \right] \right. \\ \quad \quad \left. \text{PRED} \quad \text{'mother'} \right] \end{array} \right]$$

CoargOp, here, is the f-structure corresponding to OBL_{to}, while CoargPro is the f-structure corresponding to OBL_{about}. In particular, CoargOp contains the ‘to’ node as well as the ‘who’ node; thus, since the pronoun appears before ‘to’, CoargPro f-precedes CoargOp, and (7) violates the linear prominence constraint. It is easily verified that this account makes the correct prediction for (2)b and (3), as well as for (11).

(11) Who_i did Sue talk to about his_i mother?⁷

3 A more direct account

The crucial difference between Bresnan (1995) and Dalrymple et al (2001) is the relevant material considered in (structural) relation to the pronoun. The latter account suggests that the important factor for linear prominence may be the “selecting” element: that is, the

⁷Bresnan’s (1995) predictions hold here as well, as the trace would occur immediately after “to.”

element that subcategorizes and/or assigns grammatical function to the *wh*-operator. Coarguments do this, but it may be possible to achieve the same result more directly. Pickering & Barry’s (1991) “Direct Association Hypothesis” provides a way of doing so.

The DAH proposes that a link is made directly between an extracted element and the predicate or preposition that selects for it. Pickering & Barry (1991) argue that this is more parsimonious from a processing standpoint than a trace-based account. The semblance of traces in psycholinguistic data (see Swinney et al (1988), Crain & Fodor (1985), Stowe (1986)) comes about because the extracted element is “reactivated” during processing of the selecting element, which is frequently adjacent to the proposed trace position.

This captures the intuition in Dalrymple et al (2001) about “overt” syntactic information, but eliminates the need for considering coargument structures. In the following, we adopt Dalrymple & King’s (2012) terminology, and refer to the selecting element (or subcategorizer) as the *anchor* of an extracted element.

3.1 Weak crossover via direct association

I regard the structural relationship between anchor and pronoun as the important one for establishing linear prominence. I assume that this relationship is established at f-structure (or some equivalent level in an alternative theoretical framework). See Dalrymple & King (2012) for a first approximation of how this might be achieved in LFG.

Consider our foregoing examples:

- (12) *[Who_i]_{Op} did [his_i]_{Pro} mother [greet]_{Anch}?
- (13) [Who_i]_{Op} [greeted]_{Anch} [his_i]_{Pro} mother?
- (14) *[Who_i]_{Op} did Sue talk about [his_i]_{Pro} mother [to]_{Anch} ?
- (15) [Who_i]_{Op} did Sue talk [to]_{Anch} about [his_i]_{Pro} mother?

From these, it can be seen that those examples in which the anchor precedes the pronoun are precisely those which disallow coreference (and constitute a weak crossover violation). I therefore revise the linear prominence constraint in the following manner:

- (16) **Linear prominence:** the anchor (of the operator) must precede the pronoun.⁸

3.2 Some data

In examples (12)-(15), the trace appears adjacent to the anchor. As a result, the Bresnan and anchor accounts give the same predictions. Similarly, if we consider an example in which the object of a preposition is fronted, but the preposition is stranded, we will see alignment between Dalrymple et al and the anchor accounts (see (14), (15)).

To distinguish better between Bresnan and the anchor accounts, we need to consider examples where the anchor and proposed trace are not adjacent:

⁸This can be f-precedence; but since we have only one node in each of the f-structures comprising anchor and pronoun, it is not of major significance.

- (17) [To whom_i]_{Op} did you [give]_{Anch} [her_i]_{Pro} book (t_i) ?
- (18) [In whose_i hand]_{Op} did you [put]_{Anch} [his_i]_{Pro} pen (t_i)?
- (19) (?) [To whom_i]_{Op} did you [introduce]_{Anch} [her_i]_{Pro} neighbors (t_i)?

In these examples, Bresnan predicts ungrammaticality, while the anchor account predicts acceptability. I elicited judgments from speakers of American English: (17) was ruled grammatical, (18) by a majority of speakers, and (19) approximately half the time. On the basis of (17) and (18), then, the anchor account outperforms Bresnan (1995). The confusion generated in these examples may be due to the potentially ambiguous status of the English double-object construction.

Consider also the following examples, where both objects undoubtedly have the same syntactic rank:

- (20) [Whose_i book]_{Op} did you [give]_{Anch} [her_i]_{Pro} friend (t_i)?
- (21) [To whom_i]_{Op} did Sue [talk]_{Anch} (t_i) about [his_i]_{Pro} mother (t_i) ?

(20), ruled as grammatical, unequivocally supports the anchor account. (21) has an ambiguous extraction site, and thus an ambiguously located trace. This seems to be a mark against the trace account: if extraction is from the end of the sentence, the trace account gives the wrong prediction. In the other case, it is still no better than the anchor account. Separation of anchor and trace, in general, then, appears to favour the anchor account.

4 Additional Considerations

4.1 Adjuncts

Examples (17)-(19) owe their iffiness to potentially ambiguous syntactic rank. In considering the syntactic prominence constraint independently, it is useful to look at examples which rely more heavily on syntactic prominence than linear prominence; these usually involve adjuncts.⁹

- (22) *[With whom_i]_{Op} did Jessica [visit]_(Anch) [his_i]_{Pro} cousin (t_i)?
- (23) *[In whose_i car]_{Op} did Anne [meet]_(Anch) [him_i]_{Pro} (t_i) ?
- (24) *[From whose_i house]_{Op} did George [call]_(Anch) [her_i]_{Pro} (t_i) ?

These are generally regarded as ungrammatical. As they all pass the linear prominence requirement, it must be syntactic prominence which rules them out. This is evidence for the robustness of a syntactic prominence constraint.¹⁰

⁹It is not clear whether pied-piped adjuncts are anchored. I have marked them as if they are, but nothing crucial rides on this.

¹⁰It may be noted that the Bresnan account does not need syntactic prominence to rule (23)-(25) out, although she nevertheless argues that this constraint is operative in English. There is some simplifying elegance to this; however, an account which considered Bresnan's linear prominence alone would be unable to explain (17), (18), (20) and (21).

4.2 Multiple anchors and parasitic gaps

The following examples involve multiple possible positions for the *wh*-operator.

(25) Who_{*i*} (*t_i*) will be easy for us to get his_{*i*} mother to talk to __?

(26) (?) Who_{*i*} did you advise (*t_i*) before his_{*i*} wife divorced __ ?¹¹

In these examples, operators, gaps, and trace nodes are all included in the preimage of the operator’s f-structure. Thus, Bresnan’s linear prominence rules them out.

The DAH makes less clear predictions here, as there are two possible anchor positions (associated with the main and secondary gaps). It seems plausible that the first possible position causes reactivation of the fronted element, which would allow both examples. On the other hand, if it turns out that the important position is the second possible anchor position (“talk” and “divorced,” respectively), then neither example ought to be grammatical. Data involving multiple potential anchor sites and parasitic gaps therefore needs closer consideration; in particular, it will be important to establish which position anchors the operator.

5 Conclusion

5.1 Further inquiry

Bresnan (1995) and Dalrymple et al (2001) both consider crosslinguistic data, including German and Malyalam. Considering the predictions of the anchor account against data from either of these languages would serve as another way to adjudicate between the three accounts.

Crosslinguistic data, in general, could serve to draw out the distinctions between all three accounts better; in particular, data from languages with a less rigid word order than English would help in establishing (or rejecting) the validity of a direct association principle. If the anchor account proves viable, it might also be able to shed light on the differences in mental representation between adjuncts and arguments. Data from languages where only one or the other of the constraints is relevant would be particularly useful.

Within English, there are also several directions for inquiry to proceed. For instance, it would be well worth considering whether an anchor account could handle examples of weak crossover which involve quantification (instead of *wh*-movement).¹² It might also be worth investigating whether direct association could play a role in the analysis of other coreference phenomena, such as strong crossover.

¹¹Extracting in this way is unacceptable to some speakers, regardless of indexing. I consider this example only insofar as some speakers accept it.

¹²Such examples are usually considered along with *wh*-questions, and both Bresnan (1995) and Dalrymple et al (2001) take them into account. I have omitted an examination of these here, as it is not immediately obvious that quantifiers involve the same sorts of generalizations as *wh*-operators; however, this is a question I am eager to consider moving forward.

Finally, I have not presented a formal mechanism for establishing the anchor (see Dalrymple & King (2012)). It might also be useful to consider how this relationship might be formalized in theories other than LFG, as well.

5.2 Synthetic data

Following Dalrymple, et al (2001), I present here some “data” from hypothetical languages that would help to adjudicate more sharply between the three accounts of weak crossover discussed above. These are by no means exhaustive.¹³

- I. Consider a language in which only linear prominence applies; let this language have fixed SVO word order and *wh*-fronting.

(27) $[[\text{who}_i]_{\text{Op}}]_{\text{CoargOp, OBJ}} \text{ did } [[\text{his}_i]_{\text{Pro}} \text{ mother}]_{\text{CoargPro, SUBJ}} [\text{see}]_{\text{Anch}} (t_i) ?$

This is ungrammatical on the Bresnan account because the proposed trace occurs at the end of the sentence; as the anchor occurs immediately prior to this, the anchor account agrees with Bresnan here. Dalrymple, et al (2001), on the other hand, predict grammaticality, as CoargOp f-precedes the pronoun.

- II. Let Language II be the same as Language I in all respects except that it has SOV word order.

(28) $[[\text{who}_i]_{\text{Op}}]_{\text{CoargOp, SUBJ}} (t_i) [[\text{his}_i]_{\text{Pro}} \text{ mother}]_{\text{CoargPro, OBJ}} [\text{saw}]_{\text{Anch}} ?$

Extracting from the subject position, as in example (29), yields a prediction of grammaticality from the Bresnan (1995) and Dalrymple, et al (2001) accounts. Since the verb occurs at the end of the sentence, however, the anchor follows the pronoun, and the anchor account predicts ungrammaticality.

(29) $[[\text{who}_i]_{\text{Op}}]_{\text{CoargOp, OBJ}} [[\text{his}_i]_{\text{Pro}} \text{ mother}]_{\text{CoargPro, SUBJ}} (t_i) [\text{saw}]_{\text{Anch}} ?$

The predictions of the anchor and Dalrymple, et al accounts remain the same when extracting from object position. The trace, however, has moved, giving a prediction of ungrammaticality from the Bresnan account.

- III. Language III is again the same as the previous two, but for VSO word order.

(30) $[[\text{who}_i]_{\text{Op}}]_{\text{CoargOp, OBJ}} [\text{saw}]_{\text{Anch}} [[\text{his}_i]_{\text{Pro}} \text{ mother}]_{\text{CoargPro, SUBJ}} (t_i) ?$

As the anchor occurs early in the sentence, here both the Dalrymple, et al and anchor accounts predict grammaticality. The trace, however, occurs at the end, yielding a prediction of ungrammaticality from the Bresnan account.

¹³In particular, I have not yet considered data, synthetic or otherwise, from *wh in-situ* languages.

- IV. Consider now a language in which both linear and syntactic prominence must be satisfied; let it have fixed SOV word order, and *wh*-fronting.

(31) $[[\text{who}_i]_{\text{Op}}]_{\text{CoargOp, SUBJ}} (t_i) [[\text{his}_i]_{\text{Pro}} \text{mother}]_{\text{CoargPro, OBJ}} [\text{saw}]_{\text{Anch}} ?$

The early occurrence of the trace gives grammaticality from the Bresnan account; the Dalrymple, et al account agrees here. Word order constraints, however, mean that the anchor occurs at the end of the sentence, and so the anchor account predicts ungrammaticality.

- V. Lastly, suppose there is a language which requires only that *one* of the constraints be satisfied. Observe that If an example satisfies syntactic prominence in such a language, all three accounts will predict grammaticality; thus it would only be helpful to consider examples that violate syntactic prominence. This would mean using linear prominence to adjudicate between the accounts, yielding the same predictions as for Languages I-III, depending on word order.

5.3 Summary

I have examined three accounts of weak crossover, and compared them on a range of data in English. The anchor account I have proposed appears to handle successfully all of the data for which clear predictions can be made; in has been seen to fare better than the alternative accounts on some unusual examples. Thus, I conclude that traces are not motivated strongly by weak crossover, as the facts about coreference can be explained by direct association between an extracted element and its subcategorizer. There is, of course, a great deal more work to be done in exploring this proposed association, and in formalizing the mechanisms outlined here.

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