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Prosodic Strategies for Negotiating Reference in Discourse

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By
James Sneed German

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ABSTRACT

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James Sneed German

It is a well-known observation that the reference of free, personal pronouns is sometimes influenced by the specific prosodic context in which they occur (Akmajian & Jackendoff 1970, *inter alia*). A prevailing view in the literature is that the interpretation of a pronoun bearing a pitch accent can be derived from the interpretation of some unaccented counterpart (*esp.* Kameyama 1999). In essence, accents on pronouns are assumed to induce a ‘switch’ from some default reference. While intuitively appealing, this view does not always converge with independently motivated theories of prosodic meaning. An alternative approach views the interpretation of accented pronouns as a natural consequence of the general principles that relate prosodic patterns to information structure. If this is right, then any referential effects of prosody should follow from a fully general theory of prosodic meaning.

Through a combination of experimental data collection and theoretical analysis, this dissertation addresses the adequacy of the two approaches. First, I report on a production study designed to test the predictions of a particular class of so-called ‘switching’ models against those based on the theory of nuclear accent meaning proposed in Schwarzschild (1999). Two perception studies then compare the relevance of a notion of reference switching in interpretation against an alternative set of predictions based on the meaning of nuclear accents vis-à-vis information structure. Together, the findings straightforwardly support a rejection of earlier switching models in favor of one based on inferencing in the context of a theory of information structure.

Building on the key insights of Schwarzschild (1999), I propose a new theory of the interpretation of nuclear accent placement. In an implementation of Bi-Directional Optimality

Theory (Blutner 2000), I show that a theoretically preferable treatment of the relationship between prosody and pronominal reference takes into account the distinct, but interdependent contributions of production and perception. In addition, I propose a modification to the principle that utterances should maximize anaphoric links with the context. The resulting model is shown to provide a superior account for key examples, and its compatibility with existing models of pronominal reference based on coherence relations (Kehler 2002) is discussed.

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Chapter 1

Prosody and Pronominal Reference

1.1 Introduction

Most utterances fall short of specifying a speaker's full communicative intention. Instead, the typical utterance abounds with various types of ambiguous, vague, or otherwise underspecified forms, which the hearer must somehow resolve in order for successful communication to take place. On one view, such forms impose a significant burden on the hearer, since it is assumed that their use requires the hearer to embark on a search for a missing referent. Given that more explicit forms are typically available for expressing the same meaning, the use of underspecified forms is often explained in terms of the benefits that they bring to the speaker. Because underspecified forms are phonologically, morphologically, or syntactically less complex than their more explicit counterparts, they are simply easier for a speaker to process and use. On that view, the use of such forms represents a tension between the speaker's desire to minimize effort, and the need ensure that the hearer successfully recovers the intended meaning.

On another view, underspecified forms are facilitative for both the speaker and hearer. Kehler (2002) specifically challenges the assumption that underspecified forms place a burden on the hearer, and suggests as an alternative that they are used precisely when their interpretive value is independently determined by the structure of the surrounding discourse. Instead of introducing uncertainty, in other words, underspecified forms actually facilitate interpretation for the hearer by explicitly signaling that nothing more has to be done. To the extent that underspecified forms are

easier for the speaker to use, then, their occurrence actually reflects a convergence, rather than a conflict, of speaker and hearer interests.

For Kehler (2002), the structure that guides the resolution of underspecified forms is provided by *coherence relations*, which are perhaps best characterized as conventional ways of connecting the ideas expressed by related sets of utterances. In English, however, discourse is also structured by other means. Prosody, for example, may be used to relate two utterances according to which information content is or is not shared between them. In more precise terms, the phrasing, the locations of pitch accents, and the choice of tonal units is assumed to reflect a mapping between specific parts of an utterance and the beliefs shared by the interlocutors regarding the contents of the discourse context (see esp., Pierrehumbert & Hirschberg 1990). The idea that this type of structure plays a role in facilitating the interpretation of underspecified forms, however, remains largely unexplored.

One widely noted class of examples involving pronouns suggests that this connection may actually be quite robust. In example (1) from Akmajian & Jackendoff (1970), for example, the reference of the pronoun *him* appears to depend on the specific prosodic pattern with which the sentence is uttered.^{1,2}

- (1) a. John^{||} hit Bill^{0%} and then George hit him^{0%}
 H* L- H* L-H^{0%} H* L-L^{0%}
- b. John^{||} hit Bill^{0%} and then George^{||} hit him^{0%}
 H* L- H* L-H^{0%} H* L- H* L-L^{0%}

¹ Standard ToBI labeling (Silverman et al. 1992, Beckman & Ayers 1997) is used throughout. See Section 1.5 for a discussion. Note that ‘||’ and ‘0%’ are included in the text tier to more explicitly mark the alignment of phrase accents (L-, H-) and boundary tones (L%, H%), respectively.

² The transcriptions shown here are my own. They are based on the authors’ use of capitalization to mark the locations of primary stress. I have chosen this particular intonational pattern because it gives rise to clear intuitions that are consistent with the spirit of the authors’ original observation. In doing so, I do not claim that this is the only pattern that is consistent with a contrast in reference. In particular, a considerable amount of variation in the form of the preceding clause is presumably permissible without much effect on the perceived reference of the pronoun.

According to the standard intuition, in other words, *him* seems to refer to Bill when the sentence is uttered without a pitch accent on *him* as in (1a), but seems to refer to John when the sentence is uttered with a pitch accent on *him* as in (1b).

Unfortunately, it is not at all straightforward how a theory of the interpretation of prosodic form can explain such examples. Among other issues, existing theories that try to relate prosodic form to meaning take for granted that the truth conditions of the speaker's intended sentence are known. If communication could be captured by a model of production alone, then such theories would be entirely adequate. Real communication, however, may involve underspecified forms, which implies that truth conditions are not always known to the hearer. Since the reference of the pronouns in (1) seems to depend on prosodic form, for example, then the truth conditions cannot be known prior to the interpretation of prosody. Clearly, something more needs to be said.

Further complicating the picture is the fact that the mapping from prosodic forms to their interpretations is not one-to-one. This means that a full account of the relationship between prosody and pronominal reference must be able to explain how hearers recover two dimensions of underspecification simultaneously, where the specification of one dimension may have important consequences for the other.

A number of proposals have tried to account for the relationship between prosody and pronominal reference. Typically, however, these proposals overlook the possibility that an independently motivated theory of prosodic meaning might explain that relationship. Instead, they posit principles for interpreting accents occurring on pronouns that are specifically tailored to the observed contrasts in examples like (1). These principles are typically accompanied by further assumptions that are not motivated by, or even consistent with, more general theories of prosodic meaning and pronominal reference. They tend to assume, for example, that pronouns are associated

with default heuristics for evaluating reference, which may be overridden by the specific circumstances of a given occasion of use, such as the occurrence of an ‘unusual’ prosodic form. This view goes hand-in-hand with the assumption that accented or stressed pronouns somehow represent atypical, or *marked*, forms. In other words, it is assumed that the interpretive function of accentuation on a pronoun is to undermine the default strategy for determining its reference.

On one level then, this dissertation seeks to test the hypothesis that a general theory of prosodic meaning can account for effects like those in (1). This necessarily involves a direct empirical comparison of that hypothesis against the alternatives presented by various existing accounts. In addition, however, this dissertation seeks to provide a more comprehensive picture of the meaning of prosodic form, and more specifically, how it relates to other dimensions of underspecification. Given Kehler’s challenge to more traditional views of pronominal reference, and his appeal to seek to explain ambiguity resolution in more cooperative terms, the present enterprise has important implications for the theory of pronominal reference more generally.

The next section provides a brief background for the investigation. First, it explains in more detail the overall controversy regarding the relationship between prosody and pronominal reference. It provides an overview of the kinds of proposals that have targeted the relationship between prosody and pronominal reference specifically, as well as the kinds of meaning that have been associated with prosodic form. Section 1.3 summarizes the questions that are addressed by this dissertation, while 1.4 provides both an overview of the methodology used and a brief summary of the findings. Section 1.5 addresses some of the basic theoretical assumptions that underlie this investigation, including those regarding the prosodic structure of English. Finally, section 1.6 provides an overview of the organization of the remaining chapters.

1.2 Two Distinct Approaches

As suggested in 1.1, the empirical observation at the center of this investigation involves pronouns whose reference appears to vary with specific differences in prosodic pattern. In addition to (1), there is a fairly wide range of examples that illustrate this effect. In a famous example first noted by Lakoff (1971), there are two pronouns whose reference appears to covary with the choice between two particular prosodic patterns.

- (2) a. John_{H*}|| called Bill_{H*}|| a Republican_{H*}% and then he_{H*} insulted him_{L-L%}%.
 H* L- H* L- H* L-L% H* L-L%
- a. John_{H*}|| called Bill_{H*}|| a Republican_{H*}% and then he_{H*}|| insulted him_{L-L%}%.
 H* L- H* L- H* L-L% H* L- H* L-L%

With the prosodic pattern in (2a), there is a preference for *he* to refer to John and *him* to refer to Bill. With the pattern in (2b), however, the reference of the pronouns seems to be reversed, such that *he* refers to Bill and *him* to John. In addition, the pattern in (2b), but not the one in (2a), is associated with a salient inference that calling someone a Republican counts as a form of insult. Kameyama (1999) notes a related example.

- (3) a. John kicked Bill_{H*}% He was injured_{H*}%
 H* H* L-L% H* L-L%
- b. John kicked Bill. He was injured_{H*}%
 H* H* L-L% H* L-L%

With the accent pattern in (3a), Bill seems to be the preferred referent of *he*, perhaps due to the expectation that the one being kicked is most likely to be injured. With the prosodic pattern in (3b), however, the preference is for *he* to refer to John. Similarly to the example in (2), there seems to be

a salient inference associated with (3b) to the effect that John's injury comes as something of a surprise.

It is not obvious what kind of theoretical account could explain contrasts like those in (1) through (3). Ideally, such an account would follow from an integration of what is independently known about the meaning of prosodic patterns with what is independently known about how pronouns refer. Surprisingly, that approach has received relatively little attention. Instead, the most common approach has disregarded the role of more general principles of prosodic meaning in favor of principles that are specifically tailored to contrasts like those in (1) through (3). In Section 1.2.1, I provide an overview of the range of proposals representing this type of approach, highlighting in particular the assumptions that these proposals have in common. In Section 1.2.2, I provide a sketch of an alternative approach that takes more seriously the role of a general theory of the interpretation of prosodic form. In addition, I review the few proposals that embody this approach and then survey some of the empirical evidence that supports it. The experiments and analyses in the chapters that follow seek to resolve not only which of these approaches has greater empirical validity, but also the extent to which the competing assumptions of each can be maintained in light of further evidence. In that sense, the point of comparison set up in the next two sections forms the fundamental tension at the center of this investigation.

1.2.1 The Switching Approach

The question of how prosody influences pronominal reference has most often been approached from the perspective that a pronoun in context is associated with something like a 'default' or 'unmarked' strategy for determining its reference. This default strategy is closely

associated with a prosodic pattern involving a lack of stress or accentuation on the pronoun. The alternation in reference in examples like (1) through (3) then comes about because prosodic prominence on a pronoun serves to undermine or *block* that default strategy.

To give a concrete example, Solan (1983), building on the work of Maratsos (1973) and Sheldon (1972), argues for a *Parallel Function Strategy*, whereby pronouns preferentially corefer with earlier expressions in a parallel grammatical role. Relative to examples like (2), this would predict that *he*, being in a subject position, should corefer with the subject of the preceding clause, while *him*, being in object position, should corefer with the object of the preceding clause. Smyth (1994) proposes a related notion of a default strategy on slightly different grounds. He argues that expressions have the potential to prime earlier expressions based on the number of shared syntactic, morphological and semantic features. The preferred antecedent of a pronoun is therefore the one that shares the most features with it, since that expression is most highly primed at the time the pronoun is mentioned. In both Solan's and Smyth's accounts, it is assumed that the respective default principles apply only to stressless pronouns, while an accent on a pronoun serves to block or undermine those principles. The general view is best illustrated by the following quote from Solan:

“Contrastive stress is being used to signal that the expected antecedent to the pronoun is not the one intended by the speaker...The hearer is being warned not to apply the parallel function strategy, which would yield the ‘normal’ interpretation.”
(pp. 163-164)

More recent accounts have taken a related, if somewhat more sophisticated, approach to the problem. Kameyama (1999), working within the framework of Centering Theory (Grosz et al. 1995), assumes that entities in the discourse are tracked by interlocutors in an ordered list (the *forward-looking center list*, or C_f) according to their relative *salience*. The list is updated following each utterance based on the attentional prominence of the expression with which each referent in the list gets

mentioned. In general, the primary factors that contribute to attentional prominence are grammatical role (i.e., subject, object or oblique) and exponent type (i.e., whether it is a pronoun, a definite NP or a proper name). Referential preferences are not determined directly by the ordering of the list, however. Instead, there is a general preference ordering over the different ways that the C_f can change across utterances (or *transitions*). Typically, a more preferable referent for a pronoun is one that results in a more preferable transition. Kameyama's specific contribution is the idea that the accentual status of a pronoun has consequences for the preference ordering over potential referents for a pronoun. An unaccented pronoun, it is assumed, has no effect on the ordering, so that the pronoun refers in the 'usual' way. The interpretation of an accent on a pronoun, however, is to effect a reordering of the list, so that the pronoun refers to an entity that is otherwise dispreferred by the model.

In a closely related proposal, Cahn (1995) suggests that the effect of prosody on pronominal reference can be derived from the meaning of a contrastive pitch accent (specifically L+H*) as proposed by Pierrehumbert & Hirschberg (1990). According to that theory, L+H* introduces the presupposition that (i) there is a salient scale of alternative values associated with the semantic type of the accented element and (ii) the highest member of that scale is not the actual value of the accented element. When applied to pronouns, Cahn assumes that the relevant scale that is evoked is a list of possible referents for the pronoun, ordered according to the principles of Centering Theory (i.e., according to their relative salience). The second part of the presupposition is to exclude the highest member of the scale, which implies that the reference of an accented pronoun must be different from the most salient member of the list.

A proposal in Beaver (2004) is also grounded in Centering Theoretic assumptions. Specifically, the default strategy follows from a preference for the *topic* of the discourse (roughly, the

entity referred to by the most salient expression in an utterance) to remain constant across utterances. The effects of prosody follow from a particular formulation of the principle of *partial blocking* (McCawley 1978, Kiparsky 1983) within the framework of Bi-Directional Optimality Theory (Blutner 2000), whereby dispreferred, or *marked*, forms are recruited for expressing atypical meanings. In essence, accented pronouns are assumed to represent marked forms. According to partial blocking, they therefore become associated with (in the sense of mapping onto) the non-default pattern of reference, while unaccented pronouns are reserved for ‘typical’ patterns of reference. Clark & Parikh (2007) present a closely related approach based on a game-theoretic formulation of partial blocking. Speakers and hearers, they assume, attend to cost considerations when making choices about production and interpretation. In particular, hearers are licensed to infer that a speaker will use the more costly of two forms only when the corresponding interpretation is the less probable of two alternatives. On the assumption that accented pronouns are more costly than unaccented pronouns, hearers infer that an accented pronoun refers to the less probable (i.e., unmarked) of two potential referents.

As exemplified by the proposals of Solan (1983) and Smyth (1994), the literature on pronominal reference places a heavy emphasis on syntactic factors, and the syntactic properties of potential antecedents in particular. It is perhaps not a surprise then that the above proposals all take for granted that pronouns are associated with a default pattern of reference that is independent of prosodic form. Consider that variations in prosody cannot possibly alter whether a particular pronoun counts as a subject or an object within its own sentence. Similarly, if the notion of parallelism between two clauses is syntactically defined, then it can never be affected by differences in prosody, which are assumed to be independent of syntax. Notice, however, that this assumption is closely linked to the idea that accented pronouns represent a marked class of forms. For some of

the above proposals (Beaver 2004, Clark & Parikh 2007), this is explicit in their assumptions, while for others it is merely implicit in the idea that default patterns of reference are associated with unaccented pronouns.

Crucially, none of the above proposals assumes any real role for an independently motivated model of prosodic meaning. In all major theories of prosodic meaning, interpretations are not constructed from the accentual status of individual lexical items, but emerge only from a consideration of patterns of accentuation (and phrasing) over whole sentences. Thus, the emphasis that the above proposals place on pronoun accentual status specifically more or less rules out the possibility that their models will depend on a general theory of prosodic meaning in a meaningful way.

Kameyama's model partly addresses the relationship between accents on pronouns and more general aspects of prosodic meaning. In that model, sentential accent patterns are associated with specific focus presuppositions according to the alternative semantics model of Rooth (1992). The proposal begins from the observation that there is a formal resemblance between the set of alternative values introduced by a focused pronoun, and the C_f in a Centering model, since both correspond to a set of individuals. In the final analysis, however, the proposal does not demonstrate that these two sets are formally identical. More importantly, the focus interpretations that the model invokes are in no way explanatory for the correspondence between prosodic form and reference that it is trying to account for. Instead, the effect of an accent on a pronoun is simply stipulated to be a reordering of the transition preferences.

Beaver (2004) also tries to connect his model with a general theory of prosodic meaning. The markedness of accented pronouns, it is argued, follows from the fact that an accented pronoun

incurs more violations of the constraint AVOIDF (Schwarzschild 1999).³ In Schwarzschild's Optimality-Theoretic model, AVOIDF serves to maximize anaphoric links between the current utterance and the discourse context, but it may be violated when the context does not support such linkages. Because Beaver's model directly associates violations of AVOIDF with the non-default reference of a pronoun, however, it licenses violations of AVOIDF in cases that Schwarzschild's model would not. In other words, the partial blocking mechanism effectively dissociates accentuation from the interpretive effects that it is assumed to have in the general case.

Finally, while Cahn's (1995) proposal includes a significant role for the interpretation of accent type, it explicitly argues against the idea that accents on pronouns participate in the kind of meaning usually associated with sentential prosodic patterns. According to Cahn, since pronouns are endowed with "little intrinsic semantics", an accent on a pronoun cannot contribute to the propositional content of the mutual belief state, and what remains is the effect that the accent has on the attentional state of the discourse (i.e., the preference ordering over ways of resolving the pronoun). In other words, accents on pronouns are specifically excluded from information structural considerations.

The above proposals then, represent a single approach to the relationship between prosody and pronominal reference to the extent that they have the following elements in common. First, a pronoun in context is associated with a default reference, the value of which is determined by factors independent of the prosodic form of the utterance containing the pronoun. Second, this default pattern of reference is realized by some prosodic pattern in which the pronoun is unaccented. In other words, unaccented pronouns refer in the default way. Third, the reference of an accented

³ In fact, accents may be said to violate AVOIDF only indirectly. In Schwarzschild's model, accentuation on a terminal element implies F-marking (and thus a violation of AVOIDF), but it is not the case that F-marking implies accentuation. Thus, F-marking may be required for reasons independent of accentuation, which implies that accentuation does not always lead to *additional* F-marking.

pronoun is derived from the reference of an unaccented pronoun, in the sense that the value of the former constitutes an undermining, or *blocking*, of the value of the latter. Fourth, relative to an unaccented pronoun, an accented pronoun represents a marked form. In other words, accents on pronouns are assumed to be dispreferred.

Finally, given that these accounts all exclude an explanatory role for independently motivated theories of prosodic meaning, they raise the question of whether such a theory might actually be sufficient to account for the observed contrasts in examples like (1) through (3). In other words, is it necessary to posit, as Solan (1983), Smyth (1994) and others do, that accents on pronouns signal a ‘switch’ from the default reference of the pronoun, or might this effect follow automatically from constraints that a model like Schwarzschild’s (1999) imposes on the relationship between a sentence, its associated prosodic pattern, and the contents of the discourse context? Assuming that such a theory *is* sufficient, then what is the status of the other assumptions that the above theories take for granted? Is it necessary, or even justified, for example, to assume that pronouns have anything like a prosody-independent default reference? Is it necessary to assume that accents on pronoun represent marked forms?

In Section 1.2.2, I consider an alternative to the above *switching* approach. Specifically, I explore the idea that the relationship between prosody and pronominal reference can be fully accounted for by a sufficiently elaborated theory of the meaning of sentential prosodic patterns.

1.2.2 The Generalized Approach

As suggested in 1.2, there is an alternative to the idea that the reference of an accented pronoun can be derived from the reference of some unaccented counterpart. It is the idea that

contrasts like those in (1) through (3) can instead be explained by an independently motivated theory of the interpretation of prosodic patterns over whole sentences. In other words, it is not the accentual status of the pronoun *per se* that matters, but rather the particular relationship between a sentence and the discourse context that a prosodic pattern serves to signal.

Consider, for example, that according to Rooth (1992), an expression that is interpreted as being *contrastive* with another expression introduces the presupposition that (i) the denotations of the two expressions are of the same semantic type, and (ii) the value of the two denotations differ. On the simplifying assumption that (nuclear) accentuation marks an expression as contrastive, the second part of the presupposition may serve to rule out certain pairs of utterances based on whether the contrastive presupposition is actually satisfied. (4ii) is not a possible rejoinder to (4i), for example, if it assumed that the accentuation on *Bill* serves to mark that expression as contrastive with *Bill* in (4i).

- (4) i. John hit Bill, and then...
 ii. # George_{H*} hit Bill_{L-}%
 H* L- H* L-L-%
 ii'. George_{H*} hit John_{L-}%
 H* L- H* L-L-%

If *Bill* is replaced by *John* as in (4ii'), however, then the same prosodic pattern seems acceptable. According to Rooth's theory, this is because (4ii') satisfies the presuppositions associated with its being marked as contrastive with the object of the preceding clause.

If the presuppositions associated with a contrastive meaning can effectively rule out certain utterances based on the semantic value of an expression in a particular syntactic position, then it stands to reason that those same presuppositions could have the effect of constraining the referential possibilities associated with a pronoun. If the objects in (4ii) and (4ii') are replaced with

the pronoun *him*, then the presuppositions associated with the prosodic pattern are not predicted to change. In other words, the prosodic pattern in (5ii) is predicted to introduce the presupposition that the semantic value of *him* is different from the expression with which it is being contrasted, namely *Bill*.

- (5) i. John hit Bill, and then...
 ii. George_{H*} hit him_{L-}%
 H* L- H* L-L%
 ii'. George hit him_{H*}%
 H* L-L%

In that case, if *him* is assumed to refer to Bill, then the presuppositions are not satisfied, and the prosodic pattern in (5ii) is predicted to be infelicitous, just as it was in (4ii). If *him* is assumed to refer to John, however, then the presuppositions are satisfied, and the pattern is felicitous. In essence, accented *him* in (1b) (and (5ii)) is constrained to refer to John, because that is the only way that the observed utterance counts as felicitous. Of course, this analysis does not fully explain the contrast, since it does not explain why unaccented *him* in (1a) (and equivalently in (5ii')) preferentially refers to Bill.

In the above example, I simply assumed that the contrastively marked object in each case was being contrasted with the object of the previous clause. In fact, Rooth's theory is not fully explicit about how to identify the target of a contrastively marked expression. In other words, it does not explain why nuclear accented *Bill* in (4ii) is automatically interpreted as contrastive with *Bill* in (4i) and not *John*. In addition, it does not specify how to distinguish between accentuation that marks contrast, and accentuation that marks *focus*, which is associated with slightly different presuppositions. For that reason, I apply it here only to illustrate the general type of meaning that might be able to explain phenomena like those in (1) through (3).

Schwarzschild's (1999) theory of prosodic meaning provides a further example of how pronominal reference might be constrained by the interpretation of prosody. Roughly speaking, an accent pattern like the one on the VP in (5ii) is licensed only if at least one of the following three conditions holds:

- (i) The direct object and the verb are both 'new' in the discourse, in the sense of not being recently mentioned (or *Given*)⁴
- (ii) The direct object is new and the verb is Given
- (iii) Both the verb and the direct object are Given, but the combination of the two elements is new (in other words, the VP is new even though it consists entirely of parts that are Given)

Based on the assumption that pronouns are used to refer to already salient entities, it cannot be the case that *him* in (5ii) refers to an entity that is entirely new. Observing that the verb *hit* is used in the first clause, it can also be concluded that the verb is not new. These two facts rule out (i) and (ii) as the basis for licensing the accent pattern in (5ii). If *him* refers to Bill, then the condition in (iii) is not satisfied. In other words, since *hit Bill* occurs in (5i) and would express the same meaning as *hit him*, then the meaning of the VP *hit him* would not count as new. Assuming that binding theoretic considerations prevent *him* from coreferring with *George*, the only referent available for *him* within the context is John.

While the two analyses above are admittedly preliminary, they serve to illustrate the potential for an independently motivated theory of prosodic meaning to explain examples like (1) through (3). They stand in stark contrast to the various switching accounts, since they appeal only to principles that are motivated by independent phenomena: a general theory of the interpretation of prosodic patterns, a theory of the licensing conditions for pronouns, and Binding-Theoretic principles. In other words, they assume nothing about accents that occur specifically on pronouns. Accent

⁴ See Chapters 2 and 4 for a more detailed discussion of Givenness.

patterns on utterances that include pronouns are interpreted just like accent patterns occurring on other types of utterances.

Some recent work has advocated for just such a *generalized* approach to the relationship between prosody and pronominal reference. An eye-tracking study by Venditti et al. (2001), for example, showed that listeners delay the interpretation of an accented subject pronoun until they have heard the verb that follows it.⁵ The authors suggest that the reference of accented pronouns crucially depends on the how the presuppositions associated with whole sentence prosodic patterns are satisfied, or *discharged*, in the context. The value of such presuppositions cannot be determined, however, until the value of the following material, as well as the associated prosodic pattern, is known. Thus, speakers wait until the value of the presupposition is sufficiently specified before they make a decision regarding the reference of the pronoun. In the experimental contexts, the verb provided a sufficient cue in this regard. The authors point out that if the interpretation of accented pronouns depended on the notion of a switch from some default, then listeners should be able to interpret accented pronouns immediately.

De Hoop (2004) makes the related argument that any effects of prosodic pattern on the reference of pronouns must follow from the way that the associated presuppositions are satisfied. She proposes an Optimality Theoretic (Prince & Smolensky 1993) model in which the satisfaction of a contrastive presupposition is ranked above a constraint requiring an utterance to continue the *topic* of the previous utterance. In that sense, de Hoop's model retains the notion of a default reference strategy. This default can be overridden, however, if it is incompatible with the constraints imposed by the interpretation of contrastive stress. While no precise formulation of contrastive stress or its prosodic realization is spelled out, the proposal is suggestive of an overall approach.

⁵ This study is reviewed in further detail in Chapter 2.

In a related argument, Cornish (2005) points out that the notion of a switch from some default reference does not always have a sensible interpretation. Consider the use of *her* in (6).

- (6) “To the man in the street, we do not constitute a viable alternative to the Tories – that’s why they voted for HER [and not us]”

Intuitively, *her* is being accented in this case, not because it represents a switch from the value of unaccented *her*, but because it is being contrasted with one or more members of the political party that the speaker belongs to. Importantly, the same utterance would have been infelicitous with no accent on *her* and may have even left the listener confused as to the intended referent. At the very least, this type of example shows that the choice to accent a pronoun is not *always* associated with a switch in reference. Consider that if the notion of reference switch is not a relevant notion in production, then it is somewhat surprising that it should be relevant for interpretation.

More recently, Jasinskaja et al. (2007) showed that in German, the reference of a pronoun with a fixed accentual status was predicted by the prosodic pattern of the associated predicate. In (7iii) for example, the pronoun *er* (“he”) is in principle ambiguous between coreference with *Johann* in (7i) and *Marek* in (7ii).

- (7) i. Johann hat die Möhren geschnitten.
Johann has the carrots cut
 ‘Johann cut the carrots.’
 ii. Marek hat indes die Kartoffeln geschält.
Marek has meanwhile the potatoes peeled
 ‘Meanwhile, Marek peeled the potatoes.’
 iii. Außerdem hat er die Kartoffeln geschnitten.
besides has he the potatoes cut
 ‘Besides, he cut the potatoes.’

In a perception experiment, listeners heard (7iii) produced with one of the prosodic patterns in (8).⁶

- (8) a. Außerdem hat er die KARTOFFELN geschnitten.
b. Außerdem hat er die kartoffeln GESCHNITTEN.

According to the authors' analysis, the prosodic patterns in (8a), with a nuclear accent on *Kartoffeln*, serves to indicate a contrast between two events of cutting, which is sensible only if the VP in (7iii) is identified with the VP in (7i). In that case, the notion of contrast would imply that the pronoun *er* does not refer to Johann. By comparison, the prosodic pattern in (8b) indicates a contrast between two relations involving potatoes. This contrast is only sensible if (7iii) is identified with (7ii), in which case *er* should not refer to Marek. Consistent with this prediction, there was a slight but significant positive correlation between the prosodic pattern in (8b) and the likelihood that the pronoun referred to the first-mentioned referent (i.e., *Johann*). Since the accentual status of the pronoun itself was not varied in this study, this finding lends support to the idea that sentential prosodic patterns, and not merely pronoun accentual status, is the relevant factor guiding the relationship between prosody and pronominal reference.

Finally, a recent study by Djalali et al. (2008) showed that specific prosodic patterns can influence the reference of definite NPs as well as pronouns. In contexts like those in (9), the subject of the second clause (i.e., *the wood*) may be associated with either the subject or the object of the first clause, depending on which *bridging inference*⁷ the listener makes.

- (9) The oak tree crushed the log cabin. The wood was rotten.

⁶ The authors use capitals to indicate the locus of nuclear accentuation. More detailed prosodic descriptions are not provided.

⁷ *Bridging* occurs, for example, when a hearer is able to infer from a mention of *the tree* that a subsequent use of the expression *the wood* refers to the wood that is part of the tree.

In a perception experiment, participants were more likely to associate *the wood* with the subject of the preceding clause when they heard (10b) than when they heard (10a).

- (10) a. The wood was rotten%
 H* L-L%
- b. The wood was rotten%
 H* L-L%

The authors do not provide an analysis in terms of a generalized interpretation of prosodic form. A switching approach, however, assumes that special interpretative principles apply to accents on pronouns based on the assumption that pronouns represent a special class of forms. For that reason, their predictions do not readily extend to phenomena involving non-pronominals. A generalized approach, however, does not distinguish between different classes of referring expressions a priori. In that sense, the same analysis that explains the effects of prosody on pronominal reference should explain the effects of prosody on reference by other types of expressions.

In spite of the above empirical evidence lending support to a generalized approach, the question remains whether such an approach can stand up to formal rigor. The above analyses based on Rooth (1992) and Schwarzschild (1999) were, after all, merely suggestive. Assuming, however, that a generalized approach proves to be formally and empirically adequate, there are reasons to favor it over a switching approach. First of all, a generalized approach is the more parsimonious of the two approaches since, as already mentioned, it does not require the additional assumption that accented pronouns represent marked forms. In addition, existing switching proposals assume that accents have an interpretation in more than one model of the discourse. In other words, accents that occur on pronouns are essentially treated as distinct morphological entities from accents that

occur on other expressions. The consequence of this dualism is that the predictions of switching proposals are not guaranteed to converge with the predictions of more general theories of prosodic meaning, since the two types of models are based on entirely different sets of discourse factors. By comparison, a generalized approach can never lead to such a lack of convergence, since by definition, accents are assumed to have a consistent interpretation across different types of expressions. Under this view, a pronoun does not have to manifest a reference switch in order to be accented. It may be accented, for example, if the speaker intends for it to be interpreted as contrastive. In certain contexts, the interpretation associated with a particular prosodic pattern may constrain referential possibilities and thereby serve as a disambiguating cue. In other words, an accented pronoun may, but does not necessarily, refer differently from its unaccented counterpart.

1.3 Overview of Theoretical Issues

Given the intuitive and theoretical advantages of a generalized approach, the primary question addressed by this dissertation is the following:

- (i) Is there a theory of the meaning of prosodic form that can account for examples like (1) through (3) without additional stipulation?

Assuming the answer to (i) is affirmative, it does not automatically follow that the switching approach is invalid. After all, both approaches account for the key examples in (1) through (3) equally well. In order to distinguish between the two approaches convincingly, it is necessary to identify test cases for which they make distinct predictions. By gauging the empirical reality of such

cases, it may be possible to reject one or the other approach based on how well each predicts the associated outcome. Thus, a second major aim of the investigation is to address the following:

- (ii) Do the various switching proposals and a generalized account make distinct predictions, and if so, under what circumstances?
- (iii) What do speakers and listeners actually do in such cases?

The observation in examples like (1) through (3) seems to be that pronominal reference and prosodic form covary under certain circumstances. In other words, such examples suggest not only that differences in prosody lead to different interpretational preferences, but also that different intentions will lead a speaker to produce different prosodic patterns. A speaker who considers the hearer's perspective, for example, should anticipate the interpretive consequences of form and choose a prosodic pattern accordingly. Thus, a complete answer to the questions in (ii) and (iii) consists of two parts: one that compares the predictions that each approach makes for production and one that compares the predictions that each makes for interpretation. These issues are addressed separately in Chapters 2 and 3 respectively.

As 1.2.1 explains, there are a number of assumptions that are made either explicitly or implicitly by the various switching proposals. A secondary aim then, is to evaluate the assumptions that underlie that approach. This includes, in particular, an assessment of the assumption that accents on pronouns represent marked forms. While it is true that accented pronouns are relatively rare in naturally occurring speech (Altenberg 1987, Nakatani 1997, Wolters & Beaver 2001), and while it has been suggested independently that functional categories in general are resistant to prosodic prominence (Ladd 1980, Selkirk 1995a, German et al. 2006), this evidence has not been considered in the context of existing switching proposals. Chapter 2 addresses this issue in terms of

whether the distributional facts associated with accented pronouns can be explained without assuming that pronouns are inherently resistant to prosodic prominence.

In real language use, production does not always mirror perception. As the remaining chapters will show, this issue is of particular importance to the problem of relating prosody to pronominal reference, since any plausible account requires not only that production and interpretation be modeled as separate processes, but that the interlocutors' beliefs about those processes be represented and taken into account. A final aim of this dissertation, then, is to provide a model that gives formal regard to the inherent bidirectionality of the relationship between prosodic form and pronominal reference.

This dissertation specifically addresses the question of how prosodic patterns interact with the reference of free (i.e., unbound), personal pronouns. Hirschberg & Ward (1991), Jacobson (2000), and Cornish (2005) have also addressed the relevance of prosody for the interpretation of bound anaphora. Brown-Schmidt et al. (2005) address the role of accentual status for the interpretation of demonstrative pronouns (i.e., *this, that, those, etc.*) from an experimental perspective. In this dissertation, I do not address such effects directly, though the findings do provide strong support for the idea that a single model of prosodic meaning provides real constraints on referential possibilities, and in that sense, may lead to an integrated account of the role of prosody for pronouns in the more general case.

1.4 Overview of Methodology and Findings

The research aims outlined above are approached in three parts. Chapter 2 begins by addressing the conditions that govern the accentual status of pronouns in production. According to

one particular class of switching proposals (henceforth, *attentional* models), pronouns are accented when their reference manifests a shift in the relative salience of entities in the discourse (Nakatani 1997, Kameyama 1999, Beaver 2004). In a generalized approach, however, a pronoun, or any referring expression for that matter, may be accented when it represents a new instantiation of a predicate that is saliently evoked in the context (Schwarzschild 1999). Since these two sets of factors are confounded by examples like (1) through (3), a class of contexts is identified for which the predictions of the two approaches are decoupled and may be manipulated independently.

A production experiment then tests speakers' preferred prosodic patterns for four different cases: one for which only attentional models predict accentuation on a target pronoun, one for which only a generalized model predicts accentuation on the pronoun, one for which both approaches converge to predict accentuation on the pronoun, and one for which both models converge to predict no accentuation on the pronoun. The overall design is balanced in a way that permits direct quantitative comparison of the prosodic and acoustic characteristics associated with the various outcomes.

The results of the study show, first of all, that information structure (as characterized by Schwarzschild 1999) reliably predicts accents on pronouns independently of factors associated with attentional models. By comparison, the factors associated with attentional models turn out to be relatively poor predictors of pronoun accentual status, giving rise to statistically significant, though quantitatively weaker, effects. I show that the presence of this comparatively smaller effect can be explained by implicit differences in information structure, which could not readily be controlled for in the study. Attentional models, in other words, are not only undermined by the evidence that information structure is relevant for pronoun accentuation in its own right, but the quantitatively weaker effects associated with attentional factors cannot be explained apart from a generalized

model. The possibility that the two major cases involve different categories of pitch accents is explored and ultimately rejected.

Finally, the results of the production experiment are examined from the standpoint of prosodic phonology, following the suggestion of Ladd (1980) and German et al. (2006) that function words are intrinsically resistant to accentuation. While German et al. (2006) showed that prepositions may resist nuclear accentuation in spite of information structural constraints on prosody, pronouns in the production study exhibited no such tendency. This finding suggests that the inherent accentability of different grammatical categories is not readily captured by the distinction between content words and function words.

The second part of the approach directly addresses factors influencing the interpretation of accented pronouns in perception. As already outlined, a prevailing view in the literature is that the reference of an accented pronoun can be derived from the reference of its unaccented counterpart (esp. Kameyama 1999). This view takes for granted that accented pronouns are in defiance of some default strategy for interpreting pronouns. By comparison, a generalized approach assumes that any effects of prosody on pronominal reference follow from the interpretations associated with prosodic patterns over whole sentences. Crucially, the latter type of approach, but not the former, allows for the possibility that an accent on a pronoun does not trigger a switch in reference.

To address the confound presented by examples like (1) through (3), a class of contexts is first identified for which the two approaches make distinct predictions for the reference of accented pronouns. These contexts are then implemented in two perception experiments in which the properties of the context that are relevant for information structure (according to Schwarzschild 1999) are manipulated independently of the prosodic pattern itself. This serves to establish a baseline preference for the case of unaccented pronouns, which is then used to evaluate the extent

to which a switch is manifested by the accented case. A second manipulation varies which of two reference patterns is predicted by a generalized approach according to a particular implementation of Schwarzschild (1999). The findings of the study overwhelmingly favor the generalized approach. The results show that a prosodic pattern involving an accented pronoun may actually *reinforce*, rather than inhibit, the reading associated with the unaccented pronoun. Not only does this support a rejection of the principle of a reference switch, but it challenges the notion that pronouns in context are somehow associated with a default strategy.

In Chapter 4, I propose a new model for the interpretation and production of nuclear pitch accents. The specific formulation of the model builds on the fundamental insights and empirical coverage of the model proposed in Schwarzschild (1999). Innovations to the model are proposed based on the need, first of all, to represent the inherent bidirectionality of the relationship between prosody and pronominal reference. In addition, I show that even within a generalized approach, there is a range of possible blocking inferences that are consistent with existing evidence. Together, these considerations call for a framework in which blocking inferences are not only represented formally, but emerge automatically from a minimum of theoretical assumptions. An additional issue concerns the organization of formal elements in Schwarzschild's model, which poses a problem for modeling cases in which two types of underspecification must be resolved by the hearer simultaneously. In short, the model does not provide a formal mechanism for comparing inputs with different truth conditions against an observed output. I show how these issues can be resolved if the basic formal elements of Schwarzschild's model are reconfigured and subsequently embedded in the framework known as Bidirectional Optimality Theory (Blutner 2000, Blutner et al. 2006). With a refinement to the constraint set, the result is shown to account for the key empirical facts presented here and in previous work.

1.5 Assumptions Regarding Prosodic Form and its Relationship to Meaning

Throughout this investigation, my assumptions regarding the prosodic structure of English closely follow those of Pierrehumbert (1980) and Beckman & Pierrehumbert (1986). Specifically, I assume that stress and tune are represented independently, where stress is an abstract correlate of duration, amplitude and spectral characteristics of speech segments, while tunes are sequences of tones (low or high) that influence the realization of pitch. Words in an utterance may be grouped into *intermediate phrases*, which are marked by characteristics of both tune and stress. One or more words in an intermediate phrase may be marked by a *pitch accent*, which is a prominent pitch movement consisting of a sequence of either one or two high or low *tones* (H and L, respectively). Each pitch accents has one designated head tone (labeled with *), which aligns with the most prominent syllable of the word that it marks as prominent. Thus, examples of possible pitch accents in English are H*, L+H*, L*, or L*+H.

Intermediate phrases are also marked at their right edge by a single H or L tone, which specifies both the pitch level at the end of the phrase as well as that between the end of the phrase and the final pitch accent in the phrase. In addition, the right edge of an intermediate phrase is marked by segmental lengthening or pausing. The last pitch accent in an intermediate phrase is called a *nuclear accent*. Typically, it is the most prominent pitch movement in the phrase and is associated with the word in the phrase receiving the greatest stress. Utterances are also grouped into *intonational phrases*, which are composed of one or more intermediate phrases, and are marked at their right edge by either a high or low tone (H% and L%, respectively). Since each intonational phrase boundary is also an intermediate phrase boundary, the right edge of an intonational phrase is characterized by a sequence of a phrase accent and a boundary tone.

Many of the existing theories that I address in this dissertation are imprecise regarding the specific aspects of prosodic form that are assumed to be relevant for meaning. Typically, reference is made only to the presence or absence of “primary stress”, “nuclear stress”, “accentuation” or “nuclear accentuation”. While this leaves many aspects of prosodic structure underspecified given the framework I have just laid out, in general I assume that the feature that is most relevant for theories of information structure (e.g., Schwarzschild 1999) is the distribution of nuclear accents in an utterance. More precisely, I assume that an accent feature in Schwarzschild’s model specifies the locus of greatest stress prominence in an intermediate phrase, and that the final pitch accent in the phrase is attracted to this position. Within the framework I am assuming, this position is identifiable by the fact that it is always followed by an intermediate phrase boundary (or phrase accent) with no additional accents intervening.

In general, I only consider cases in which all accentuation is nuclear, in the sense that there is a one-to-one correlation between accents and intermediate phrases. This implies that between any two neighboring pitch accents, exactly one phrase accent and no additional accents intervene. Note that this is not an inherent limitation of English prosodic form, but merely a simplification meant to facilitate the comparison of different proposals within a single theoretical framework. Indeed, prenuclear accents are observed in the results of the production study reported on in Chapter 2. Where appropriate, therefore, I make the necessary distinction through the use of labeling.

This simplification follows from the assumption that intermediate phrase boundaries have consequences for the interpretive status of pitch accents that they separate (Welby 2003). The importance of phrasing is especially apparent for cases where pronominal reference seems to depend on prosody. Notice, for example, that whereas (11a) gives rise to a clear intuition that *him* refers to

John, the intuition is much less clear when there is no intervening intermediate phrase boundary as in (11b).

- (11) a. John_{H* L-} hit Bill_{H* L-H%} and then George_{H* L-} hit him_{H* L-L%}
 b. John_{H* L-} hit Bill_{H* L-H%} and then George hit him_{H* L-L%}

Throughout the dissertation, then, I use “accent” and “accentuation” to refer to a particular combination of pitch accent placement and phrasing, such that the position in question is not only a nuclear accent, but the only nuclear accent in its intermediate phrase. Where appropriate, I indicate this with an explicit ToBI transcription (Silverman et al. 1992, Beckman & Ayers Elam 1997). With the exception of Chapter 2, which partly addresses the role of pitch accent type in differentiating between putative discourse functions, the role of tune type is largely ignored. This does not imply that these factors are irrelevant to the full interpretation of the examples I address. It does not appear, however, that differences in phrase accent type or boundary tone type have consequences for the reference of pronouns in these examples. For that reason, the present investigation is limited to specific minimal contrasts in form (i.e., accentuation and phrasing) that have clearly observable consequences for known key examples. The relevance of other aspects of prosodic form for pronominal reference is left to future studies.

1.6 Summary and Overview

To summarize, the questions addressed by this dissertation center around the apparent covariation between prosodic patterns and pronominal reference observed in examples like (1)

through (3). A full examination of these effects, however, touches on a much wider range of theoretical issues, including the proper interpretation of prosodic form, the principles governing pronominal reference, and the role of shared beliefs in negotiating the use of underspecified forms. The point of departure for the investigation is an exploration of the possibility that the effects can be accounted for by an explicit and fully general theory of the meaning of prosodic form. Through a series of experimental studies, this approach is evaluated and compared to an alternative approach, which instead assumes a special status for pitch accents that occur specifically on pronouns.

In Chapter 2, these issues are addressed from the perspective of production. Specific predictions are laid out for each type of approach, and these are evaluated by a balanced experimental study. The results of the study are discussed, both in connection with a comparison of the two approaches, as well as in connection with the status of pronouns as prosodically weak function words. Chapter 3 addresses the problem from the perspective of interpretation. The two approaches are shown to give rise to competing predictions regarding the discourse factors deemed relevant for interpreting pronouns. These competing sets of predictions are then tested directly in two perception experiments. Chapter 4 shows that the model faces certain formal issues when extended to a wider range of examples. A new model of the interpretation of accent patterns is proposed that addresses these formal issues directly. Finally, Chapter 5 provides an evaluation of the findings of the overall investigation with respect to its stated goals.

Chapter 2

Conditions for Accenting Pronouns in Production

2.1 Introduction

This chapter addresses the conditions that lead a speaker to place pitch accents on pronouns in production. While a wide range of factors have been shown to influence the distribution of pitch accents (including, for example, speaking rate, phrasing, tonal crowding, and content versus function status), it is generally assumed that the placement of nuclear pitch accents in an utterance has consequences for its meaning. In this chapter, I focus on two classes of proposals concerning the meaning of accents that bear on the accentual status of pronouns. The predictions of the two approaches are compared and shown to conflict in certain contexts. A production experiment evaluates the empirical validity of each set of predictions as a means of deciding between the two approaches.

In Chapter 1, a distinction was made between models of pronoun accentual status based on the notion of a “switch” from some default reference (i.e. *switching* models), and those based on a more general type of meaning that relates accent patterns over whole utterances to the contents of the discourse (i.e., *generalized* approaches). Switching models, it was explained, are specialized in that their predictions are relative to the accentual status of particular pronouns in a sentence and nothing else. By comparison, the generalized approach treats accent patterns over whole utterances without regard to the particular types of expressions involved. The fact that the two classes of models both make predictions for the accentual status of pronouns on the basis of distinct factors raises the

possibility that the two sets of predictions may actually come into conflict. In other words, if the two sets of conditions for pronoun accentuation can be manipulated independently of one another, it should be possible to test the validity of corresponding proposals.

The switching approach was shown to crucially depend on the assumption that each pronoun is associated with a default reference, which (i) is recoverable to both speaker and hearer apart from its accentual status and (ii) is the reference the pronoun would have if it occurred in the same context without an accent. One issue that this raises is how to establish predictions that do not take for granted that this key assumption is warranted. Since most analyses emphasize the role of pronoun accentual status in perception, the notion of a default reference is somewhat trivial – it is just the empirically determined preferred reference in some particular case for which the pronoun is unaccented. In production, however, the issue is to determine what effect a particular referential value for the pronoun has on its accentual status. The question, then, is how the notion of a ‘switch’ may be characterized so that its relationship to pronoun accentual status can be evaluated.

Unfortunately, most switching proposals are either too vague with regard to the factors influencing the default preference, or too limited in empirical scope to be useful in making predictions about production. Furthermore, since different proposals predict this preference in different ways, it is not possible to test all of them simultaneously. For these reasons, the investigation in this chapter is restricted to a subset of switching proposals that are both empirically precise enough, and similar enough to each other, to be usefully applied to the same dataset. Specifically, I will consider the proposals of Kameyama (1999) and Beaver (2004), which, as noted in Chapter 1, are grounded in the Centering-Theoretic principle that referential preferences reflect the ordering of entities in an attentional model of the discourse according to relative *salience*. As with most switching models, a pronoun is accented if it represents a deviation from a default reference.

In contrast to the majority of switching models, the notion of a default reference in a Centering Theoretic model is well-defined for many contexts.

The predictions of these two models (henceforth *attentional* models) are compared against an alternative set of predictions based on the theory of prosodic meaning found in Schwarzschild (1999). While there are a number of related theories that give rise to similar predictions in this case, I have chosen to apply Schwarzschild's theory for two reasons. First of all, it predicts the possibility of accents on discourse given expressions without stipulating a separate notion of contrastive focus (Rooth 1992, Selkirk 1995b). This implies that it is not necessary to assume that pronouns will be accented only when they are contrastive. Second, Schwarzschild's model provides relatively straightforward predictions for the accent pattern of a sentence given a context. It is a problem for most theories of accent placement, Schwarzschild (1999) included, that accent placement and its associated meaning are assumed to be a matter of speaker intention, and cannot, therefore, be predicted directly from a context. Schwarzschild's model is somewhat unique, however, in that accent patterns are assumed to reflect presuppositions, not about the mutual beliefs of the interlocutors per se, but about the *linguistic* contents of the discourse context. Thus, whereas many theories are at a loss to say which textual aspects of the context might predict a speaker's choice of accent placement, it is a reasonable simplifying assumption under Schwarzschild's model that explicit and recent mention of particular syntactic constituents will render subsequent mention of identical constituents as *Given*.

The study in this chapter therefore seeks to address, first of all, whether the specific claims of the attentional models differ from those based on Schwarzschild's model. Are there contexts, in other words, for which the predictions of the two classes of models make distinct predictions for the accentual status of a particular pronoun? I show that the contextual factors deemed relevant by each

class of models can, in fact, be manipulated independently. This gives rise to four classes of contexts for which the two sets of predictions either converge or conflict in different ways.

Given that such cases of conflicting predictions exist, the second aim of this study is to test those predictions empirically. A production study was designed to elicit speaker preferences regarding the prosodic form of sentences containing pronouns. This not only provides a means for evaluating each type of model independently, but it promises to address many of the questions raised in Chapter 1 by helping to distinguish between two broad approaches to the relationship between prosody and pronominal reference. In other words, if Schwarzschild's model accurately predicts pronoun accentual status when the factors associated with that theory are decoupled from those associated with attentional models, then there is good support for a generalized approach to the relationship between prosody and pronominal reference. If on the other hand, the factors associated with attentional models accurately predict the accentual status of pronouns independently of those associated with Schwarzschild's model, then there is support for a rejection of the generalized approach.

A third possibility is that the factors associated with the two classes of models reflect sufficient, rather than necessary conditions. This would imply that accents are associated with two distinct, and possibly parallel, discourse functions. If that is the case, then it is reasonable to suspect that the two ostensible functions are realized by distinct prosodic forms. Looking beyond the mere accentual status of pronouns, then, the present study promises to address this issue through careful prosodic and phonetic analysis of the speakers' productions. In particular, the question is addressed whether accents on pronouns that ostensibly reflect attentional factors are phonetically distinct from those that reflect information structure.

Ladd (1980), Selkirk (1995a) and others have suggested that function words, such as prepositions, determiners and auxiliaries, are inherently resistant to prosodic prominence, and may therefore influence the distribution of pitch accents in an utterance. German et al. (2006), in fact, showed that prepositions tend to resist accentuation even when this results in a non-optimal form from the standpoint of information structure. While pronouns clearly pattern with other function words in many aspects of prosody, it is an open question whether they pattern with function words with respect to accentability. The design of the present study partly addresses this question. Two of the four experimental conditions closely mirror the German et al. study in that accents are predicted to occur on pronouns for reasons of information structure. If pronouns pattern with other function words prosodically, and with prepositions in particular, then they should exhibit lower-than-expected rates of accentuation in these contexts.

The next section provides a review of two previous studies that bear on the issue of the accentual status of pronouns in production. Section 2.3 provides the theoretical background for the study. This includes a review of the three proposals at the center of the study, as well as a detailed application of those proposals to four key classes of examples. Section 2.4 describes the design of a production study, while 2.5 presents the results of that study. In Section 2.6, I discuss the results of the study, first from the perspective of pronominal reference, and then from the perspective of pronouns as function words. Finally, Section 2.7 provides some concluding remarks.

2.2 Previous Studies

The questions raised above have been addressed in part by two previous empirical studies. Wolters & Beaver (2001) tested the effect of what they term a *topic shift* by looking at whether subject

pronouns and definite NPs were more likely to be accented when they coreferred with objects in the preceding sentence versus when they coreferred with subjects in the preceding sentence. They provide the example in (12).

- (12) i. Julia went to a bar last night.
 ii. She chatted with Nathan for a while.
 iii. He had been waiting for this chance for ages.
 iii'. She also spent some time at the bar.

According to their definition, the subject pronoun *he* in (12iii) exemplifies a topic shift, since it corefers with the object of (12ii). By comparison, (12iii') involves no topic shift, since *she* corefers with the subject of (12ii). The study found that pronouns were slightly more likely to be accented when they coreferred with objects, though this finding did not reach statistical significance ($p < 0.1$). The authors attribute this lack of significance to low overall rates of accentuation, which reached only 30% in the “+Shift” condition (i.e., (12iii)). For nouns, there was no effect of a topic shift on accentuation rates.

Nakatani (1997) also addresses the role of attentional factors in predicting pronoun accentual status through an analysis of a corpus of spontaneous narrative speech from a single speaker. The analysis is grounded in the Centering Theoretic (Grosz et al. 1995) assumption that the entities referred to in an utterance are represented in an ordered list (the *forward-looking center list*, or C_p), and that this ordering has consequences for the preferred reference of pronouns in following utterances. The study found that overall pronouns had a very low likelihood of being accented (21%) relative to other types of referring expressions (81%). Among the 25 cases of accented subject pronouns, 16 (64%) corresponded to a *shift*, in the sense that they referred to some entity other than the locally most prominent one (roughly, the highest-ranked member of the input C_p). Of those cases that embodied a shift, nine involved a shift to an entity mentioned in the immediately preceding

utterance (a *local* shift), while eight cases involved a shift to an entity mentioned in some earlier utterance (a *global* shift). Interestingly, of the remaining nine cases (44% of total) that did not involve a shift, six were attributed to ‘emphasis or contrast’, while three were said to require ‘limited inference to determine the pronoun referent’. While it is not clear from the description of the study what formal criteria were used to establish the notions of contrast and inference, the overall pattern of the results suggests that accents on pronouns participate in one of two distinct discourse functions. In other words, accents on pronouns seem to signal either (i) a shift in the attentional state of the discourse or (ii) that the pronoun is being used to signal contrast in some model of information structure.

What is absent from either of the above studies, and what the present study crucially contributes, is a balanced comparison of contexts that manipulate only attentional factors with contexts that manipulate only those factors associated with information structure. Most importantly, the materials used in the present study control for the textual form of the sentences being measured, as well as their segmental and lexical prosodic characteristics. In other words, the same sentence occurred in each experimental condition, making it possible to directly compare phonological outcomes across conditions. By comparison, the Wolters & Beaver study manipulated the factor of interest (topic shift) by varying the textual content of the sentences being measured, thereby confounding the outcomes with differences in the prosodic and segmental characteristics of the materials. Nakatani’s use of naturally occurring speech presents a similar issue. Finally, the present study improves on previous studies by including a substantially larger number of tokens in the analysis.

2.3 Theoretical Background

In this section, two classes of models are shown to make predictions for the accentual status of pronouns based on distinct contextual factors. First, 2.3.1 provides an overview of two so-called *attentional* models. Next, an overview of Schwarzschild's (1999) model of accent meaning is reviewed in 2.3.2, followed by a discussion of how that model bears on the accentual status of pronouns specifically. Finally, in 2.3.3, a set of examples is reviewed in which the two classes of models are shown to make either converging or conflicting predictions.

2.3.1 Attentional Models: Kameyama (1999), Beaver (2004)

A number of proposals have approached the relationship between prosody and pronominal reference from the perspective of Centering Theory (Grosz et al. 1995). This means that the interpretation and production of accented pronouns is assumed to follow from the way that the *attentional status*, or relative salience, of entities in the discourse is updated. These proposals include, for example, Nakatani (1993, 1997), Cahn (1995), Kameyama (1999) and Beaver (2004). Two of them, Kameyama (1999) and Beaver (2004), make particularly clear and overlapping predictions for the set of examples that are reviewed here.

Kameyama's (1999) account of accented pronoun interpretation follows basic Centering Theoretic assumptions in that each utterance U_i in a model of the discourse is associated with an ordered list of the entities that are referred to in U_i . This list is called the *forward-looking center list*, or $C_f(U_i)$. The ordering of $C_f(U_i)$ corresponds to the relative salience of the entities after U_i has been uttered and is determined primarily by the two factors: grammatical role (e.g., subject versus object)

and nominal expression type (e.g., pronoun versus NP). In general, entities referred to by subject pronouns rank highest in salience, while entities referred to by indefinite NPs in object positions rank lowest.

Centering Theoretic models also assume a set of preference rules that rank the various ways in which the forward-looking center list may change over short discourse segments. These preference rules favor transitions that preserve the ordering of the list from utterance to utterance, with the result that salience-imparting expressions (such as subject pronouns) in an utterance tend to preferentially corefer with salience-imparting expressions in the preceding utterance. The discourse segment in (13) illustrates this effect.

- | | | |
|------|-------------------------------------|---|
| (13) | i. Babar went to a bakery. | $C_f(i) = [\text{Babar} > \text{bakery}]$ |
| | ii. He greeted the baker. | $C_f(ii) = [\text{Babar} > \text{baker}]$ |
| | iii. He pointed at a blueberry pie. | Preference: Babar « the baker |

Since *he* in (13ii) cannot refer to an inanimate object (i.e., the bakery) and must therefore refer to Babar, the preference rules do not play a role in the transition between (13i) and (13ii). In (13iii), however, there are two potential candidates for the referent of *he*. If Babar is chosen as the referent, then $C_f(13iii)$ becomes $[\text{Babar} > \text{blueberry pie}]$. If the baker is chosen, however, then $C_f(13iii)$ becomes $[\text{the baker} > \text{blueberry pie}]$. Since Babar is the highest ranked element of $C_f(13ii)$, the former choice, but not the latter, results in a transition between (13ii) and (13iii) that preserves the status of Babar as the highest ranked element. As a result, Babar is preferable to the baker as the referent of *he* in the utterance in (13iii).

The foundation of Kameyama's proposal follows from her observation that the interpretation of (unaccented) pronouns in a Centering model and the interpretation of focused nominals (including pronouns) in an alternative semantics model (Rooth 1992) both involve a

presupposition that (i) there is a contextually determined set of entities that contains at least one member, and (ii) the expressions involved are constrained to refer to a member of that set. In Centering Theory, this set is just the set of entities mentioned in the preceding utterance (i.e., the $C_f(U_{i-1})$). In alternative semantics, the relevant set is some contextually identified subset of the focus semantic value of the focused expression. Noting the formal similarities between the two models, Kameyama attempts to integrate them into a single account of accented pronoun interpretation.

The proposal consists of essentially two parts. The first part is an operation for computing the reference of an accented pronoun based on the hypothesis in (14).

- (14) **Complementary Preference Hypothesis (CPH):** A focused pronoun takes the complementary preference of the unstressed counterpart

Operationally, the CPH requires that a preference ordering over various ways of resolving the unaccented pronoun first be computed. The inverse of that ordering is then calculated (by reordering each pair in the list such that $x > y$ becomes $y > x$), and the preferred interpretation of the accented pronoun is based on the new ordering. In simplified terms, if an unaccented pronoun preferentially refers to the highest-ranked member of the $C_f(U_{i-1})$, then an accented pronoun preferentially refers to the lowest-ranked member of $C_f(U_{i-1})$. This is illustrated in example (15).⁸

- | | | |
|------|--|---|
| (15) | i. John was angry. | $C_f(i) = [\text{John}]$ |
| | ii. He hit Bill. | $C_f(ii) = [\text{John} > \text{Bill}]$ |
| | iii. Then he hit Mary ⁰ %
H* L-L% | Preference: John « Bill |
| | iii'. Then he hit Mary ⁰ %
H* L- H* L-L% | Preference: Bill « John |

⁸ Kameyama assumes that an accent on *be* in (13iii) results in infelicity due to the additional constraints associated with the focus model. For that reason, another, more illustrative example is given here.

On the assumption that John is ranked above Bill in the $C_f(15ii)$, then John is also preferred over Bill as the referent of *he* in (15iii). According to Kameyama's model, then, accentuation on *he* in (15iii') has the effect of reversing the ordering of preferred referents, so that Bill is preferred over John. In other words, unaccented *he* in (15iii) is predicted to refer to *John*, while accented *he* in (15iii') is predicted to refer to Bill.

It is important to note that transition preferences associated with the forward-looking center list are just *one* source of an ordering relation over the possible referents of a pronoun. In certain cases, the transition preferences may be overridden by other principles such as syntactic parallelism, or even general world knowledge about typical interactions. One such *common sense rule* is given in example (16).

(16) **HIT**: When an agent x hits an agent y, y is normally hurt

This rule is assumed to explain the preference ordering for the unaccented pronoun in (17ii), for example, which actually runs counter to the preference based on the ordering in $C_f(17i)$.

- | | | |
|------|----------------------|--------------------------|
| (17) | i. John hit Bill. | $C_f(i) = [John > Bill]$ |
| | ii. he was injured% | Preference: Bill « John |
| | H* L-L% | |
| | ii'. HE was injured% | Preference: John « Bill |
| | H* L-L% | |

Based on **HIT**, Bill is preferred over John as the referent of unaccented *he* in (17ii). Kameyama's CPH therefore predicts that the preferred referent of accented *he* in (17ii') is John, which is consistent with the standard intuition for examples like (17).

Kameyama's proposal also assumes that an accent on a pronoun has a second interpretation within an alternative semantic model of focus (Rooth 1992). In other words, in addition to its effect

on the preference ordering, the accent on the pronoun in (17ii') introduces the presupposition that there is some contextually salient set of propositions of the form {x was injured} formed by instantiating x with salient alternatives for *he*, and that the ordinary semantic value of *he was injured* in (17ii') is an element of that set. The algorithm for computing the interpretation of an accented pronoun includes a step requiring that this presupposition be discharged in the context. Kameyama asserts that “the difference between stressed and unstressed counterparts is in the presuppositions, and that there is a systematic relation between them coming from the interaction between the semantic focus interpretation of the stressed pronoun and the centering principles associated with its unstressed counterpart” (p. 307). However, the focus semantic component of the model is not actually referenced in either the CPH or in the portion of discourse model associated with referential preferences. In other words, it does not play a role in actually explaining how accented pronouns refer. Instead, it is merely stipulated that an accent on a pronoun induces a reordering of the interpretational preferences associated with that pronoun. In that sense, Kameyama’s proposal is specifically tailored to an account of the referential effects associated with accented pronouns and does not depend on independently motivated principles of prosodic meaning (in this case, Rooth’s focus model) in any meaningful way.

While Kameyama’s model is formally stated as an interpretation algorithm, the assumption within Centering Theory more broadly is that factors related to the local coherence of the discourse context impose constraints on a speaker’s choice among referential forms (i.e., production). Interpretive effects come about when the hearer makes inferences based on the constraints that are known to guide a speaker’s choices. For that reason, Kameyama’s model is assumed here to be a model of production as well as one of interpretation. In other words, the reversibility of the

algorithm implies that a pronoun must be accented whenever the reference intended by the speaker constitutes a deviation from the operative preference ordering, and unaccented otherwise.

A related proposal is found in Beaver (2004), in the sense that the preferred reference of pronouns is grounded in an attentional model of the discourse. The greater part of the proposal, in fact, is concerned with recasting the key principles of Centering Theory within Bi-Directional Optimality Theory (Blutner 2000). Instead of merely stipulating a reordering of the default preference, Beaver's model invokes a particular formal interpretation of the principle of *partial blocking* (Kiparsky 1983) to explain the correspondence between accentual status and pronominal reference. Essentially, partial blocking predicts that *marked* (or dispreferred) linguistic forms are made available for expressing marked (or atypical) meanings, while unmarked forms are reserved for expressing unmarked meanings. Based on the assumption that accented pronouns represent marked forms, the model predicts that an accented pronoun should refer in a non-default way, while an unaccented pronoun should refer in a default way.

Formally, partial blocking comes about in Beaver's model through an interaction of two constraints. The first constraint, stated in (18), serves a function similar to the transition preferences in Kameyama's model, in that it distinguishes between preferred and non-preferred patterns of pronominal reference.

(18) COHERE: The topic of the current sentence is the topic of the previous one

The *topic* of a sentence is defined in (19), where a "minimally oblique" expression is one that imparts maximal salience to its referent relative to other expressions in the same sentence.

(19) *"The topic of a sentence is the entity referred to in both the current and previous sentence, such that the relevant referring expression in the previous sentence was minimally oblique. If there is no such entity, the topic is undefined."* (p. 14)

As in Kameyama's Centering model, the constraint in (18), paired with the definition in (19), gives preference to discourse segments in which pronouns corefer with the most salience-imparting expression in the previous sentence. Beaver gives the example in (20).

- | | | |
|------|---------------------|------------------|
| (20) | i. Fred was eating. | Topic: undefined |
| | ii. He saw Jim. | Topic: Fred |
| | iii. He winked. | |

In (20i), there is no previous sentence, so the topic is undefined. In (20ii), *he* is assumed to refer to Fred, since there is no other referent mentioned in (20i). Fred counts as the topic for (20ii), since that entity is referred to in both (20i) and (20ii), and the expression used in (20i), namely *Fred*, is the most salient (i.e., least oblique) referring expression in its sentence. Notice that if *he* in (20iii) refers to Fred, then Fred is also the topic of (20iii). That is because the expression that refers to Fred in (20ii), namely *he*, is the most salient in its sentence by virtue of being a pronoun and a syntactic subject. In that case, COHERE is satisfied. If, on the other hand, *he* in (20iii) refers to Jim, then the topic is undefined for (20iii), and COHERE is violated. All else being equal, COHERE predicts a preference for *he* in (20iii) to refer to Fred.

Following Schwarzschild (1999), the model also assumes that accented pronouns bear the feature F in the syntax, and that each instance of F in a sentence incurs a violation of the constraint AVOIDF, stated in (21).

- (21) AVOIDF: Do not F-mark

Beaver's assumption, then, is that all else being equal, a sentence with an accented pronoun incurs at least one extra violation of AVOIDF than its counterpart with no accentuation on the pronoun. It is in this sense that accented pronouns are assumed to represent marked forms. Relative to (22iii),

for example, (22iii') is a dispreferred form, and is not predicted to be available for expressing either the proposition that Fred winked or the proposition that Jim winked.

- | | | |
|------|---------------------|------------------|
| (22) | i. Fred was eating. | Topic: undefined |
| | ii. He saw Jim. | Topic: Fred |
| | iii. He winked% | |
| | H* L-L% | |
| | iii'. he winked% | |
| | H* L- H* L-L% | |

Together, then, COHERE and AVOIDF predict that there is only one pairing of a form with a meaning that is permitted by the grammar, namely one involving an unaccented pronoun that refers to the COHERE-satisfying referent. In Beaver's Bidirectional OT model, however, partial blocking permits dispreferred forms to be used to express dispreferred meanings. Relative to COHERE and AVOIDF, this means that accented pronouns may be used to refer in a way that violates COHERE, while unaccented pronouns are reserved for reference that satisfies COHERE. In other words, unaccented *he* in (22iii) is predicted to refer to Fred, while accented *he* in (22iii') is predicted to refer to Jim.

In the general case, Beaver's model predicts that the reference of a pronoun will covary with accentual status as long as one of the potential referents satisfies COHERE and the other does not. Beaver (2004) explicitly states that the model applies to production as well as perception, though this also follows from the standard assumptions of the Bidirectional OT framework. Thus, among other predictions of the model, a pronoun should be accented whenever (i) there is an available referent for the pronoun that would satisfy COHERE, but (ii) the actual referent of the pronoun does not satisfy COHERE. This may happen, for example, if the pronoun corefers with the less salient of

two expressions in the previous utterance, or alternatively, when the reference of a pronoun is drawn from outside the set of those mentioned in the previous sentence.

For both Kameyama and Beaver, the principles governing the interpretation and production of accented pronouns are motivated by a subset of the data that is specific to pronouns as a class of lexical items. As a result, both models raise the possibility of conflict between their own predictions and the predictions of a more general model of accent interpretation and production. Kameyama partially circumvents this issue by requiring that focus interpretations be satisfied after all other constraints of the model are satisfied. Nevertheless, the model stipulates a function for accents on pronouns that is potentially at odds with a more general theory of accent production.

To the extent that partial blocking is a generalized feature of the grammar of English, and to the extent that AVOIDF is an independently motivated principle governing accent interpretation and production, Beaver's model derives the relevant effects without resorting to stipulation. However, it is not clear what predictions the model would make if additional features of Schwarzschild's model were included. In other words, it is not necessarily the case that the particular alternation in reference predicted by a partial blocking effect based on AVOIDF is guaranteed to converge with the predictions of Schwarzschild's model as a whole.

2.3.2 A Generalized Model: Schwarzschild (1999)

The model of prosodic meaning proposed in Schwarzschild (1999) is fundamentally a theory of anaphora. Specifically, a syntactic constituent (or *node*) in a sentence that is interpreted as *Given* presupposes that there is some other node (i.e., an *antecedent*) in the discourse context with which it

stands in a particular semantic relation.⁹ Whereas pronominal anaphora is associated with the requirement that antecedents and their targets be coreferential, the semantic relation associated with Givenness imposes conditions on potential antecedents based on entailment. The particular form of the condition associated with a node interpreted as Given depends on the distribution of the feature F in the subtree dominated by that node. In general, more F-marking below a particular Given node implies a weaker condition on possible antecedents. The definition in (23) makes this more precise.

- (23) *Given* (informal version):
 An utterance U^{10} counts as *Given* iff it has a salient antecedent A and
 a. if U is type e, then A and U corefer
 b. otherwise, modulo *existential type shifting*, A entails the *existential F-closure* of U

As (23b) suggests, for phrases that do not denote individuals, Givenness is based on entailment. Crucially, though, the notion of entailment is only meaningful between two propositions. *Existential type shifting* is a way to transform phrases into logical expressions of the right type for the purposes of evaluating entailment relations. Informally, existential type-shifting fills all unfilled arguments of an expression with variables and existentially binds them. The NP *apple*, for example, becomes $\exists x[apple(x)]$, and *ate an apple* becomes $\exists x[x \text{ ate an apple}]$. For transitive verbs, the two arguments are filled with differently-named variables, such that *ate* becomes $\exists x \exists y[x \text{ ate } y]$.

Existential F-closure determines the interpretation of F-marking in a subtree dominated by some Given node. In essence, it determines the ‘strength’ of the condition on the possible antecedents for that node, where more F-marking implies that more antecedents will satisfy the entailment condition. A definition is given in (24).

⁹ This assumes that the relevant syntactic descriptions are compared at the level of a logical form.

¹⁰ By *utterance*, Schwarzschild means something like a syntactic constituent or node, which crucially may be a syntactic subpart of an utterance in the more traditional sense of a complete unit of speech.

(24) *Existential F-Closure of U (ExClo):*

The result of replacing F-marked phrases in U with variables and existentially closing the result, modulo existential type shifting

As an example, $\llbracket \text{John ate } [\text{an apple}]_F \rrbracket$ becomes $\exists Y \llbracket \text{John ate } Y \rrbracket$. F-marking on a VP-node introduces a property-type variable, such that $\llbracket \text{Alice } [\text{ate an apple}]_F \rrbracket$ becomes $\exists P[P(\text{Alice})]$. Note that whereas existential type shifting applies to both a potential antecedent and the node being evaluated (i.e., the *target*), Existential F-closure only applies to a target. The pattern of F-marking on the antecedent does not play a role.

A node U can be checked for whether it satisfies Givenness relative to a particular antecedent A by first existentially type-shifting both expressions, then generating the existential F-closure (ExClo) of the type-shifted target, and finally checking whether the resulting propositions stand in an entailment relation. If the VP *hit Bill* in (25a) is salient in the context, for example, then any of the nodes in (25b-d), but not the one in (25e), count as Given.

- (25)
- a. Antecedent: hit Bill
 - b. hit John_F
 - c. hit_F Bill
 - d. hit_F John_F
 - e. hit_F John

To see why, consider that the result of existentially type-shifting the various VPs in (25) yields the corresponding expressions in (26).

- (26)
- a. Antecedent: $\exists x[x \text{ hit Bill}]$
 - b. $\exists x[x \text{ hit John}_F]$
 - c. $\exists x[x \text{ hit}_F \text{ Bill}]$
 - d. $\exists x[x \text{ hit}_F \text{ John}_F]$
 - e. $\exists x[x \text{ hit}_F \text{ John}]$

Finally, applying Existential F-closure to (26b-e) yields the propositions in (27). (Note that Existential F-closure does not apply to antecedents.)

- (27) a. Antecedent: $\exists x[x \text{ hit Bill}]$
 b. $\exists Y \exists x[x \text{ hit } Y]$
 c. $\exists P \exists x[P(\text{Bill})(x)]$
 d. $\exists Y \exists P \exists x[P(Y)(x)]$
 e. $\exists P \exists x[P(\text{John})(x)]$

Now checking whether the VPs in (25b-e) count as Given amounts to verifying that (27b-d), but not (27e), are entailed by (27a).

Schwarzschild's model also includes a system of OT-like constraints that govern the relationship between Givenness and the placement of nuclear accents in an utterance. Inputs to the model may be thought of as pairs consisting of a sentence and a discourse context. A set of candidate forms is generated from an input sentence by freely enriching that sentence with F-marking on nodes, as well as with pitch accent features on terminal nodes. The candidates are then filtered by the constraint set following the principle of *strict dominance*. In other words, candidates that violate more highly ranked constraints are always worse than those that violate only lower ranked constraints. The constraints themselves are given in (28).

- (28) a. GIVENNESS: If a node is not F-marked, it must be Given
 b. FOC: An F-marked node that is not immediately dominated by an F-marked node contains an accent¹¹
 c. AVOIDF: Do not F-mark
 d. HEADARG: A head is less prominent than its internal argument

The ranking of the constraints in Schwarzschild's model is as in (29).

¹¹ I have rewritten FOC to incorporate the notion of a FOC-phrase directly into the constraint. This has no consequences for the predictions of the model.

(29) GIVENESS, FOC \gg AVOIDF \gg HEADARG

In addition to the constraints in (28), Schwarzschild explicitly assumes that accentuation on a terminal node always implies that the node is F-marked, though this is not formally stated as a constraint. For ease of exposition, I will encode this assumption as the inviolable constraint in (30).

(30) $\text{ACC} \rightarrow \text{F}$: An accented node is F-marked

Thus, the final constraint ranking that I assume is shown in (31).

(31) GIVENESS, FOC, $\text{ACC} \rightarrow \text{F}$ \gg AVOIDF \gg HEADARG

To see how these constraints apply to predict the accentual status of pronouns, consider the example in (32ii), where (32i) represents the discourse context.

- (32) i. Anna's brother saw the camel.
ii. She saw the camel.

Note first of all that the node corresponding to *the camel* in (32ii) counts as Given, since it is coreferential with *the camel* in (32i). GIVENESS therefore does not require F-marking on that node.¹² The verb *saw* in (32ii) also counts as Given. This is because the existentially type-shifted version of *saw* in (32i) (i.e., $\exists x \exists y [x \text{ saw } y]$) entails the existentially type-shifted version of *saw* in (32ii) (i.e., $\exists x \exists y [x \text{ saw } y]$). Therefore, GIVENESS does not require F-marking on *saw*. The same principle applies to the VP in (32ii). That is, $[saw \text{ the camel}]$ in (32ii) is Given since the existential

¹² By contraposition, GIVENESS says that a node that is not Given must be F-marked.

type-shift of *[saw the camel]* in (32i) entails the existential type shift of *[saw the camel]* in (32ii). Therefore, GIVENNESS does not require F-marking on the VP in (32ii).

The pronoun *she* in (32ii) is also Given, since it is coreferential with *Anna* in (32i). GIVENNESS does not therefore require F-marking on *she*. Without F-marking on *she*, the IP node does not count as Given, since *[Anna's brother saw the camel]* does not entail *[she saw the camel]*. According to GIVENNESS, then, this seems to require that the IP be F-marked. Consider, however, that if the IP is F-marked, then FOC requires an accent on one of the terminal nodes within IP. By ACC→F, this also implies an F-marker on a terminal node. In other words, to satisfy GIVENNESS by F-marking IP entails at least two violations of AVOIDF.

An alternative is to F-mark *she*. Notice that GIVENNESS does not prohibit this, since it is stated over non-F-marked nodes. Now the IP counts as Given without itself being F-marked, since *[Anna's brother saw the camel]* entails $\exists x[x \text{ saw the camel}]$. Moreover, this second option requires only one F-marker instead of two, and by AVOIDF, is therefore preferable to the first option. In fact, with the addition of accentuation on *she* to satisfy FOC, the candidate in (33) is optimal.¹³

- (33) She saw the camel%
 H* L-L%

Since *she* is already assumed to be F-marked, however, ACC→F does not imply any additional F-marking. Given that the configurations in (32) and (33) satisfy GIVENNESS, FOC and ACC→F equally, (33) is preferable since it incurs the fewest violations of AVOIDF (i.e., it includes less F-marking). In other words, Schwarzschild's model predicts the accent pattern in (33) for (32ii) in the context of (32i).

¹³ Schwarzschild (1999) uses capitalization to mark the loci of pitch accents and does not address the role of accent type, phrase accents or boundary tones, though I assume that an accent on *she* translates approximately into the prosodic pattern shown here.

Generalizing to a broader class of cases like (32), the model predicts that a referring expression in subject position will be accented whenever it represents a novel instantiation of a VP expression that has been explicitly mentioned in the preceding discourse. Notice that in contrast to the attentional models, this prediction is not specific to pronouns. Consider, for example, that the same argument applies to predict that the proper name *Anna* in (34ii) has the same accent pattern as the pronoun in (33).

- (34) i. Anna's brother saw the camel.
 ii. Anna saw the camel^{0%}
 H* L-L^{0%}

2.3.3 The Accentual Status of Pronouns in Production

In this section, four classes of examples are reviewed for which attentional models and Schwarzschild's model either conflict or converge in their predictions regarding the accentual status of subject pronouns. To clarify how the two models can come into conflict, I begin with an example for which their predictions converge, and then make modifications to it to illustrate the other three cases. None of the models discussed predicts accentuation on the pronoun in (35iv).

- (35) i. Max likes to play golf.
 ii. Last Sunday, he played a round with Anna.
 iii. At the ninth hole, he hit his longest drive ever.
 iv. Later in the round, he made a hole-in-one.

To see why, recall first of all that Kameyama's (1999) Centering Theoretic model predicts that highly salient referring expressions usually refer to the most highly ranked entity of those mentioned in the

previous sentence.¹⁴ Moreover, pronouns are predicted to be unaccented when their intended referent conforms to this pattern, and accented when they deviate from it. In this case, $C_r(35iii)$ is just {Max}, since Max is the only entity referred to in that sentence.¹⁵ By default, then, Max is the most highly ranked element of $C_r(35iii)$, and since *he* in (35iv) refers to Max, the model predicts no accent on *he*.

Recall that Beaver's model predicts accentuation on a subject pronoun whenever (i) it refers in a way that violates the constraint COHERE, and (ii) there is some other available referent that does not violate COHERE. Since satisfaction of COHERE depends on the topic of both the current and previous sentence, it is first necessary to establish the topic (if any) for both (35iii) and (35iv). In (35iii), the topic is Max, because that entity is referred to in both (35ii) and (35iii), and in both cases, the referring expressions used are maximally salient by virtue of being subject pronouns. Exactly the same reasoning applies to (35iv). Max is again the topic because that entity is referred to in both (35iii) and (35iv), and in each case by a subject pronoun. Since COHERE is satisfied whenever the reference of a pronoun is preserved as the topic across two utterances, Beaver's model predicts no accentuation on *he* in (35iv).

Schwarzschild's model predicts an accent on a subject pronoun whenever its referent represents a novel instantiation a recently mentioned, or Given, VP expression. In this case, the predicate associated with *he* in (35iv) does not meet this condition. In other words, there is nothing in the context that entails $\exists x[x \text{ made a hole-in-one}]$, so the model predicts no accentuation on *he*. The

¹⁴ This is an oversimplification since, technically, the preference is for the most salient expression to refer to the *backward-looking center* (or *Cb*), which I have not defined here. However, in all the examples that I cover, the referent of the third sentence is the preferred center of both the third *and* second sentences, which means that it is also the C_b of the third sentence. Thus, reference to that entity by the subject in the fourth sentence constitutes a *continue* transition, while reference to the alternative constitutes a *smooth shift*.

¹⁵ Technically, C_r s should include all entities referred to in a sentence, not just those that are semantically compatible with the pronoun in question. In the examples used here, however, such entities never have consequences for the predictions, so they are omitted.

narrative in (35), then, represents one type of context for which the predictions of attentional models and those of Schwarzschild's model converge.

In the second type of example, shown in (36), both Kameyama's and Beaver's models predict that an accent on the underlined pronoun is obligatory, while Schwarzschild's model predicts that either accentuation or non-accentuation is possible.

- (36) i. Anna likes to play golf.
 ii. Last Sunday, she played a round with Max.
 iii. At the ninth hole, she hit her longest drive ever.
 iv. Later in the round, he made a hole-in-one.

As with the previous example, since *he* is the most salient referring expression in (36iv), it is possible to check the predictions of Kameyama's model by checking whether that pronoun refers to the most salient entity in the previous sentence. In this case, Max is not actually mentioned in (36iii) and therefore does not technically occur in $C_f(36iii)$. Strictly speaking, Kameyama does not make predictions about the production of accents in such cases. In discussing interpretation, however, she proposes that accented pronouns with only one potential antecedent can be interpreted in one of two ways – either the reordering of the referential preferences applies as usual and has a null effect on the reference of the pronoun (since a reordering of a unary list is vacuous), or the presupposition induced by the focus interpretation forces the listener to accommodate an extra entity into the $C_f(U_{i-1})$. She notes that a likely source of this extra entity is the *global* attentional state, which includes entities from the whole discourse segment, as opposed to just those from the preceding utterance. Based on this comment, I make the simplifying assumption that entities in the global attentional state serve as very low-ranked elements of the forward-looking center list of any given utterance. This assumption accords with Nakatani's (1993) finding that stressed pronouns may signal a shift to a previous center of either the local *or* global attentional state. In other words, I

assume that the output $C_f(36iii)$ is the ordered list [Anna > Max].¹⁶ If that is the case, then Kameyama's model is relatively clear in predicting that an accent on *he* in (36iv) is necessary to reorder the preference ordering for that pronoun.

Strictly speaking, Kameyama's model does not make a prediction for pronouns that are disambiguated by gender. The issue is that semantic constraints on pronominal reference, such as gender, are assumed to preclude incompatible referents from being considered in the preference ordering. For interpretation, Kameyama points out that this feature of the model derives the correct result that accentuation on an unambiguous pronoun has no effect on its reference. For production, however, this would predict that the accentual status of unambiguous pronouns is in free variation, up to satisfaction of any constraints that are imposed by the focus component of the model. Such an assumption is undermined, however, by a slight variation on Kameyama's own example:

- (37) i. Sue hit John.
 ii. She was injured%
 H* L-L%
- ii'. ? She was injured%
 H* L-L%

If Sue is the only entity in the preference ordering for (37ii) and (37ii'), then Kameyama's model cannot explain why (37ii') is dispreferred. If it is assumed, on the other hand, that John is not only in the preference ordering for (37ii) and (37ii'), but also ranked above Sue based on the rule **HIT**, then Kameyama's model would predict that accentuation on *she* is required in order to reverse the preference ordering. For the purposes of the present analysis, I assume that this slight modification preserves the spirit of Kameyama's model and actually improves its empirical coverage.

¹⁶ Note that this added assumption does not change the predictions for the example in (35). If anything, the predictions are made clearer since an accent on *he* in (35iv) would no longer be vacuous – that is, it would have real consequences for whether that pronoun refers to the highest-ranked entity of the $C_f(35iii)$ – and would therefore be prohibited.

Recall that Beaver's model requires that the topic of two consecutive utterances be identified. In (36iii), the topic is Anna, because that entity is referred to in both (36ii) and (36iii), and the expression that refers to it in (36ii) is maximally salient by virtue of being a subject pronoun. In (36iv), however, the topic is undefined since neither Max nor Anna is mentioned in both (36iii) and (36iv). COHERE is therefore violated by (36iv), and Beaver's model predicts that an accent is required on *he*.

Beaver does not discuss the accentual status of pronouns that are disambiguated by gender. Relative to a particular intended referent, however, partial blocking rules out only those candidate forms that are optimal for some other referent. If the unaccented pronoun is not optimal for some other choice of a referent, in other words, then it is not ruled out by partial blocking, and the marked (i.e., accented) form is not made available. Consider a variation on example (20) from earlier:

- | | | |
|------|---------------------|------------------|
| (38) | i. Fred was eating. | Topic: undefined |
| | ii. He saw Judy. | Topic: Fred |
| | iii. Fred winked% | |
| | H* L-L% | |
| | iii'. She winked% | |
| | H* L-L% | |
| | iii". SHE winked% | |
| | H* L- H* L-L% | |

Notice that both (38iii') and (38iii'') violate COHERE, since the topic is undefined in both cases. Normally, if two female referents were available in (38ii), one of which was a topic, then partial blocking would dictate that the *unaccented* pronoun could not be used to refer to the COHERE-violating referent. This would then free up the otherwise dispreferred *accented* pronoun for use with that referent. Since Judy is the only potential referent of *she* in this case, however, partial blocking does not apply to prevent (38iii') from being used, in spite of the fact that reference to Judy by *she*

violates COHERE. Furthermore, (38iii') is preferable to (38iii'') since it incurs one less violation of AVOIDF. If nothing specifically rules it out, then (38iii') is predicted to be the optimal form for expressing the proposition that Judy winked in this context. Indeed, the model predicts that unambiguous pronouns will never be accented.

It is not clear that this consequence of the model is born out by the data in the above example. In that sense, it is an empirical question whether accents on pronouns very generally reflect violations of COHERE, or whether the effect is specific to pronouns that are not disambiguated by gender. For the purpose of establishing predictions in the present analysis, I make the former assumption tentatively. Specifically, I assume that partial blocking effects occur between forms that are not, strictly speaking, close alternatives for the same input meaning. This means, for example, that the optimality of (38iii) relative to the proposition that Fred winked results in blocking of (38iii'). To be fair to Beaver's proposal, then, the predictions I lay out for the four key examples in this section more closely reflect the hypothesis that accents on pronouns covary with violations of COHERE than Beaver's own hypothesis that partial blocking explains the accentual status of ambiguous pronouns.

Returning now to (36), repeated below, Schwarzschild's model predicts that accentuation on *he* in (36iv) is optional.

- (36) i. Anna likes to play golf.
 ii. Last Sunday, she played a round with Max.
 iii. At the ninth hole, she hit her longest drive ever.
 iv. Later in the round, he made a hole-in-one.

In this case, there is no node in the context that, when existentially type shifted, would entail the existential closure of the VP in (36iv). Nevertheless, there are multiple co-optimal patterns of F-marking that correspond to different accent patterns. These are given in (39).

that list. On the one hand, both *he* and *Anna* are salient by virtue of being in subject position. However, since *he* is a pronoun and *Anna* is a proper name, then Max is ranked more highly than Anna. In addition, Miltsakaki (2003) showed that referents of expressions occurring in matrix clause positions, as compared to referents of expressions in embedded positions, are more likely to be referred to by later expressions. From a Centering perspective, this finding suggests that all else being equal, subjects of matrix clauses are more salient than subjects of embedded clauses. Two attentional factors therefore contribute to the higher salience of Max relative to Anna following the utterance of (40iii). This implies that *he* in (40iv) should remain unaccented.

According to Beaver's model, the topic of (40iii) is Max since that entity is referred to by maximally salient expressions in both (40ii) and (40iii). Max is also the topic of (40iv) since it is referred to by maximally salient expressions in both (40iii) and (40iv). Since COHERE is satisfied by this state of affairs, *he* in (40iv) is predicted to be unaccented.

Schwarzschild's model makes the opposite prediction. Put simply, this is because the VP is identical in both (40iii) and (40iv) but is predicated of different individuals in each case. Another way of stating this is that *[Anna made a hole-in-one]* entails $\exists x[x \text{ made a hole-in-one}]$ but does not entail *[Max made a hole-in-one]*. Therefore, the model straightforwardly predicts accentuation on the pronoun in (40iv).

In the final type of example, attentional models and Schwarzschild's model converge to predict an accent on *he* in (41iv).

- (41) i. Anna likes to play golf.
 ii. Last Sunday, she played a round with Max.
 iii. At the ninth hole, she made a hole-in-one.
 iv. Later in the round, he made a hole-in-one.

Kameyama's model, for example, predicts an accent on *he* in (41iv) for exactly the same reasons as in (36iv). Assuming as before that entities in the global attentional state count as low-ranked members of the C_f of the previous utterance, then $C_f(41iii)$ is just [Anna > Max]. Since *he* refers to the lower-ranked of these two entities, the model predicts that it must be accented.

Beaver's model makes a similar prediction. Anna is the topic of (41iii) since that entity is referred to by maximally salient expressions in both (41ii) and (41iii). However, the topic of (41iv) is undefined. As in example (35), this means that COHERE is violated. Since (41iv) would have satisfied COHERE if *he* referred instead to Anna, the model predicts that accentuation of *he* is obligatory.

Schwarzschild's model predicts accentuation on the pronoun for exactly the same reasons as in (40). In other words, the VP [*made a hole-in-one*] occurs in both (41iii) and (41iv), but it is predicated of different individuals in each case. Thus, (41) represents a case where both attentional models as well as Schwarzschild's model converge to predict accentuation on a pronoun.

In this section, I have identified four specific examples for which two attentional models on the one hand, and one generalized model on the other, either converge or conflict with regard to the accentual status of a particular pronoun. The four examples may be viewed as abstract templates for generating an entire class of examples that vary with regard to the specific textual contents while preserving the relevant discourse properties. The two cases of conflicting predictions, in particular, provide a means for deciding between these two broad approaches.

2.4 Design of Experiment 1

This section reports on a production experiment that was designed to gather speakers' naturalistic productions of four types of narrative discourses based closely on the four examples covered in section 2.3.3. The study aims to assess the validity of the claims of three principle models (Kameyama 1999, Beaver 2004, and Schwarzschild 1999), by testing how the accentual status of a pronoun in a single sentential context differs across four distinct discourse contexts.

2.4.1 Materials

The materials for the study consisted of short narrative discourses in four conditions corresponding to each of the four examples discussed in 2.3.3. Thus, a *Baseline* condition included 32 narratives patterned after example (35), in the sense that the two classes of models converge to predict that the relevant pronoun is unaccented. A *Shift* condition included 32 narrative discourses patterned after example (36), such that Kameyama's and Beaver's models predict accentuation on a pronoun, whereas Schwarzschild's model predicts that accentuation is optional. A *Focus* condition included 32 narrative discourses patterned after example (40), such that Schwarzschild's model predicts accentuation on the target pronoun, whereas Kameyama's and Beaver's models predict no accentuation on the pronoun. Finally, a *Shift+Focus* condition corresponds to example (41), for which both classes of models converge to predict accentuation on the pronoun. For ease of reference, these examples are repeated together below along with the condition labels.

- (35) *Baseline*
- i. Max likes to play golf.
 - ii. Last Sunday, he played a round with Anna.
 - iii. At the ninth hole, he hit his longest drive ever.
 - iv. Later in the round, he made a hole-in-one.

- (36) *Shift*
- i. Anna likes to play golf.
 - ii. Last Sunday, she played a round with Max.
 - iii. At the ninth hole, she hit her longest drive ever.
 - iv. Later in the round, he made a hole-in-one.
- (40) *Focus*
- i. Max likes to play golf.
 - ii. Last Sunday, he played a round with Anna.
 - iii. At the ninth hole, he cheered when Anna made a hole-in-one.
 - iv. Later in the round, he made a hole-in-one.
- (41) *Shift+Focus*
- i. Anna likes to play golf.
 - ii. Last Sunday, she played a round with Max.
 - iii. At the ninth hole, she made a hole-in-one.
 - iv. Later in the round, he made a hole-in-one.

Notice that examples (35), (36), (40) and (41) all involve a similar story frame. All items used in the study were matched in this way. Thus, there were 32 *item sets* in all, each corresponding to a distinct story frame, and each containing one item in each of the four conditions. Only two features were varied to generate the four conditions: the order of mention of the referents in the first and second sentences, and the overall content and syntactic form of the third sentence. In all other respects, the four items in each set were identical.

Sentence (iii) was the primary locus of the experimental manipulation. This was achieved by varying (i) whether or not the referent of the target pronoun is referred to with the most salient expression (relevant for the attentional models) and (ii) whether the VP of the target sentence is introduced (relevant for Schwarzschild's model). Crucially, the fourth sentence (henceforth the *target sentence*) was identical across all four items in an item set. This not only facilitates direct comparison of prosodic measurements across conditions, but also permits fully blind coding and measurement, since the condition of gathered tokens cannot be determined from their textual content alone. All

items ended with a fifth sentence designed to add to the overall coherence of the narratives as well as to distract participants from the experimental significance of the target sentences.

In addition to the 32 matched sets of test items, there were 16 matched pairs of experimental control items and 16 filler items. Control items were designed to gauge participants' overall level of cooperation and attentiveness to the task. These were five-sentence narratives that occurred in either a "*Deaccenting*" or a "*No Decaccenting*" condition. In the *Deaccenting* condition, a noun occurs in the target sentence (sentence (iv)) that is identical to some noun in the preceding sentence (sentence (iii)). Crucially, however, the two nouns are preceded by different modifiers. For example, the word *necklaces* occurs in both (42iii) and (42iv), but in (42iii) it is modified by *sapphire* and in (42iv) it is modified by *ruby*.

(42) *Deaccenting*

- i. Angela was recently invited to a fund-raising dinner for a local politician.
- ii. She wanted to look her best, so she went shopping for some new jewelry.
- iii. At the jewelry store, she was immediately drawn to some sapphire necklaces.
- iv. After seeing the selection of ruby necklaces, however, she changed her mind.
- v. At the dinner, Angela looked stunning and was complimented by nearly everyone.

Items in the *No Decaccenting* condition were identical to their *Deaccenting* counterparts, except that the target noun does not occur in a preceding sentence. In (43), for example, *earrings* occurs in sentence (iii) in place of *necklaces*.

(43) *No Decaccenting*

- i. Angela was recently invited to a fund-raising dinner for a local politician.
- ii. She wanted to look her best, so she went shopping for some new jewelry.
- iii. At the jewelry store, she was immediately drawn to some sapphire earrings.
- iv. After seeing the selection of ruby necklaces, however, she changed her mind.
- v. At the dinner, Angela looked stunning and was complimented by nearly everyone.

The assumption is that in the *No Deaccenting* condition, attentive participants will place a pitch accent on the target noun because it constitutes entirely new information. In the *Deaccenting* condition, attentive participants should instead notice the repetition of the target noun and deaccent it accordingly by shifting accentuation onto the modifier. Inattentive or uncooperative participants are likely to treat all target nouns as new and therefore accent them regardless of condition. A comparison of participants' scores in the *Deaccenting* condition against their scores in the *No Deaccenting* condition was used as a basis for exclusion from the experimental analysis.

The 16 filler items resemble both the test items and the control items in overall form, but did not include factors relevant for the experimental conditions, such as repeated VPs, topic shifts, or dispreferred Centering transitions.

2.4.2 Prosodic Design Considerations

Because the pronouns *he* and *she* are short words with voiceless onsets, they do not lend themselves particularly well to intonational analysis. Additional steps were therefore taken to ensure that phonetic measurements were reliable and informative. In order to facilitate timing estimates, target sentences were constructed so that each target pronoun was immediately followed by consonants with a readily detectable oral closure. In addition, since *he* is prone to reduction to /i/, all instances of *he* were preceded directly by a stop consonant. Finally, in order to reduce variability in the strength of the preceding prosodic boundary, target pronouns were preceded by an adverbial phrase set off by a comma. This measure is thought to encourage the use of stronger boundaries (i.e., level 3 or 4 in ToBI) (Pierrehumbert & Talkin 1991).

2.4.3 Procedure

Participants were presented with one of four versions of the experiment. Each version consisted of a total of 64 items, including 32 test items, 16 control items, and 16 filler items. Each version was counterbalanced for condition, and no version included more than one item from the same item set. Items were randomized within 8 blocks and the order of the blocks was pseudo-randomized four times resulting in four orders of presentation for each version.

During the experiment, participants were seated in a sound-attenuated recording booth and presented with experimental items as text on computer screen. Participants' speech was captured by a Shure SM81 microphone and recorded digitally at a sampling rate of 22,050 Hz.

Presentation of sentences was self-paced. For each item, sentences appeared cumulatively, such that one new sentence appeared each time the participant pressed a button, but previous sentences remained on the screen until an item was completed. A title screen intervened between items to reinforce the sense that each item corresponded to a distinct narrative discourse.

Participants were given the instruction to first read each sentence silently to "get a sense of its meaning and how it fits into the story". They were instructed to then read the sentence "out loud as if telling a friend about something that really happened" (Wolters & Beaver 2001). Following the instruction phase, participants completed a practice item with both supervision and feedback from the experimenter.

2.4.4 Participants

32 Northwestern undergraduate students participated in the experiment for credit in an introductory linguistics course. Ten of the subjects were male, and 22 were female. All participants were native, first-language speakers of a North American dialect of English.

2.4.5 Coding

Target sentences were automatically extracted from the collected recordings using Triggerwave.¹⁸ NAligner¹⁹ was then used to automatically generate textgrids that were both word- and phoneme-aligned to each target sentence. Next, the resulting 1,024 textgrids and their associated audio files were hand-labeled in Praat by the author using a modified version of the ToBI labeling system (Silverman et al. 1992, Beckman & Ayers Elam 1997). In this modified system, target pronouns were labeled according to the full inventory of ToBI pitch accent categories. Pitch accents elsewhere in a target sentence were labeled at the approximate location of their nuclear target, but were not labeled for type. The strength and category of the prosodic boundary immediately preceding the target pronoun was labeled according to the full ToBI inventory, whereas boundaries elsewhere in the target sentence were labeled only according to whether they were an intermediate phrase boundary, an intonational phrase boundary, or a disfluency.

The position of the F0 maximum was labeled for all target pronouns. If present, the position of the onset of the final rise to the F0 maximum was measured.

¹⁸ Triggerwave is an automatic audio segmentation utility designed by Chun Liang Chan that segments audio tracks based on pulses recorded on a parallel track.

¹⁹ NAligner is an automatic phonetic alignment utility based on the Sonic Toolkit dictionary. It was designed by Chun Liang Chan.

During labeling, word and phoneme boundaries were hand corrected to insure the accuracy of duration measurements. Pitch measurements were extracted from labeled textgrids automatically using Praat (Boersma & Weenink 2008). The pitch floor and pitch ceiling for this analysis was set on a per-speaker basis, using values estimated from visual inspection. All tonal timing and duration measurements were extracted automatically based on the labeling.

Control items were coded separately using a simplified schema. Specifically, target nouns were coded as either accented or unaccented based on ToBI labeling guidelines.

2.4.6 Predictions and Questions

The primary aims of the study concern the extent to which the accentual status of target pronouns reflects the predictions of attentional models versus Schwarzschild’s model.

Table 1 provides an overview of these predictions for each of the four experimental conditions.

Condition:	Attentional Models: Kameyama (1999), Beaver (2004)	Information Structure: Schwarzschild (1999)
<i>Baseline</i>	No accent	No accent
<i>Shift</i>	Accent	Optional
<i>Focus</i>	No accent	Accent
<i>Shift+Focus</i>	Accent	Accent

Table 1. Predicted accentual status of the target pronoun by condition (rows) and predictor (columns)

If target pronouns are accented at a high rate in the *Focus* and *Shift+Focus* conditions, then there is good evidence that information-structural factors are sufficient for pronouns to be accented

independently of attentional factors. If, in addition, low rates of target accentuation occur in the *Shift* condition, then there is support for a rejection of the attentional models in favor of a generalized account of the relationship between prosody and pronominal reference.

Since Schwarzschild's model is consistent with both accentuation and non-accentuation of target pronouns in the *Shift* condition, a high rate of target accentuation in that condition does not, in and of itself, support a rejection of that model. However, in combination with a low rate of target accentuation in the *Focus* condition and a high rate of target accentuation in the *Shift+Focus* condition, such a result provides support for an account of pronoun accentual status based on attentional models.

If target pronouns are accented at relatively high rates in both the *Shift* and *Focus* conditions, then the results are consistent with two possibilities. One is that information-structural factors are driving pronoun accentuation in both cases. In other words, speakers are accenting pronouns in the *Focus* condition because it is obligatory, and in the *Shift* condition because it is optional.

The other possibility is that both information-structural factors and attentional factors provide sufficient conditions for pronoun accentuation. This would imply that pitch accents participate in two distinct, but parallel discourse functions. If that is the case, then it is important to ask whether the two ostensible discourse functions have distinct phonological realizations. The results of the study will reveal whether coded accent type differs systematically across conditions. In addition, it will reveal whether various phonetic measures are systematically correlated with experimental condition.

Since the predictions of both classes of models converge in their predictions for the *Baseline* and *Shift+Focus* conditions, pronouns are expected to be universally unaccented in the former case and universally accented in the latter. However, in case both sets of factors prove to be sufficient

for pronoun accentuation, then the question arises whether these factors interact in a systematic way. In other words, if each discourse factor is viewed as an independent cue to pronoun accentuation, what is the outcome when the two cues are operative simultaneously? Is the rate of pronoun accentuation higher than when only one of the two cues is operative? Are there particular phonetic properties, such as pitch excursion or syllable duration, that respond monotonically to the presence of each set of cues? And if there are specific prosodic features associated with each discourse function, which one predominates when both sets of cues are, in some sense, competing to be realized simultaneously?

2.5 Results

Five participants were excluded from the analysis due to low scores on the control items (less than 50% correct). The mean percentage of correct responses for the remaining 32 participants was 78% in the *Deaccenting* condition. The mean for the *No Deaccenting* condition was 91% with a minimum of 63% and a maximum of 100%. The minimum and mean for the *Deaccenting* condition is somewhat lower than estimates of participant error from a previous study using a similar control paradigm (German et al. 2006). However, the robustness of the difference between the *Baseline* condition and the *Shift+Focus* condition is a good indication that participants' overall level of attention and cooperation was high.

The mean proportion of target pronoun accentuation for the test items is summarized in Figure 1.

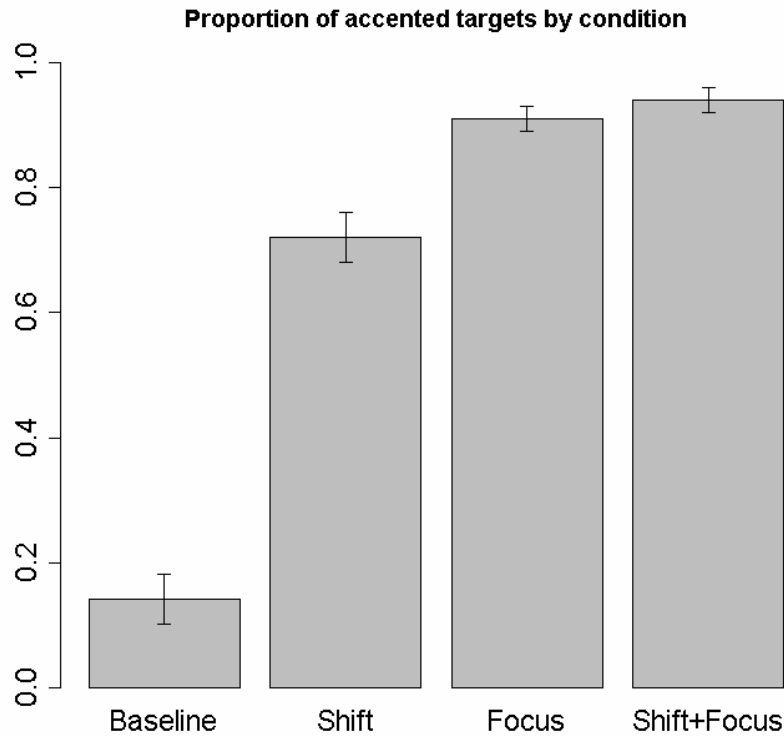


Figure 1. Proportion of accented targets by condition

Overall, target accentuation rates in the *Baseline* condition were low (14%), whereas accentuation rates in the *Focus* and *Shift+Focus* conditions were relatively high (91% and 94%, respectively). The accentuation rate for the *Shift* condition was intermediate (72%).

There was a strong tendency (99%) for accents on target pronouns in the *Focus* and *Shift+Focus* conditions to be the last accent in the target sentence. This pattern is illustrated in Figure 2.

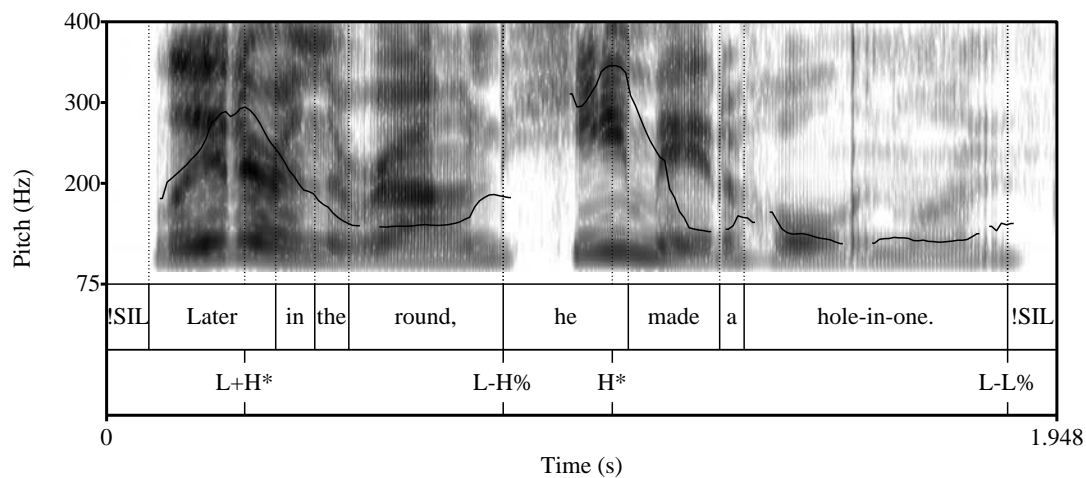


Figure 2. Typical pattern for targets in the Focus and Shift+Focus conditions.

A large majority (89%) of accents on targets in the *Shift* condition were followed immediately by a phrase accent as well as one or more additional intermediate phrases. This pattern is illustrated in Figure 3.

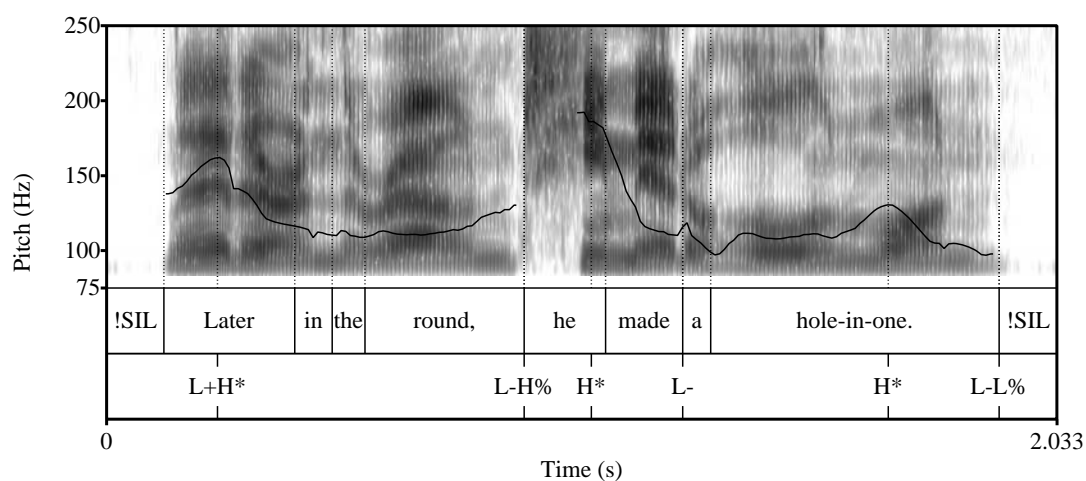


Figure 3. Typical pattern for nuclear accented targets in the Shift condition.

The remaining 11% of accented targets in the *Shift* condition were prenuclear, meaning that there was no intervening phrase accent between the accented target and a following pitch accent. This is illustrated in Figure 4.

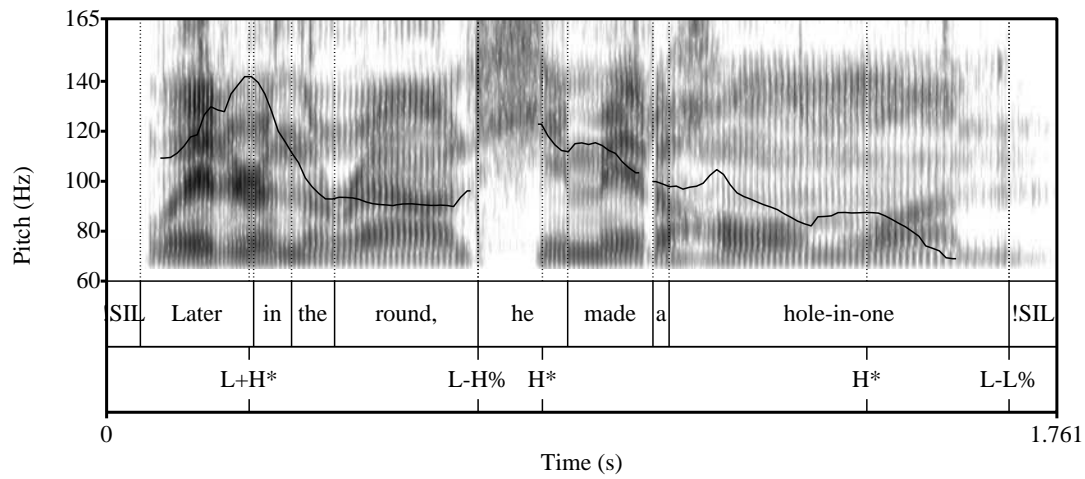


Figure 4. Typical pattern for prenuclear accented targets in the *Shift* condition.

Accented targets in the *Baseline* condition were either nuclear but not the last in the sentence as in Figure 3 (66%), or prenuclear as in Figure 4 (44%). Figure 5 shows a typical pattern for unaccented targets in the *Baseline* and *Shift* conditions.

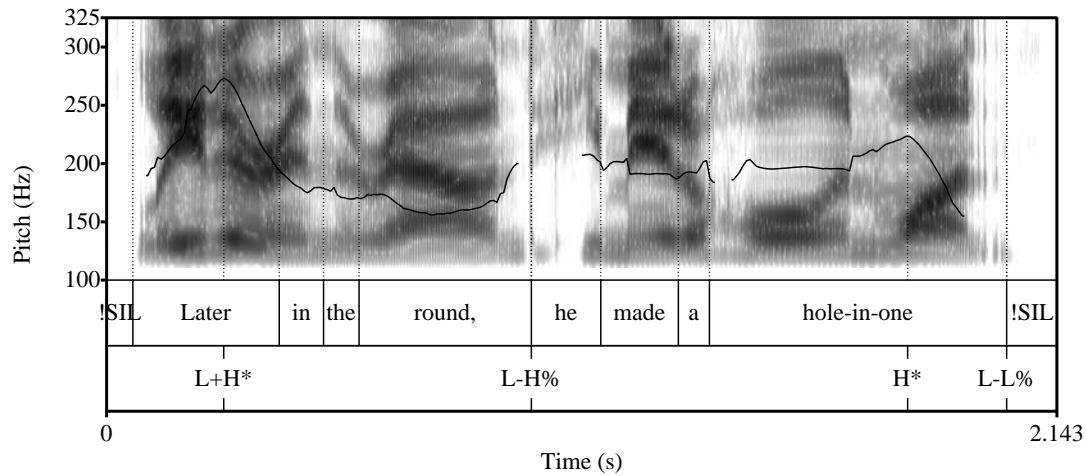


Figure 5. Typical pattern for unaccented targets in the Baseline and Shift conditions.

The dependence of pronoun accentual status on the factors associated with each class of model may be statistically analyzed. For convenience, I will refer to these two factors as \pm SHIFT (attentional models) and \pm FOCUS (Schwarzschild's model). This dependence was tested using a linear mixed logistic regression model.²⁰ Accentual status was treated as the dependent variable, and participants and items were treated as random factors.²¹ As the result summary in Table 2 shows, the likelihood of target accentuation was positively correlated with +SHIFT ($z = 12.8$, $p < 0.001$) and with +FOCUS ($z=15.2$, $p < 0.001$). There was also a highly significant interaction of +SHIFT and +FOCUS ($z= -6.12$, $p < 0.001$), due to the fact that the accentuation rate in the *Shift+Focus* condition is smaller than predicted by the combined effect of both factors together.

²⁰ See Baayen (2008), Ch. 7 for a discussion of the statistical methods used here.

²¹ Inclusion of participants and items as random factors was justified by a series of likelihood ratio tests.

Predictor	B	SE B	Odds Ratio (e^B)
+SHIFT	3.27***	0.26	26.31
+FOCUS	4.88***	0.32	131.63
Interaction: +SHIFT * + FOCUS	-2.75***	0.45	0.06

Table 2. Summary of mixed logistic regression analysis of the likelihood that the target pronoun is accented. (Standard deviation of random intercept terms: subjects (0.82), items (0.66))

Given that pronoun accentuation exhibits a dependence on the factors associated with both types of models, a somewhat more interesting question is whether the rates of accentuation differ significantly between particular pairs of conditions. In other words, does the accentuation rate in *Shift* differ from that in either *Focus* or *Shift+Focus*? Similarly, does the accentuation rate in the *Focus* condition differ from that in *Shift+Focus*? A series of linear mixed logistic regression analyses were used to make these pairwise comparisons, once again treating target accentual status as the dependent variable, and participants and items as random factors. For the comparison of *Shift* and *Focus*, the likelihood of target accentuation was positively correlated with *Focus* ($z=5.91$, $p<0.001$). Target accentuation was also positively correlated with *Shift+Focus* for the comparison of *Shift* and *Shift+Focus* ($z=6.58$, $p<0.001$). However, the likelihood of target accentuation was not different for *Focus* and *Shift+Focus* ($z=1.45$). These results are summarized in Table 3.

Comparison (* indicates the predictor)	B	SE B	Odds Ratio (e^B)
<i>Shift</i> vs. <i>Focus</i> *	1.69***	0.29	5.42
<i>Shift</i> vs. <i>Shift+Focus</i> *	2.23***	0.34	9.30
<i>Focus</i> vs. <i>Shift+Focus</i> *	0.56	0.39	1.75

Table 3. Summary of pairwise mixed logistic regression analyses of the likelihood that the target pronoun is accented.

In order to determine whether there are systematic differences in the categories of pitch accents that occur in each condition, the dataset was restricted to just those tokens for which the target was labeled as accented. This drastically reduced the number of items available for analysis in the *Baseline* condition to 36, while *Shift*, *Focus*, and *Shift+Focus* were reduced to 183 items, 233 items, and 241 items, respectively. Out of 693 target pronouns that received pitch accents, 670 were labeled as H*, while the remaining 23 were labeled as L+H*. Furthermore, the instances of L+H* were more or less evenly distributed among *Shift* (6 tokens), *Focus* (8 tokens), and *Shift+Focus* (9 tokens). Three linear mixed logistic regression analyses confirmed that accent type is not correlated with condition for any of the following pairwise comparisons: *Shift* versus *Focus*, *Shift* versus *Shift+Focus*, and *Focus* versus *Shift+Focus*.²²

Since the words *he* and *she* are both (i) short in duration and (ii) only voiced on the syllable nucleus, any low tone targets preceding a high tone (as in the case of L+H*) are likely to be obscured. Furthermore, tone compression tends to reduce the temporal distinctness of two tonal events occurring on a single syllable. As a result, bitonal accents may go undetected in transcription

²² A pairwise comparison was chosen over a multi-factor analysis, since the investigation seeks to answer the question whether pitch accent type is correlated with the expression of SHIFT versus FOCUS, whereas there are no a priori predictions about the role of pitch accent type in expressing the absence of +SHIFT or +FOCUS (i.e., for the *Baseline* condition).

(Pitrelli et al. 1994). In order to address this issue, three objective phonetic measures were used. As Pierrehumbert (1980) and others have shown, the difference between H* and L+H* is most reliably correlated with the relative size of the pitch rise from a low point preceding the H* target to the F0 peak. In other words, H* may begin as a rise from the middle of the speaker's pitch range, but L+H* typically begins as a rise from a much lower part of the range. Thus, overall pitch excursion from a preceding low point to the F0 peak is one objective measure of the presence of a prenuclear L tone. In order to adjust for psycho-acoustic scaling of pitch differences, raw F0 differences were converted to Barks.

A second objective measure of pitch accent type is the timing of the F0 peak relative to the end of the nuclear syllable (peak delay). L*+H accents are characterized by the tendency for a low tone target to be realized within the nuclear syllable of the word to which the pitch accent is aligned. There was little evidence for the widespread presence of low tone targets of any kind, so it is unlikely that instances of L*+H were underrepresented in the labeling as the result of an obscured pitch track. Instead, I assume that any systematic difference in peak delay is most likely associated with the difference between H* and L+H*. This difference would follow from the effects of tone compression in the case of L+H*, which tend to result in a general movement of tone targets away from the center of the syllable nucleus. Thus, the prediction is that instances of L+H* are associated with *later* F0 peaks. In order to adjust for differences in speaking rate, raw peak delay measures were relativized to the duration of the target vowel (i.e., $\text{relative peak delay} = \text{peak delay (msec)} \div \text{vowel duration (msec)}$).

A third analysis tested for a correlation between target syllable duration and experimental condition. It is assumed that such a correlation would follow from a difference in accent type, since bitonal accents (i.e., L+H*) may lead to lengthening when they are constrained to monosyllables.

Summary results for the three measures are given in Table 4 through Table 6. The boxplots in Figure 6 through Figure 8 show the median (bold horizontal line) and interquartile range (upper and lower edges of the boxes) for each of the three variables by condition. The whiskers extend to 1.5 times the interquartile range, while the points represent observations occurring outside of 1.5 times the interquartile range. The pattern is very similar across all three measures. There are slight differences in the mean and median values for the *Shift* condition as compared to the *Focus* and *Shift+Focus* conditions, with tokens in *Shift* tending to have shorter excursions, earlier F0 peaks (i.e., more negative values), and shorter durations. By comparison, the means, medians and quartile ranges of the *Focus* and *Shift+Focus* conditions differ only slightly across the three measures. The *Baseline* observations were the most extreme, and tended to have shorter excursions, earlier F0 peaks, and shorter durations than those of the other three conditions. It should be noted, however, that *Baseline* is represented in this dataset by only 25 observations, as compared to 183, 233, and 241 for the *Shift*, *Focus*, and *Shift+Focus* conditions respectively.

	<i>Baseline</i>	<i>Shift</i>	<i>Focus</i>	<i>Shift+Focus</i>
Mean (barks)	0.079	0.139	0.214	0.238
Standard Error	0.026	0.017	0.018	0.019

Table 4. Summary statistics for F0 excursion

	<i>Baseline</i>	<i>Shift</i>	<i>Focus</i>	<i>Shift+Focus</i>
Mean (msecs/msecs)	-0.511	-0.416	-0.348	-0.336
Standard Error	0.078	0.026	0.022	0.020

Table 5. Summary statistics for F0 peak delay

	<i>Baseline</i>	<i>Shift</i>	<i>Focus</i>	<i>Shift+Focus</i>
Mean (msecs)	172	223	234	238
Standard Error	7.63	4.99	3.61	4.38

Table 6. Summary statistics for target duration

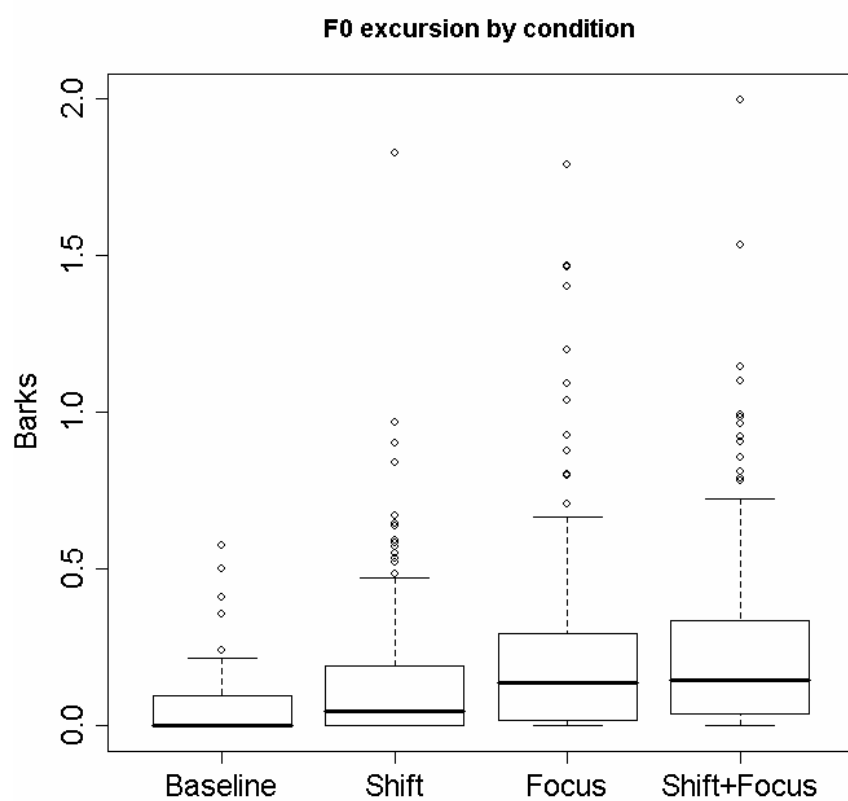


Figure 6. Boxplot of F0 excursion in Barks by condition

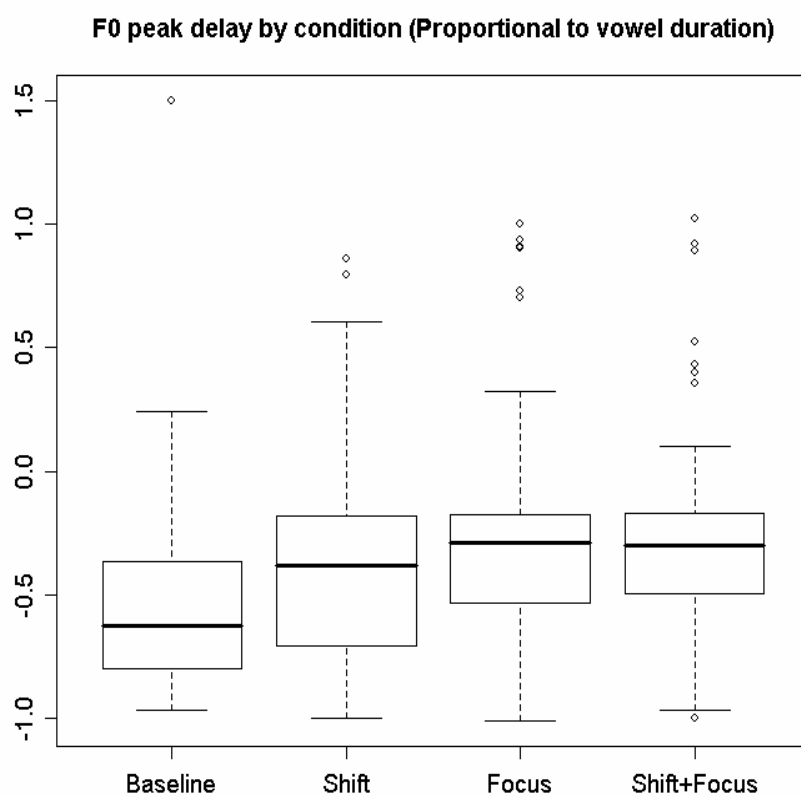


Figure 7. Boxplot of relativized peak delay by condition

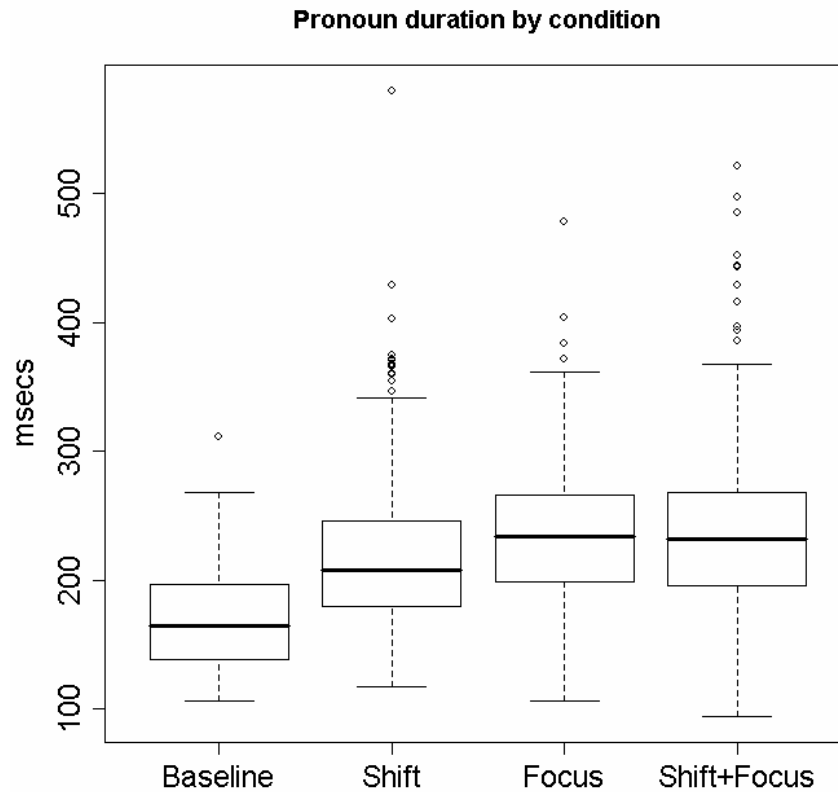


Figure 8. Boxplot of target duration by condition

The effect of experimental condition on each of the three measures was modeled using a linear mixed logistic regression analysis with subjects treated as a random factor.²³ For smaller datasets, there is no clear way to determine the degrees of freedom associated with each model, and p-value estimates based on upper bounds of the degrees of freedom may be anticonservative (Baayen 2008). As an alternative, the parameters of each model were used in a Markov Chain Monte Carlo sampling with 10,000 repetitions, which provides close approximations of the posterior distributions of those parameters. P-values were then be estimated based on the t-statistics associated with these approximated distributions (Baayen 2008).

²³ The inclusion of items as a random factor was not justified by a likelihood ratio test.

The analyses were conducted in a pairwise manner to determine whether *Shift* differed from either *Focus* or *Shift+Focus*, and whether *Focus* differed from *Shift+Focus*. Accents in the *Baseline* condition were not considered. For pitch excursion, there was a significant main effect of condition for the comparison of *Shift* and *Focus* ($p < 0.0001$), as well as for the comparison of *Shift* and *Shift+Focus* ($p < 0.0001$). There was no significant difference between *Focus* and *Shift+Focus*. Similarly for F0 peak delay, there was a significant main effect of condition for the comparison of *Shift* and *Focus* ($p < 0.05$), as well as for the comparison of *Shift* and *Shift+Focus* ($p < 0.01$), while *Focus* and *Shift+Focus* did not differ significantly. Duration followed the same pattern as the other two measures. *Shift* and *Focus* differed significantly ($p < 0.05$) as did *Shift* and *Shift+Focus* ($p < 0.01$), whereas *Focus* and *Shift+Focus* did not differ.

A statistically significant difference between two sets of observed phonetic measures may reflect categorical differences in the abstract representations that generate phonetic implementations. Such differences, however, are not sufficient to establish that the two sets of measures are associated with distinct perceptual categories. If the question is whether the two ostensible discourse functions are distinguished by the category of pitch accents occurring on pronouns, it is therefore important to ask not just whether the means of the phonetic measures are different, but also whether their distributions are distinct enough to be used in predicting category membership (i.e., condition). Perceptual categories are not necessarily encoded in a single phonetic dimension, however, so it is important to test for discriminability when multiple phonetic dimensions are considered simultaneously.

To address this question, a linear discriminant analysis was used. In this case, the idea is to predict the experimental condition of an observed pitch accent with linear discriminants based on three predictor variables: pitch excursion, (proportional) peak delay, and target duration. The

method seeks linear discriminants which maximize the differences between group means while minimizing the variances associated with those means. These analyses were restricted to a comparison of *Shift* and *Focus*. Since the idea is to find out how well the observations can be classified based on the discriminants, a leave-one-out cross-validation was used. This method involves systematically excluding one observation from the dataset and then performing a linear discriminant analysis based on the remaining observations. The result is then used to assign a posterior probability to the category membership of the observation that was excluded, which is then compared to the observed value (i.e., the known condition of each observation. The overall success rate²⁴ for the 690 accented targets was 0.593, which is low when compared to chance (i.e., the prior probability of an observation belonging to *Focus*, equal to 0.561). A binomial test confirmed that the difference between the success rate and chance does not reach significance ($p < 0.1$). If the accents on target pronouns in the *Shift* and *Focus* conditions do indeed reflect distinct accent types, there is little support for the hypothesis that these categories are reliably discriminated on the basis of pitch excursion, peak delay, syllable duration or any combination thereof. In short, it is unlikely that accents on target pronouns in the *Shift* and *Focus* conditions belong to different perceptual categories.

²⁴ In other words, the proportion of analyses for which the known category of an observation was assigned a probability > 0.5 .

2.6 Discussion

2.6.1 General Discussion

The principal question addressed by this study is whether the accentual status of pronouns is better explained by factors associated with attentional models or by factors associated with Schwarzschild's model based on information structure. The predictions of these two classes of models were shown to converge for the *Baseline* and *Shift+Focus* conditions. The fact that target pronouns in those conditions were accented at very low rates and very high rates respectively, not only affirms the overall design of the experiment, but also provides a useful quantitative baseline against which to compare the two cases of conflicting predictions.

One important finding is that the rate of target accentuation in the *Focus* condition was very high and did not differ from that in the *Shift+Focus* condition. This finding confirms that the discourse factors associated with pronoun accentuation in Schwarzschild's model reflect at least *sufficient* conditions for the accentuation of pronouns. While it is plausible that the lack of a difference between *Focus* and *Shift+Focus* (as well as the presence of an overall interaction) may be attributable to a ceiling effect associated with +FOCUS, the rate of accentuation in *Focus* was very high, which runs counter to the prediction of attentional models that non-accentuation of target pronouns is obligatory in that condition.

While comparably high rates of target accentuation in the *Shift* condition would tend to support a hybrid model, in which a generalized model and an attentional model both present sufficient conditions for accentuation, this was not supported by the results. Consider that target accentuation rates in the *Shift* condition were significantly lower than in the *Focus* or the *Shift+Focus* conditions. Attentional models do not predict accentuation to be optional in this case, so they

cannot account for the observed intermediate rates of accentuation. Schwarzschild's model, on the other hand, predicts target accentuation to be optional in the *Shift* condition and therefore provides a superior account of the findings. Together, the findings support a rejection of the attentional models in favor of a generalized model of pronoun accentual status in production.

An alternative interpretation is that the contextual cues associated with attentional factors and those associated with information structure have different psycholinguistic properties. On that interpretation, the lower rate of target accentuation in the *Shift* condition reflects a reduced ability on the part of participants to notice the presence of a "shift". Given that Kameyama's and Beaver's models provide only categorical predictions, however, there is no a priori basis for making such a distinction. Moreover, the items used in the study were carefully designed to meet all relevant criteria implied by the models being evaluated. In the absence of an explicit quantitative theory of contextual cue strength, it is therefore difficult to evaluate the plausibility of such an interpretation.

If accents on pronouns in the *Shift* condition do, in fact, reflect attentional factors, then it is important to ask whether the two ostensible discourse functions are associated with different prosodic realizations. In one sense, the predominant prosodic pattern in the *Shift* condition is distinct from that in the *Focus* condition, since accents on target pronouns were typically the last accent in the sentence in the latter condition but not in the former. This distinction is merely a fact about the specific manifestation of shift used in this study, however, and does not reflect a general fact about attentional models. After all, the prosodic pattern in the *Shift+Focus* condition exemplifies the relevant attentional factors to the same extent, yet the predominant prosodic pattern observed in that case is identical to that in the *Focus* condition. So while *Shift* is arguably distinguished from *Focus* and *Shift+Focus* on the basis of overall sentence prosody in the context of this experiment, a more

interesting question is whether the two ostensible discourse functions are associated with different realizations of the accented targets themselves.

A qualitative assessment of accent type based on conventional ToBI labeling standards found no difference in the use of L+H* versus H* for *Shift*, *Focus*, or *Shift+Focus*. In a quantitative assessment of three phonetic variables known to be highly correlated with pitch accent category (namely, F0 excursion, F0 peak delay and syllable duration), the *Shift* condition differed significantly from *Focus* and *Shift+Focus*. Specifically, accented targets in the *Shift* condition tended to have earlier F0 peaks, shorter F0 excursions, and shorter syllable durations than those in *Focus* or *Shift+Focus*. Thus, if there is any correlation between accent category and discourse function, it is that accentuation associated specifically with information structure is more likely to be expressed by L+H*.

A more likely explanation for the differences, however, has to do with the prosodic structure of the material following the target pronouns. As already mentioned, accents on targets in the *Focus* and *Shift+Focus* conditions were, almost without exception, the last accent in the utterance and were therefore followed by a full intonational phrase boundary (e.g., L-L%), which occurred temporally much later in the sentence. By contrast, most accents on targets in the *Shift* condition occurred in a non-final intermediate phrase (88% of accented targets), and were followed immediately by an intermediate phrase boundary (e.g., L-). The presence of an intermediate phrase boundary so close to the accented target is likely to have an effect of tonal crowding (Silverman & Pierrehumbert 1990, Prieto et al. 1995, D'Imperio 2001, Prieto 2005, Arvaniti et al. 2006a, Schepman et al. 2006). In other words, more articulatory gestures (in this case, tone targets) have to be completed over a shorter time frame when L- closely follows the accent. As a consequence, the peak of the H tone shifts backward in order to facilitate the task of reaching the following low tone target. This would

account for the slight but significant difference in peak delay for *Shift* as compared with *Focus* and *Shift+Focus*.

Another likely effect of such crowding is that H tones are underarticulated (i.e., they reach a lower peak F0) because the pitch targets must be reached more quickly relative to the onset of the word. Thus, target accents in the *Shift* condition are expected to have shorter excursions for reasons independent of discourse function per se. In addition, while typical target accents in *Focus* and *Shift+Focus* were always the last nuclear accent in their intonation phrase (IP), those in the *Shift* condition were never IP-final. Since IP-final status is associated with greater prominence, which in turn is associated with larger excursions, there are at least two reasons to expect shorter excursions in *Shift*. Finally, the greater prominence associated with IP-final status also accounts for the slightly longer durations in *Focus* and *Shift+Focus*.

Crucially, no combination of the three phonetic dimensions mentioned above could be used to reliably discriminate between pitch accents occurring in *Shift* and those occurring in *Focus*. Thus, while the statistically significant differences are consistent with the presence of two distinct abstract pitch accent categories in the speaker's representation, there is no evidence for distinct perceptual categories based on pitch accent category alone. The findings therefore do not support the conclusion that accent category is used to disambiguate between accents that reflect attentional factors on the one hand, and those that reflect information structure on the other.

2.6.2 The Prosodic Status of Pronouns

The distinction between *function words* and *content words* is widely assumed to have consequences for prosodic structure. Selkirk (1995a), for example, notes that in contrast to lexical

category items, such as nouns or lexical verbs, functional items, such as prepositions, determiners and pronouns are (i) more likely cross-linguistically to occur in reduced forms or clitic structures, and (ii) only optionally parsed as prosodic words. In essence, function words appear to be inherently predisposed to realization with weak prosodic status.

Ladd (1980) suggests that this inherent prosodic weakness translates into a resistance to pitch accentuation, which in English follows from the fact that pitch accents are attracted to metrically prominent syllables (Pierrehumbert 1980). Following up on this suggestion, German et al. (2006) showed that sentence-final prepositions are dispreferred as the locus of nuclear pitch accentuation, even when the resulting form is not optimal from the standpoint of information structure. More specifically, they used a production study to test speakers' preferred prosodic pattern for sentences like (52ii).

- (44) i. Why aren't the kids playing their game?
 ii. Paul took down the tent that they play their game in%
 (H*) (H* L-) H* L-L%

In the experiment, speakers produced a pitch accent on the preposition only 32% of the time, which is significantly lower than expected compared to experimental controls. Instead, speakers preferred to accent the left adjacent NP (i.e., *their game*), reflecting a pattern that is argued to be dispreferred from the standpoint of information structure in this context. The authors conclude that this otherwise dispreferred prosodic pattern results from an inherent resistance by prepositions to carry pitch accents.

In the present study, the *Focus* and *Shift+Focus* conditions closely parallel the design of the German et al. study since pronouns in those conditions occur in positions that, from the standpoint of information structure, are predicted to receive nuclear accentuation. Unlike the prepositions in

the German et al. study, however, pronouns exhibited no resistance to nuclear accentuation. Instead, pronouns were accented in the *Shift* and *Shift+Focus* conditions at rates that were actually slightly higher than expected based on experimental controls. This suggests that pronouns do not pattern with prepositions and other function words with respect to accentability.

On one view, such a finding raises the question of whether the content-function distinction provides a meaningful classification. Consider, however, that a rather wide body of evidence indicates that pronouns share lexical properties with other function words. This includes, among other evidence, distinctions based on relative sensitivity to word frequency in lexical decision reaction times (Bradley 1978, Gordon & Caramazza 1982), error recognition rates in proofreading (Rosenberg et al. 1985), as well as brain localization (Pulvermuller 1999).²⁵ Combined with Selkirk's observations, this suggests that the content-function distinction is indeed relevant for prosodic description, but that there is a fundamental dissociation between the notion of prosodic weakness as suggested by Selkirk and the inherent tendency to carry (or resist) pitch accentuation. In other words, accentability as a property of a lexical class appears to vary independently of prosodic weakness, with the latter, but not the former, being linked to the content-function distinction.

At first glance, this independence leaves no explanation for the difference in accentability between prepositions and pronouns. It has long been noted, however, that for the purposes of accent assignment, syntactic heads, including lexical verbs, are less likely to be accented than (their own) internal arguments. Recall that in Schwarzschild's model, this is encoded in the constraint HEADARG. This correctly predicts that non-Given internal arguments will be accented when present, but that nuclear accentuation may default to a verb that lacks an internal argument. The combined finding that prepositions, but not pronouns, resist accentuation suggests that the head-

²⁵ See Hicks (2006) for a more comprehensive review of the evidence for a content-function distinction.

argument constraint should not be stated in relational terms, but rather in absolute terms. In other words, words that lexically select for an internal argument, such as transitive verbs, determiners or prepositions, seem generally to be assigned reduced prominence relative to words that do not select for internal arguments, such as nouns, intransitive verbs and pronouns.

2.7 Conclusion

In this chapter, the claims of two types of models were evaluated and compared through a production study. The study asked whether the accentual status of personal pronouns are better accounted for by a model based on the attentional status of referents in the discourse, as Kameyama (1999), Beaver (2004) and others have proposed, or by a model based on general principles of prosodic meaning such as the one proposed by Schwarzschild (1999). The findings clearly support the conclusion that the latter type of model provides sufficient conditions for pronoun accentuation, independently of the predictions of the former type of model. In other words, focus predicts accents on pronouns even when attentional factors do not. Moderate rates of accentuation in one experimental condition lend partial support for the claims of attentional models, though it is argued that those effects are better explained by the optionality provided by Schwarzschild's focus model. Finally, both a qualitative and quantitative analysis of three phonetic correlates of pitch accent category revealed that, to the extent that attentional models and focus models both provide sufficient conditions for the accentuation of pronouns, the two functions are not disambiguated by perceptually distinct accent categories.

Chapter 3

Strategies for the Interpretation of Accented Pronouns

3.1. Introduction

This chapter addresses the relationship between prosody and pronominal reference from the perspective of perception. As in Chapter 2, this involves a comparison of two broad approaches based on examples for which the predictions of the two approaches conflict. The predictions for several key examples are evaluated directly in two perception experiments.

The study presented in Chapter 2 addressed the likelihood that a pronoun will be accented given that its reference is known. This served to test a particular set of claims regarding the mapping from discourse contexts and patterns of pronominal reference to accent patterns. Ideally, this production-oriented mapping could simply be reversed in order to predict the reference of ambiguous pronouns based on accent patterns and discourse contexts. Such an assumption is problematic in this case for two reasons, however. First of all, it is a general fact about language that the probability of a particular form given a meaning, and the probability of a meaning given a form, may be quite distinct. Thus, a full picture of the relationship between prosody and pronominal reference requires a consideration of each process separately.

Second, the findings of the production study tend to support a generalized approach, and Schwarzschild's (1999) model of accent meaning, in particular. In contrast to the various switching models, the relationship between prosodic form and pronominal reference is indirect in that model. Accent patterns, in other words, are predictable based on the relationship between whole utterances

and the discourse context. Thus, there is no guarantee under such a model that an alternation in reference will give rise to an alternation in prosodic form. In the same way, it is not a necessary fact about the model that an alternation in prosodic form will give rise to an alternation in the reference of particular pronouns. To the extent that prosodic form and pronominal reference are relatable, it is only because of specific properties of particular contexts. Therefore, any predictions about how reference will vary with prosodic form have to be established on a context-by-context basis.

Whereas the study in Chapter 2 singled out Kameyama (1999) and Beaver (2004) from among the class of switching models, the present study addresses a key assumption that is common to all switching models. Specifically, it evaluates the claim that the reference of an accented pronoun is predictable, in the sense of being necessarily distinct from, the reference of some unaccented counterpart. A class of examples is identified for which this broad claim is contradicted by the predictions of a generalized approach based on Schwarzschild (1999).

Given the shift in the theoretical landscape compared to Chapter 2, the next section revisits the range of proposals that bear on the interpretation of accented pronouns, as well as providing an overview of some of the major empirical findings that bear on the issue. Section 3.3 then reviews a set of examples for which the basic claims of the switching models are undermined by an analysis based on Schwarzschild (1999). Sections 3.4 and 3.5 report on two perception experiments designed to distinguish between the two sets of claims empirically. This is followed by a general discussion of the results of both studies in the context of the broader questions addressed by this thesis.

3.2 Previous Studies

The effect of accentual status on pronominal reference has been documented experimentally in several studies. Solan (1983), for example, showed that 5-, 6-, and 7-year-olds are sensitive to whether a subject pronoun, an object pronoun, or both the subject and object pronouns receive nuclear stress in selecting referents during a toy-moving task. In sentences like those in (45)²⁶, unaccented subjects tended to refer to subjects, accented subjects tended to refer to objects, unaccented objects tended to refer to objects, and accented objects tended to refer to subjects.

- (45) a. The lion hit the camel, and then he/HE hit the elephant.
 b. The lion hit the camel, and then the elephant hit him/HIM.
 c. The lion hit the camel, and then he/HE hit him/HIM.

The effect was shown to be stronger for the older children in the study. The author interprets this result as evidence that accentuation on a pronoun serves to block parallelism effects.

Leddon et al. (2004) used materials produced as child-directed speech to test the effects of prosodic pattern on pronominal reference. In a picture-matching task, the preferred reference of adult listeners was highly correlated with pronoun accentual status. In a task-oriented study, Brown-Schmidt et al. (2005) showed that the accentual status of a personal pronoun may influence the likelihood that a listener will choose the theme of the previous sentence as its referent. When given the instructions in (46), for example, participants were less likely to choose the theme of the previous sentence (*the balloon*) as the referent of *it* when that pronoun was stressed, versus when *it* was unstressed.

- (46) Put the balloon next to the road. Now put it next to the clip.

²⁶ Only the location of primary stress, as indicated by capitalization, was provided by the author.

More recently, a study by Djalali et al. (2008) showed that a pronoun in subject position is less likely to refer to the subject of the preceding sentence when it is the sole nuclear accent in a clause, versus when it is unaccented. For example, the accented pronoun in (47ii') is more likely than its unaccented counterpart in (47ii) to corefer with *the minnow*.

- (47) i. The trout chased the minnow.
 ii. It was determined%
 H* L-L%
 ii'. It was determined%
 H* L-L%

Venditti et al. (2001, 2002) provides empirical support for the idea that accented pronoun interpretation is driven by general principles of accent meaning. In an eye-tracking experiment, listeners resolved the reference of unaccented subject pronouns more or less immediately, but delayed interpretation of accented pronoun until the onset of the following verb or later. Immediately after hearing *he* in (48iv), for example, participants' looking times were relatively balanced between the lion and the alligator, indicating that they had not yet settled on a referent for *he*.

- (48) i. The animals were playing out near the barn when something unexpected happened.
 ii. The lion started going ballistic.
 iii. He hit the alligator with a long wooden rake.
 iv. Then HE hit the duck.²⁷
 L+H* L-

It is not until they began to hear the word *hit* that looks to the alligator dominated. The authors take this to indicate that listeners delay resolution of an accented pronoun until the specific presupposition introduced by the accent pattern can be evaluated. They assume, for example, that listeners evoke the contrast set {the lion, the alligator} upon hearing accented *he* in (48iv), but must

²⁷ Only the intonational contour associated with the target pronoun is provided by the authors.

wait until they hear the verb to determine whether the current utterance is being contrasted with the preceding sentence (i.e., 48iii) or with some other proposition, possibly outside the immediate discourse context. The authors point out that this finding would be surprising on an analysis in which accents induce a switch from a default reference, since listeners should in that case be able to resolve the reference of an accented pronoun just as quickly as an unaccented pronoun.

In a second experiment, the verb phrase following the target pronoun was less clearly related to the action of the previous sentence. Whereas (48iv) actually repeats the verb of the previous sentence, for example, it is only weakly evident in (49iii) that *got out some sponges* is related to the sequence of actions preceding it.

- (49) i. The zebra asked the pig to help wash the car.
 ii. He put a bucket of soapy water next to the pig near the front of the car.
 iii. Then HE || got out some sponges%
 L+H* L- H* H* L-L%

According to the authors, this means that there are multiple ways of accommodating or *discharging* the contrastive presupposition. If the presupposition is accommodated to the immediately preceding sentence, then the pronoun is predicted to refer to the pig. If the presupposition is accommodated outside of the local discourse, then the pronoun may refer to the pig or the zebra. As in the first experiment, listeners initially exhibited equal looking preferences to the two available referents. Upon presentation of the verb, however, looks to the first referent (i.e., the zebra) increased slightly. This result confirms the prediction that the pronoun is consistent with multiple interpretations, and supports the authors' suggestion that the reference of accented pronouns is better explained in terms of the contrastive presupposition that the accent pattern introduces.

In summary, the effects of prosody on pronominal reference are robust and highly reproducible. Venditti et al.'s study provides initial support for the idea that the effects of prosody

on pronominal reference follow from a general model of accent meaning. The current study extends those findings through a fully balanced test of the predictions of a specific generalized model against those of a switching model.

3.3 Theoretical Background

While Kameyama (1999) and Beaver (2004) were singled out in Chapter 2 based on their ability to make predictions for a wide range of cases, the assumption that the interpretation of an accented pronoun is predictable from the reference of some unaccented counterpart is not unique to attentional models. In fact, it represents a rather widespread and deeply ingrained tradition in the literature on pronominal reference. Solan (1983), for example, argues that pronominal reference is guided by a *Parallel Function Strategy* (Sheldon 1972), whereby pronouns preferentially corefer with expressions in a parallel grammatical role. Accentuation on a pronoun is viewed “as a signal that the expected antecedent to the pronoun is not the one intended by the speaker...The hearer is being warned not to apply the parallel function strategy, which would yield the ‘normal’ interpretation” (pp. 163-164). Akmajian & Jackendoff (1970) and Smyth (1994) similarly assume that the effect of accentuation on a pronoun is to block the default reference.

In an approach closely related to that of Beaver (2004), Clark & Parikh (2007) argue that speakers and hearers attend to cost considerations when making choices about production and interpretation. On the assumption that accented pronouns are more costly to use than their unaccented counterparts, hearers make an inference that a speaker will only use such a form when the actual reference of the pronoun is the less probable of two alternatives.

Regardless of the particular construal of a default reference or the mechanism that is responsible for undermining it, these accounts all have in common the assumption that the preferred reference of an accented pronoun *differs* from the preferred reference of some unaccented counterpart. This view is typically accompanied by the assumption that accented pronouns represent marked forms. This is, after all, implicit in the idea that the reference of an accented pronoun always deviates from the default. In addition, this view implicitly assumes that accents that occur specifically on pronouns are interpreted differently than accents in the general case. For Kameyama (1999), this is an explicit assumption of the model, since accents that occur on pronouns have consequences for two parallel models of the discourse. On the one hand, the overall pattern of accents, including those on pronouns, is assumed to introduce specific presuppositions, which relate the contents of the utterance to the previous discourse (i.e., contrastive focus). On the other hand, accents on pronouns are stipulated to have special consequences for a model of the discourse based on attentional status and transition preferences (i.e., Centering). The former interpretive principle is general to accents on all types of lexical items, while the latter is stipulated for accents that occur specifically on pronouns. Cahn (1995) and Nakatani (1997) express a similar view.

From the perspective of parsimony, the idea that pitch accents are associated with multiple interpretive models depending on the lexical category of the word they occur on is less than ideal. Given that existing models of prosodic meaning are motivated by multiple sources of converging evidence, it is also problematic that the interpretation of pronoun accentual status is typically tailored specifically to examples like those in (1) through (3) in Chapter 1. By comparison, then, a generalized approach promises to avoid such stipulations and the associated unparsimonious consequences. Among other advantages, such an approach has no need to posit the notion of a default reference in the first place. In addition, if there is no sense in which the reference of an

A strategy based on grammatical role parallelism (e.g., the subject assignment strategy or the parallel function strategy) poses a similar problem. Such a principle predicts that *he* in (51ii) should corefer with the subject of the previous sentence, but Alex and Roger are both the subject of some clause. It is not clear therefore, whether the default reference of *he* should be Alex or Roger. Beaver (2004) also makes no prediction for *he* in (51ii). Since (51i) is discourse-initial, the notion of *topic* is undefined for that sentence.

To the extent that (50) and (51) represent licit discourses under the above-mentioned theories, however, those theories tend to predict that the reference of accented *he* in (51ii) should differ from that of unaccented *he* in (50ii). Thus, if it turns out to be the case empirically that unaccented *he* (50ii) preferentially corefers with the matrix subject (*Alex*), then any switching theory straightforwardly predicts that accented *he* in (51ii) should corefer with the embedded subject (*Roger*).

In contrast to the various switching models, a generalized model straightforwardly predicts that accented *he* in (51ii) should refer to Alex, regardless of the interpretation that is preferred for unaccented *he* in (50ii). On an intuitive level, the argument is closely related to that made by both de Hoop (2004) and Venditti et al. (2001, 2002). Specifically, the narrow accent pattern on the subject pronoun in (51ii) is assumed to introduce a presupposition that the associated predicate [*made a request*] is being compared to some similar (and possibly identical) predicate in the preceding context. Moreover, the presupposition is contrastive in the sense that the instantiation of the predicate must differ in the two instances. If it is assumed that [*made a request*] in (51ii) is being compared to [*ask for the executive suite*] in (51i), then the subject of the embedded predicate, and the referent of *he* in (51ii) must be distinct individuals. Since the subject of *ask for the executive suite* is Roger, the presupposition can only be satisfied if *he* refers to Alex.

salience than the subject of the matrix clause. In other words, there is reason to believe that Alex is ranked above Roger in the C_f after the utterance of either (50i) or (51i).

Schwarzschild's (1999) model of accent meaning makes this prediction in a very precise way.

To see why, consider that the main clause *he made a request*, uttered with the prosodic pattern in (51ii), is predicted to introduce two specific conditions on the discourse context. These are given in (52).

- (52) (a) There is some antecedent A in the context, such that the existential type shift of A²⁹ entails $\exists x[x \text{ made a request}]$
 (b) There is no antecedent B that entails $[k \text{ made a request}]$, where *k* is the entity referred to by *he*

The condition provided in (52a) represents a necessary condition for the VP to remain unaccented under Schwarzschild's model. Given that (52a) is satisfied, (52b) reflects a necessary condition for *he* to be accented.

Notice now that (52a) is satisfied based on the embedded VP in (51i), since $\exists x[x \text{ ask for the executive suite}]$ entails $\exists x[x \text{ made a request}]$.³⁰ Crucially, however, (52b) is satisfied only if *he* refers to Alex. To see why, consider that whether (52b) is satisfied depends on the value of the pronoun. If the pronoun refers to Roger, then it must be the case that no clausal constituent in the context entails the proposition $[Roger \text{ made a request}]$. This is not satisfied in the context of (51i), however, since I am assuming that $[Roger \text{ ask for the executive suite}]$ entails $[Roger \text{ made a request}]$.³¹ If the pronoun refers to Alex, on the other hand, then (52b) is satisfied, since nothing in (51i) entails $[Alex \text{ made a request}]$. Under Schwarzschild's model, the conditions introduced by the accent pattern in (51ii)

²⁹ This operation was defined in Chapter 2.

³⁰ Following Schwarzschild (1999), I assume that tense does not matter for the purposes of evaluating Givenness. In other words, I assume that the tenseless "proposition" in (i) effectively entails the proposition in (ii).

(i) $\exists x[x \text{ ask for the executive suite}]$

(ii) $\exists x[x \text{ made a request}]$

Notice, for example, that deaccenting of the VP in (ii) seems to be licensed by (i), in spite of the tense discrepancy.

(iii) Yesterday, Megan ran six miles.

(iv) Today, I will run six miles%

H* L-L%

³¹ I further assume here that (24i) contains a non-finite clause of the form $[PRO \text{ ask for the executive suite}]$, where PRO is a null pronominal that is coreferential with Roger.

in (55i), since $\exists x[x \text{ made a request}]$ is entailed both by $\exists x[x \text{ ask for the executive suite}]$ and by $\exists x[x \text{ implored Roger to ask for the executive suite}]$. The crucial difference in this case is that (52b) cannot be satisfied under any choice of a referent for *he*. If *he* refers to Roger, for example, then (52b) is violated because $[\text{Roger made a request}]$ is entailed by $[\text{Roger ask for the executive suite}]$. Similarly, if *he* refers to Alex, then (52b) is violated because $[\text{Alex implored Roger to ask for the executive suite}]$ entails $[\text{Alex made a request}]$.

There are several different ways to think about the predictions of the model in this case. It could be assumed, for example, that (55ii) is simply infelicitous in the context of (55i). Another possibility is that the presupposition in (52b) is satisfied by accommodating a third referent into the discourse as the referent of *he*. Yet a third possibility takes into account the fact that, formally, a failure to satisfy (52b) amounts to one extra violation of AVOIDF, which is assumed to be a violable constraint in the model. In other words, the form in (55ii) results in exactly the same constraint violations when *he* refers to Roger as when *he* refers to Alex. In that sense, then, these represent equally viable pairings of inputs with outputs in the model. Regardless of what is assumed, however, it is clear that Schwarzschild's model predicts an equal preference (or dispreference) for *he* in (55) to refer to either the matrix subject or the embedded subject.

In contrast to the switching models, then, Schwarzschild's model makes specific predictions for the reference of the pronouns in (51) and (55) that are independent of the preferred reference of their unaccented counterparts in (50) and (54). In particular, the model predicts that the preferred reference of narrowly accented *he* in (51ii) is *Alex*, while the preferred reference of narrowly accented *he* in (55ii) is ambiguous between Roger and Alex. This particular prediction of the model can be generalized to other cases where a narrow accent pattern occurs on a subject pronoun. This is expressed by the corollary of Schwarzschild's model shown in (56).

- (56) A clause of the form $\begin{matrix} PRON & VP \\ H^* & L-L\% \end{matrix}$ introduces the following constraints on the context:
- a. There is some antecedent A in the context, such that the existential type shift of A entails the existential type shift of VP, or $ExClo(A)$ entails $\exists x(\llbracket VP \rrbracket(x))$
 - b. The value of $\llbracket PRON \rrbracket$ is such that there is no antecedent B in the context, such that the existential type-shift of B entails $\llbracket PRON VP \rrbracket$

In other words, the reference of the pronoun must be such that the value of the whole clause is not entailed by some antecedent clause in the context.

Since the specific predictions of a switching model are conditional on the empirically determined preferred reference of the unaccented case, it is not possible to compare them to the predictions of a generalized model directly. Nevertheless, the two approaches differ markedly in terms of the contingencies that they present. If it is determined empirically that unaccented pronouns like those in (50) and (54) preferentially corefer with the matrix subject of the preceding sentence, then switching models straightforwardly predict a preference for the embedded subject in cases like (51) and (55). In the case of (51), this would place switching models in direct opposition to Schwarzschild's model, which predicts that only a matrix reading is possible. In the case of (55), there is some overlap between the two sets of predictions. While either type of model is consistent with a preference for the embedded subject, only Schwarzschild's model is also consistent with either a preference for the matrix subject or a mixed preference.

possible referent for the target pronoun, since the target clause is entailed by the embedded clause of the preceding sentence.

(59) *Matrix Only*

- i. At the hotel check-in counter, Alex reminded Roger to ask for the executive suite.
- ii. While ordering room service that night% he made a request%
H*
L-H% H*
L-L%

In *Matrix/Embedded* contexts like (60), on the other hand, the target pronoun is predicted to be equally likely to refer to the matrix subject or the embedded subject.

(60) *Matrix/Embedded Subject*

- i. At the hotel check-in counter, Alex implored Roger to ask for the executive suite.
- ii. While ordering room service that night% he made a request%
H*
L-H% H*
L-L%

If the target pronoun refers to the embedded subject, then the target clause is entailed by the embedded clause of the preceding sentence, while if it refers to the matrix subject, then it is entailed by the matrix clause.

Each target sentence included a subject pronoun that was either *he* or *she* according to the gender of the referents mentioned in the preceding sentence. No other pronouns or human or animate referring expressions occurred in the target sentences. All target sentences began with one or more temporal adverbial phrases that preceded the target pronoun. These adverbial phrases contained additional accents and ended with a L-H% boundary tone.

The results of Venditti et al. (2001, 2002) suggest that the effect of accentuation on pronoun interpretation interacts with the type of *coherence relations* (Kehler 2002) that are made salient by the context. The variation between items was minimized in this respect by including adverbial phrases that reinforce the sense that (i) events described in the target sentences are dislocated in time and

space from the events described in the context sentences, and (ii) the two sets of events are not causally connected. This measure is intended to reinforce an *Occasion* relation, which imposes relatively few constraints on the arguments of the utterances involved (Kehler 2002), and to disfavor a *Result* relation, which has been shown to produce an object bias for subject pronouns (Kertz et al. 2006).

The auditory versions of the items were produced by a native speaker of a North American variety of English who has training in prosody. The contexts were recorded separately from the targets, and simplified prosodic labeling was used to minimize differences between paired items. For the context sentences, a H* L- contour was placed on each proper name, and a pattern best characterized as broad focus was used elsewhere. As (61) illustrates, paired contexts were produced with identical prosodic patterns allowing for minor differences in the segmental characteristics of the matrix verbs.

(61) *Matrix Only:*

At the hotel check-in counter^{0%} Alex^{||} reminded Roger^{||} to ask for the executive suite^{0%}
 H* H* L-H% H* L- H* L- H* L-L%

Matrix/Embedded:

At the hotel check-in counter^{0%} Alex^{||} implored Roger^{||} to ask for the executive suite^{0%}
 H* H* L-H% H* L- H* L- H* L-L%

In order to address possible effects of anticipatory lengthening of the preceding adverbial phrases (Arnold et al. 2003) in the target sentences, the preceding adverbial phrases were spliced in at the point of the onset of the pronoun, so that paired Broad and Narrow targets were identical up to that point. During recording, the speaker repeatedly listened to a prerecorded sample of her own voice that exemplified a typical utterance onset near the middle of her range. She was further instructed to begin each utterance at the same pitch level as the sample. This measure greatly

reduced any register mismatch that would normally result from splicing together portions of different utterances. After recording and splicing, all recorded sentences were inspected auditorily and visually in Praat for the desired prosody and for naturalness, and any anomalous sentences were rerecorded or respliced.

Each set of matched items was associated with a text-only *probe*, designed to elicit participants' judgments regarding the reference of the pronouns in the target sentences. These were generated by replacing the pronoun in the target sentence with each of the proper names occurring in the context. Minimal deviation from the form of the target sentence was permitted, such as placing the temporal adverbial in an undislocated position to the right of the VP. The probe associated with (59) and (60) is given in (62).

- (62) a. Roger made a request while ordering room service that night.
b. Alex made a request while ordering room service that night.

In addition to the test items, there were 44 filler items occurring in one of six groups. Each item in Group 1 (8 items) included an unaccented pronoun that was designed to be easily resolved based on the semantic features of available referents such as gender or number. Group 2 items (8 items) included an explicit (i.e., non-anaphoric) verb phrase in conjunction with a trivially resolved subject expression (either a pronoun, a definite NP or a proper name). Group 3 items (4 items) included a proper name or definite NP that occurred felicitously in a broad accent pattern, while Group 4 items (8 items) included a proper name or definite NP that was felicitously accented. Group 5 items (8 items) included pronouns that were specifically designed to be difficult to resolve in the given context. Group 6 items (8 items) included anaphoric verbal expressions (e.g., *do so*, VP-ellipsis) that were difficult to resolve in the associated context.

The items in Groups 1 through 4 were designed with several purposes in mind. First, they all involve trivially resolvable target pronouns and should therefore be answered in a consistent and predictable way by all attentive and cooperative participants. Second, by introducing a range of referential expression types (pronouns, proper names, definite NPs) in subject position of the target sentences, they serve to distract participants from the experimental significance of pronouns. Third, by including probe sentences that target different types of syntactic constituents, including subjects, objects, verbs and verb phrases, they distract participants from the importance of the subject position and encourage them to attend to the global meaning of target sentences. Finally, it is merely an assumption that the target pronouns in test items are actually resolvable to at least one of the contextually available referents. Items in Groups 5 and 6 therefore serve to minimize the distinction between test and filler items by presenting participants with items representing the full range of resolvability.

There were 32 matched sets of test items in all. These were divided into four experiment versions such that (i) each version contained exactly one item from each of the 32 matched sets and (ii) the versions were counterbalanced for condition. Thus, no version included more than one condition from the same matched set. Test items were counterbalanced for the gender of the referents and target pronouns. Each version included all 44 filler items. Within each version, items were divided into 8 blocks which were then pseudo-randomized to generate four orders. Items within each block were randomized separately for each trial.

3.4.3 Procedure

During the experiment, participants wore headphones and were seated in a sound-attenuated chamber in front of a computer. Items were presented using the Superlab 4.0 software package. Presentation was self-paced and cumulative on a sentence-by-sentence basis. Presentation of the audio version of each sentence immediately preceded presentation of the text version. Thus, the sequence of presentation for each item was as follows: Participants pressed a button to hear the first sentence. Immediately after playback of the sentence was complete, the text of the sentence appeared on the screen. The participants then pressed a button to hear the audio of the second sentence. During playback of the second sentence, the text of the first sentence remained on the screen. After playback of the second sentence, the text of the second sentence appeared directly below that of the first sentence. The participants then had the option of pressing a button to replay the audio of both sentences while the text remained on the screen. After the desired repetitions of audio playback, the participants pressed a button to advance to the answer portion of the trial, at which point the text of the item disappeared, and the two probe sentences, labeled “a” and “b”, appeared on the screen. They then pressed one button to select “a” and another to select “b”.³² Their instructions, presented prior to the start of the experiment, were to “choose the sentence from the lettered options that represents the best paraphrase of the *second* sentence that you heard.”

³² Items were counterbalanced with regard to whether the first- or second-mentioned referent occurred first in the probe.

3.4.4 Participants

Thirty-two native speakers of North American English participated in the study. Fourteen participants were undergraduate students at Northwestern University and participated in the experiment for credit in an introductory linguistics course. The remaining 18 participants were undergraduate and graduate students of Northwestern University who were paid for their participation.

3.4.5 Results

The overall results for this experiment are shown in Figure 9.

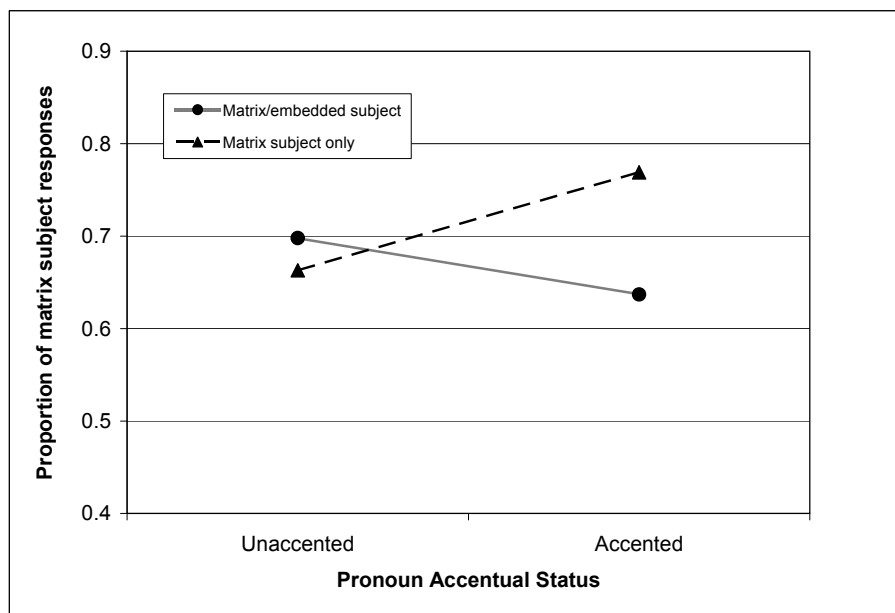


Figure 9. Experiment 2: Proportion of matrix subject responses by Prosodic Pattern and Context.

There was an overall preference for the pronoun to refer to the matrix subject across all four conditions (mean = 0.69). In addition, the results suggest an interaction of Prosodic Pattern with Context. This interaction was confirmed in a quantitative assessment of the dependence of a matrix subject response on Prosodic Pattern and Context using a linear mixed logistic regression model (Baayen 2008). The inclusion of both participants and items as random factors was justified by a likelihood ratio test ($\Pr(>\chi^2) < 0.001$). As the summary in

Table 7 shows, the likelihood of a matrix subject reading was not significantly correlated with a Matrix Only context or with a Narrow prosodic pattern. However, there was a highly significant interaction of the two factors ($p < 0.01$) due to the fact that the proportion of matrix subject readings in the Matrix Only/Narrow condition is larger than predicted by the combined effect of the two factors.

Predictor	B	SE B	Odds Ratio (e^B)
<i>Context:</i>			
Matrix/Embedded Subject vs. Matrix Subject Only	-0.20	0.22	0.82
<i>Prosodic Pattern:</i>			
Broad vs. Narrow	-0.34	0.20	0.71
<i>Interaction:</i>			
Context * Prosodic Pattern	0.95**	0.29	2.59

Table 7. Summary of mixed logistic regression analysis of the likelihood of a matrix subject response. (Intercept and error terms are reported as the logit(p). Standard deviation of random intercept terms: participants (0.88), items (0.37))

Although the overall pattern, at first glance, resembles a crossover interaction, the likelihood of a matrix subject reading is not, in fact, correlated with Context when the analysis is restricted to the Broad prosodic pattern ($B = -0.25$, $SE B = 0.21$, Odds Ratio = 1.28). Instead, the interaction is

better explained by the fact that a matrix subject reading is positively correlated with a Matrix Subject Only context when the analysis is restricted to the Narrow prosodic pattern ($p < 0.001$, $B = 0.77$, $SE\ B = 0.21$, Odds Ratio = 2.16).

In order to gauge the extent to which a Narrow prosodic pattern is associated with a ‘switch’ relative to the preferred reference of the Broad pattern, it is also important to test for the effects of Prosodic Pattern within each level of Context individually. Restricting the analysis to the Matrix Only context, the likelihood of a matrix subject reading is positively correlated with a Narrow prosodic pattern ($p < 0.01$, $B = 0.62$, $SE\ B = 0.21$, Odds Ratio = 1.86). For the Matrix/Embedded context, on the other hand, the likelihood of a matrix subject reading is not correlated with prosodic pattern ($B = -.034$, $SE\ B = 0.20$, Odds Ratio = 0.71).

The mean for all participants answering correctly on the filler items in Groups 1-4 was 98%, with a minimum of 92%.

3.4.6 Discussion

The results of Experiment 2 show an overall preference for pronouns occurring in a Broad prosodic pattern to refer to the matrix subject of the previous sentence. Therefore, switching models straightforwardly predict a preference for pronouns in a Narrow prosodic pattern to refer to the embedded subject. The results are not consistent with this prediction, however. Instead, a Narrow prosodic pattern is actually associated with a *higher* proportion of matrix subject readings in one context (Matrix Subject Only). In other words, it appears that the Narrow prosodic pattern not only failed to induce a reference switch in the Matrix Only context, but, consistent with the prediction of Schwarzschild’s model, it actually reinforced the preferred reference associated with

the unaccented counterpart (i.e., the Broad prosodic pattern). This finding alone strongly supports a rejection of the switching approach in favor of a generalized account of the relationship between prosody and pronominal reference.

In the Matrix/Embedded context, the preference for a matrix subject reading was not significantly correlated with a Narrow prosodic pattern. This absence of a trend towards an embedded subject preference is not consistent with the predictions of switching. Since Schwarzschild's model predicts no particular preference, however, this finding is consistent with the predictions of that model. Recall that in the Matrix/Embedded context, both potential referents result in a violation of the same conditions associated with the Narrow prosodic pattern. In that sense, the model does not distinguish between the two patterns of reference. While this prediction implies that the model is consistent with any outcome, it also provides a viable explanation for the observed interaction. In other words, to the extent that either referent is equally permissible in the Matrix/Embedded context, then that context raises the likelihood of an embedded subject reading relative to the Matrix Only context, which strictly favors matrix subject readings. The model therefore explains why embedded subject readings might be more likely in the Matrix/Embedded context. By comparison, a switching model provides no basis for explaining the observed sensitivity to context, since the predictions for the Narrow prosodic pattern do not depend on the entailment properties of the context.

3.5 Experiment 3

3.5.1 Purpose

The purpose of Experiment 3 is to test whether the sensitivity to context observed in Experiment 2 is an artifact of the particular design used, or whether it is a result of the conditions imposed by the Narrow prosodic pattern as predicted by a generalized approach. The items in Experiment 3 are similar to those in Experiment 2, except that the context manipulation is such that Schwarzschild predicts an interaction in the opposite direction. In other words, the Narrow prosodic pattern is predicted to give rise to an embedded subject preference in one context, and no particular preference in the other context. Assuming that participants show a similar preference for matrix subject readings for items with a Broad prosodic pattern, the predictions of switching models are not different from those in Experiment 2.

3.5.2 Materials

The materials used in this experiment consisted of 128 two-sentence narratives occurring in one of four conditions. They differed from the items in Experiment 2 only with regard to the manipulation of Context. In this case, the entailment properties of the contexts were manipulated by varying the embedded VP rather than the matrix verb. In the *Embedded Only* context in (63i), for example, only the embedded subject satisfies the presupposition introduced by the accent pattern in (63ii).

- (63) *Embedded Only*
- i. During the trial, Darrell blackmailed Sean into admitting to the love affair.
 - ii. A month after the trial% he broke the law%
- H* L-H% H* L-L%

To see why, consider that Schwarzschild predicts (63ii) to introduce the presuppositions in (64).

- (64) (a) There is some antecedent A in the context, such that the existential type shift of A entails $\exists x[x \text{ broke the law}]$
 (b) There is no antecedent B that entails $[k \text{ broke the law}]$, where k is the value of $\llbracket be \rrbracket$

I assume that it is a fact about English that an act of blackmail constitutes a violation of the law. Thus, (64a) is satisfied by the matrix VP in (63i), since this implies that $\exists x[x \text{ broke the law}]$ is entailed by $\exists x[x \text{ blackmailed Sean into admitting to the love affair}]$. In case *he* refers to Sean, then (64b) is also satisfied, since neither the matrix clause nor the embedded clause entails $[Sean \text{ broke the law}]$. If *he* refers to Darrell, however, then (64b) is not satisfied, since $[Darrell \text{ broke the law}]$ is entailed by $[Darrell \text{ blackmailed Sean into admitting to the lover affair}]$. Schwarzschild's model therefore predicts that the pronoun will corefer with the embedded subject in examples like (63).

In examples like (65), on the other hand, the model does not distinguish between the two potential antecedents.

- (65) *Matrix/Embedded*
 i. During the trial, Darrell blackmailed Sean into lying under oath.
 ii. A month after the trial% he broke the law%
 H* L-H% H* L-L%

In this case, $[Sean \text{ broke the law}]$ is entailed by the embedded clause, and $[Darrell \text{ broke the law}]$ is entailed by the matrix clause. Therefore, the condition in (64b) is violated by either choice of a referent for *he*.

All other aspects of the test items, including the details of the prosodic manipulation, were identical to Experiment 2. Experiment 3 used the same 40 filler items as Experiment 2. The design

of the experiment with respect to the four experiment versions was also identical to that in Experiment 2.

3.5.3 Procedure

The procedure used in Experiment 3 was identical to that used in Experiment 2.

3.5.4 Participants

Thirty-two native speakers of North American English were used in the study. Ten were undergraduate students at Northwestern University who participated for credit in an introductory linguistics course. The remaining 22 participants were current undergraduate students, recent undergraduate students, and graduate students of Northwestern University who were paid for their participation.

3.5.5 Results

The results of Experiment 3 are summarized in Figure 10.

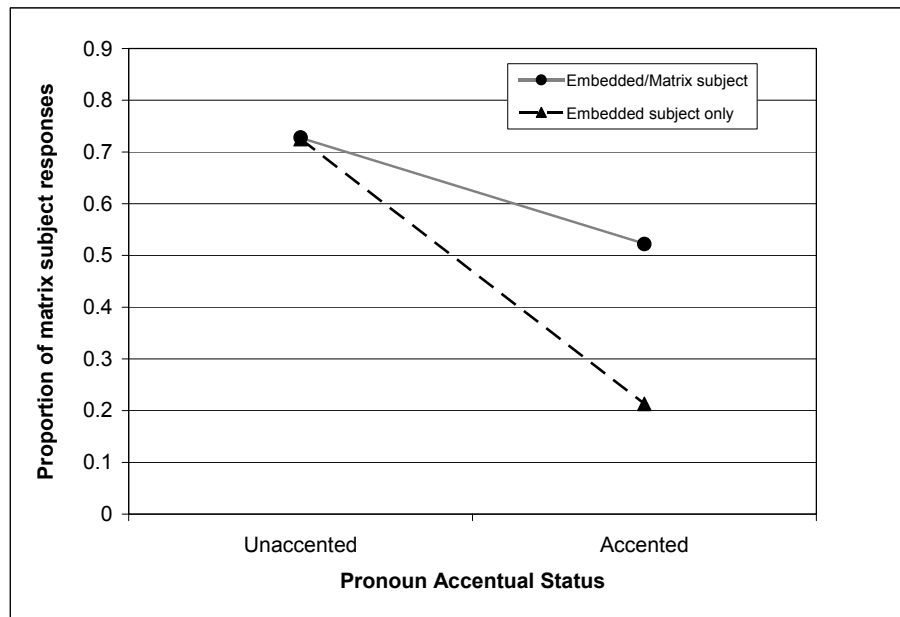


Figure 10. Experiment 3: Proportion of matrix responses by accent pattern and context.

As in Experiment 2, there was an overall preference for a matrix subject reading in both conditions involving a Broad prosodic pattern. While the Narrow pattern was associated with a general decrease in matrix subject readings, this effect appears to be stronger for the Embedded Only context than for the Matrix/Embedded context. This suggests an interaction of Prosodic Pattern and Context. Using the same statistical method as before, these effects were confirmed by a quantitative analysis. As

Table 8 shows, the likelihood of a matrix subject response was negatively correlated with a Narrow prosodic pattern ($p < 0.001$), and there was a significant interaction of Prosodic Pattern and Context ($p < 0.001$) due to the smaller than expected proportion of matrix subject responses for the Narrow prosodic pattern in the Embedded Only context. Matrix subject responses were not significantly correlated with Context overall.

Predictor	B	SE B	Odds Ratio (e^B)
Context: <i>Matrix/Embedded vs. Embedded Only</i>	-0.02	0.21	0.98
Prosodic Pattern: <i>Unaccented vs. Accented</i>	-1.02***	0.20	0.36
Interaction: <i>Context * Prosodic Pattern</i>	-1.52***	0.29	0.22

Table 8. Summary of mixed logistic regression analysis of the likelihood of a matrix reading. (Standard deviation of random intercept terms: participants (0.47), items (0.58))

Restricting the analysis by level of Context, the likelihood of a matrix subject response is negatively correlated with a Narrow prosodic pattern for both the Embedded Only context ($p < 0.001$, $B = -2.53$, $SE\ B = 0.22$, Odds Ratio = 0.08) and the Matrix/Embedded context ($p < 0.001$, $B = -1.03$, $SE\ B = 0.20$, Odds Ratio = 0.36). Finally, restricting the analysis by level of Prosodic Pattern, matrix responses are negatively correlated with an Embedded Only context for the Narrow prosodic pattern ($p < 0.001$, $B = -1.78$, $SE\ B = 0.22$, Odds Ratio = 0.17), but not for the Broad pattern ($B = 6E^{-4}$, $SE\ B = 0.21$, Odds Ratio = 1.00).

The mean for all participants answering correctly on the filler items in Groups 1-4 was 98%, with a minimum of 91%.

3.5.6 Discussion

The results show an overall preference for a matrix subject reading for items in the Broad prosodic condition. As with Experiment 2, therefore, switching models predict a preference for an embedded subject reading for accented pronouns in the Narrow condition. In that sense, the results

of Experiment 3 are consistent with the predictions of switching models. However, since the switching approach does not make a specific prediction based on differences in the context, it cannot explain why the effect of prosodic pattern was stronger for the Embedded Only context than for the Matrix/Embedded context.

Schwarzschild's model, by comparison, predicts that the entailment properties of the context have important consequences for the possible antecedents of pronouns in a Narrow prosodic pattern. Specifically, it predicts that in an Embedded Only context, only the embedded subject is a possible antecedent, whereas in a Matrix/Embedded context, the matrix subject and the embedded subject are equally preferred. If it is assumed that the lack of a specific preference associated with the Matrix/Embedded context gives rise to a random response strategy, then the higher rate of matrix subject responses for pronouns in a Narrow prosodic pattern in that context can be explained by Schwarzschild's model. In other words, listeners used the available cues provided by the prosody to establish a preference for the embedded subject in the Embedded Only context leading to a very low proportion of matrix responses. In the Matrix/Embedded context, the cues were not useful in this regard, so they resorted to guessing, which resulted in a more moderate proportion of matrix responses (i.e., close to 50%).

In summary, while the results of Experiment 3 are consistent with either a switching model or a generalized model, only the latter provides an explanation for the specific quantitative effects that are observed. In addition, the fact that the direction of the interaction mirrored that in Experiment 2 provides corroborating evidence that the results of Experiment 2 are indeed reflective of the predictions of the generalized model, and not simply an artifact of the specific design paradigm.

3.6 General Discussion

The pairing of the two sets of results in Experiments 2 and 3 provides strong support for a model in which the reference of accented pronouns follows from a general theory of the interpretation of prosodic form. Specifically, it supports the analysis presented here based on Schwarzschild (1999). That analysis not only predicted the qualitative effects of specific prosodic patterns based on the entailment properties of the discourse, but it was also able to explain the specific quantitative outcomes in the two experiments. By contrast, the results of Experiment 2 were inconsistent with the predictions of switching models, since accented pronouns in one condition were actually associated with an increase in responses corresponding to the empirically determined ‘default’ reference. In addition, switching models provide no basis for explaining the presence of an interaction in each experiment, much less the specific quantitative outcomes that were observed. Overall, the findings in Experiments 2 and 3 provide support for a rejection of the switching approach to the relationship between prosody and pronominal reference, and suggest that a generalized account of the associated phenomenon should be explored more fully.

Schwarzschild’s model predicts that for two types of contexts used in Experiments 2 and 3, the conditions imposed by a narrow prosodic pattern cannot be satisfied by just any choice of a referent for the pronoun. Formally, this implies that such an accent pattern is illicit in those contexts. On the assumption that *he* in (66ii) is constrained to refer to Alex or Roger, for example, then the accent pattern shown would be blocked by the ‘accentless’ form in (66ii)³³, since the latter incurs fewer violations of AVOIDF.

³³ This supposes that forms like (66ii) are not ruled out for independent reasons, such as a phonological constraint against long post-nuclear tails, for example.

It is far from clear that this is how communication actually proceeds. In addition, this is somewhat inconsistent with Schwarzschild's own suggestion that the grammar of accent placement depends on what the speaker chooses to present as Given. In other words, it should be permissible under such an assumption for a speaker to choose an accent pattern that is not strictly licensed by the explicit context, even if the sentence contains an underspecified expression such as a pronoun. As the model stands, this situation cannot even be represented in the model. In that sense, there is no formal way to represent how a hearer uses prosodic cues to resolve the reference of a pronoun in the general case.

In the chapter that follows, I propose a model that partially addresses these issues. Specifically, I show how a model that (i) provides for a formal representation of interpretation, and (ii) takes into account the speaker's and hearer's perspectives simultaneously, can explain how the conditions introduced by particular prosodic patterns can directly constrain the referential possibilities of pronouns.

Chapter 4

A Bi-Directional Model of Prosodic Meaning

4.1 Introduction

The results of the previous chapter converge with existing empirical evidence to highlight the need for an account of accented pronoun effects that integrates with an independently motivated model of prosodic meaning. In particular, these combined results suggest that the reference of pronouns under different prosodic patterns may be best accounted for by principles governing the interpretation of prosodic form in the general case, and moreover, that they do not depend on the notion of a deviation from some default. In other words, a general theory of prosodic meaning should be sufficient to account for at least some cases of accented pronoun effects without further stipulation. This chapter presents a new model of prosodic meaning that seeks to account for the relationship between prosody and pronominal reference in just such a way.

For certain basic cases, there is a highly intuitive way to understand how the interpretation of prosodic form interacts with the reference of pronouns. If it is assumed, for example, that hearers attend to the different expressive options that a speaker faces in production, then the observed effects follow from a particular class of inferences based on ordering relations that are associated with those options. Essentially, these are *blocking* inferences based on the hearer's consideration of alternatives to the form that was actually uttered, which were shown in Chapter 3 to be essential to the mapping between pronominal reference and prosody. Crucially, however, the ordering relations that are part of such inferences may be construed in different ways with similar results. This raises

the issue of what constitutes a theoretically preferable account in such cases. One motivation of the new model, then, is to provide a formal basis for comparing the consequences of different ordering relations, and to explore the possibility that principles that are intrinsic to the grammar of prosodic meaning are sufficient to account for the relationship between prosody and pronominal reference. Since Optimality Theoretic (Prince & Smolensky 1993) grammars inherently involve a comparison of alternative inputs relative to any given output, they capture such blocking effects automatically – that is, without the need to stipulate specific blocking constraints. The model presented in this chapter is therefore grounded in one particular formulation of Optimality Theory, taking as its starting point the model of nuclear accent placement presented in Schwarzschild (1999).

The model is also motivated by the need to formally represent the sense in which pronominal reference and prosodic meaning represent two dimensions of underspecification that are interpreted in parallel. While the model proposed in Schwarzschild (1999) is shown to provide a useful ordering relation, the fact that there is no explicit notion of interpretation in the model presents a problem for certain cases. Recent work within Bidirectional Optimality Theory (Blutner 2000, Blutner et al. 2006) has demonstrated the potential of that framework to capture a wide range of meaningful interactions between ordering principles on the one hand, and the resolution of various kinds of underspecification on the other. In addition, the assumptions of that framework permit multiple types of underspecified meaning to be treated simultaneously.

One important innovation of the model I propose is a fundamental reallocation of formal objects into those that a hearer can observe directly, and those that are known only to the speaker. In addition, I show that the fundamental component of prosodic meaning proposed by Schwarzschild (i.e., Givenness) has an inherent scalar structure, and that a bi-directional model can account for pronominal reference if it is sensitive to that structure. The resulting model not only

permits pronoun resolution and the interpretation of prosody to proceed in parallel, but it accurately accounts for several key cases without the need to stipulate additional ordering principles.

The layout of the chapter is as follows: 4.2 provides an overview of various generalized approaches based on different ordering relations. 4.3 motivates the applicability of BOT to the problem at hand, in addition to providing an overview of the formal assumptions that underlie that framework. 4.4 discusses both the advantages of Schwarzschild's (1999) model as well as some of the theoretical issues that it raises. 4.5 presents the new model, in addition to showing how it applies to three key sets of examples. Finally, 4.6 provides concluding remarks including a discussion of some of the open questions that remain.

4.2 Blocking and Bi-Directionality

In this section, I review four different accounts of the relationship between prosody and pronominal reference. While the accounts give rise to very similar predictions, they are based on four different ways of ordering the various forms and interpretations that are involved: contrastive presupposition satisfaction, informativity, presupposition maximization, and the relative markedness of forms. I discuss some theoretical issues associated with choosing between analyses that have similar empirical coverage. I introduce the notion of a bi-directional inference and explain why it has certain theoretical advantages in such cases. In 4.3, the four analyses are ultimately rejected in favor of a bi-directional model with much wider empirical coverage.

4.2.1 The Contrastive Presupposition

In certain basic cases, the idea that the interpretation of prosody constrains pronoun reference can be understood quite intuitively. According to one theory of focus (Geurts & van der Sandt 2004, *inter alia*) for example, the accent pattern in (67ii) triggers the presupposition in (68).

- (67) i. John hit Bill, and then
 ii. George_{H*} hit him_{L-}%
 H* L- H* L-L%

- (68) $\exists x \exists y [x \text{ hit } y]$

The presupposition in (68) is clearly satisfied by the context in (67i), regardless of which referent is chosen for *him*. In that sense, (68) does not constrain the reference of *him*. Nevertheless, there seems to be a salient inference that since *John hit Bill* is the particular instantiation of (68) that satisfies the presupposition, then *Bill* is not the intended referent of *him*.

It is tempting to remedy this problem by adding a contrastive presupposition to the meaning of the prosodic pattern in (67ii). For instance, (68) might be replaced with the presupposition in (69).

- (69) $\exists x \neq [\textit{him}]. \exists y \neq [\textit{George}]. \text{hit}(x)(y)$

Notice that if (69) is to be satisfied by the assertion in (67i), then the value of *him* must be distinct from the value of *Bill*. Assuming that binding theoretic considerations prevent *him* from coreferring with *George*, then John is the only value for the pronoun that would meet these conditions. Effectively then, the assumption of a presuppositional meaning such as (70) partially predicts alternations like those in (1) through (3) in Chapter 1.

4.2.2 Informativity

In fact, there are several ways to derive the same result without appealing to a contrastive presupposition like the one in (69). In other words, it is possible to explain how the more basic presupposition in (68) can lead to the inference that *him* in (67ii) refers to John and not Bill. Consider that under the same assumptions as in (68), the prosodic pattern in (71ii) is associated with the presupposition in (72).

- (71) i. John hit Bill, and then
 ii. George hit him%
 H* L-L%

- (72) $\exists x[x \text{ hit him}]$

Whereas the presupposition in (68) is satisfied by (67i) regardless of the value of *him*, the presupposition in (72) is satisfied only if *him* refers to Bill. In other words, if *him* refers to anyone other than Bill, then it is not the case that (72) is true in the context. Since the prosodic pattern in (67ii) is consistent with either value for the pronoun, whereas the pattern in (71ii) is consistent with only one value for the pronoun, (71ii) actually constitutes a more informative utterance.

On the basis of this distinction, standard neo-Gricean principles provide the means to predict that *him* in (67ii) refers to John. Levinson (1987), for example, proposes that interpretation and production are guided by the principle in (73).

- (73) *Q-principle*: Do not provide a statement that is informationally weaker than your knowledge of the world allows (unless providing a stronger statement would contravene the I-principle)

Applied to the present example, (73) says that a speaker should use (71ii) whenever possible, since that statement, by way of its presuppositions, excludes more possibilities for the hearer and is

therefore informationally stronger. It was already established that (71ii) is licensed whenever *him* refers to Bill. On that basis, the hearer can reason that a cooperative speaker will use (71ii) whenever *him* refers to Bill. By contraposition, if the hearer observes that the speaker did not use (71ii) on a particular occasion, then it must be the case that the intended referent of *him* is not Bill (i.e., it must be John). Otherwise, the speaker would not be obeying (73). In other words, the speaker uses the more informative utterance in (71ii) unless he is forced to use the less informative one in (67ii). The fact that he is forced to use a less informative utterance implies that the intended meaning is not consistent with the more informative alternative. In the context of (67i), this implies that *him* refers to John.

4.2.3 Presupposition Maximization

In the previous analysis, an inference is licensed based on the assumption that a cooperative speaker will opt for more informative utterances when they are available. In that case, informativity was characterized by which utterance was consistent with fewer possible referents for the pronoun. The informativity of an utterance may also be characterized another way, however. Abstracting away from the specific case of pronouns, consider the examples in (74a) and (74b).

- (74) a. George_{H*} hit Bill_{L-}%
 H* L- H* L-L%
- b. George hit Bill_{H*}%
 H* L-L%

Applying the same model of focus as before, these give rise to the presuppositions in (75a) and (75b) respectively.

- (75) a. $\exists x\exists y[x \text{ hit } y]$
 b. $\exists x[x \text{ hit Bill}]$

The presupposition in (75b) expresses a stronger proposition than the one in (75a) because, among other things, it excludes more possible worlds. In slightly different terms, (75b) is more informative because it is consistent with (or satisfied by) fewer contexts. In contrast to the previous example, this ordering between the presuppositions is irrespective of the truth-conditional possibilities associated with the assertoric content of the utterance. In other words, the two sentences do not include pronouns, so the truth conditions associated with their assertoric content is fixed.

This alternative characterization of informativity gives rise to an almost identical inference when applied to (67ii) and (71ii). Specifically, a cooperative speaker who follows the Q-Principle in (73) is assumed to always use the strongest presupposition that is licensed by the context. This implies that if the assertoric content is equivalent to *George hit Bill*, then the speaker is obligated to express the presupposition associated with the accent pattern in (71ii). This in turn implies that if the speaker has expressed a weaker presupposition by uttering (67ii), then the content of the sentence must be such that the stronger presupposition would not have been satisfied. In other words, *him* must refer to John and not Bill.

The distinction between these two ways of characterizing informativity is subtle. The primary difference is in the level of generality at which the ordering applies. In one case, the ordering arises specifically because the utterances contain pronouns. In the other case, the ordering applies to the use of presuppositions more generally, and is independent of whether pronouns are involved. Indeed, this latter type of ordering is closely related to the proposal by Heim (1991) that the non-uniqueness presupposition associated with the indefinite article is not part of its lexical entry,

but arises through a scalar inference. Sauerland (2005) builds on this notion of *presupposition maximization* to explain why deaccenting of Given material typically appears to be obligatory.

4.2.4 Relative Markedness of Forms

Finally, the utterances in (67ii) and (71ii) can be ordered yet another way. Recall from earlier that it has often been assumed that a pitch accent on a pronoun introduces additional markedness relative to the same utterance with no accentuation on that pronoun. On that basis, (71ii) is preferable to (67ii) by virtue of having one less accented pronoun. As mentioned in previous chapters, Beaver (2004) and others have appealed to this type of ordering to explain how a partial blocking effect might give rise to the referential preferences associated with examples like (67ii) and (71ii). An ordering based on markedness can be applied in another way, however. Consider the counterpart to the Q-principle (Levinson 1987), shown here in (76).

- (76) *I-principle*: Say as little as necessary, i.e., produce the minimal linguistic information sufficient to achieve your communicational ends (bearing the Q-principle in mind)

Typically, the notion of ‘minimal linguistic information’ is equated with something like the length or morpho-syntactic complexity of an utterance. If the markedness associated with an accented pronoun is viewed in these terms, then the I-principle gives rise to a scalar inference in a way that is exactly analogous to that arising from the Q-principle in connection with informativity. Specifically, since the utterance in (71ii) is less marked, then (76) says that a speaker will use (71ii) whenever possible. In this case, (71ii) is possible precisely when *him* refers to Bill. If the hearer observes that the speaker has used (67ii), then he is able to infer that the speaker was *forced* to do so, presumably

because the presupposition associated with (71ii) was not licensed in the context. From this, the hearer infers that *him* does not refer to Bill.

4.2.5 Selecting an Ordering Relation

The fact that so many different analyses appear to explain the contrast in (67ii) and (71ii) calls for some caution. Among other issues, the different ordering relations are not guaranteed to generalize in the same way. This is already evident from the fact that the notion of informativity based on referential possibilities is specific to the case of pronouns, whereas informativity based presupposition maximization is more general. While the reasoning behind these two types of inferences applies in a nearly identical way in the case of (67) and (71), it is in principle possible that the relationship between presupposition maximization and referential possibilities is reversed, so that a stronger presupposition would actually be consistent with more referential possibilities. This is, after all, the lesson of Chapters 2 and 3: An ordering based on the markedness of accented pronoun has remained mostly unchallenged, yet it fails to generalize to cases where other kinds of ordering (i.e., Schwarzschild's model) make a different prediction. When two different ordering relations give rise to similar predictions for all known evidence, it is therefore important to consider whether there are independent reasons to prefer one analysis over the other.

In this regard, I want to clarify several points. First of all, with the exclusion of the contrastive presupposition analysis, all of the above analyses constitute a type of blocking argument. Notice that this requires, at the very least, an asymmetry in the number of meanings that are consistent with each of the two forms. More specifically, it requires that two forms have partially overlapping meanings, but one of those forms is consistent with fewer meanings than the other. In

the above examples above, (67ii) and (71ii) have partially overlapping meanings because (67ii) is consistent with either Bill or John as the referent of *him*, whereas (71ii) is consistent with only Bill as the referent of *him*. Thus, reference to Bill in (67ii) may be said to be *blocked* by (71ii).

Often, blocking is simply invoked as a general rule, in the sense that mapping configurations of the type described above are assumed to give rise to blocking. Notice, however, that there is an implicit assumption in such a rule that the forms are ordered, in the sense that more specific forms are preferred when available. In the examples I gave, blocking is never invoked as a rule. Instead, the different ways of ordering the forms is dealt with as a separate issue, and blocking arises as the result of a deductive interaction between a particular ordering relation and the inherent mapping asymmetry associated with the forms involved. In principle, the ordering among forms may be motivated independently of the notion of specificity, and in that sense, blocking may be said to be an emergent effect rather than a rule.

By contrast, the principle of partial blocking is always invoked as a rule. In other words, given a particular ordering over two forms and a particular ordering over two meanings, there is no chain of inference that leads to the conclusion that marked forms will be used to express marked meanings. Instead, that notion has to be stipulated. This fact is particularly important given the example in 4.2.4, which showed that the assumption of markedness is logically sufficient to derive the preferences associated with (67ii) and (71ii). In other words, a partial blocking effect is not only stipulative, but it is essentially extraneous in many cases. With a rudimentary theory of the meaning of sentential prosodic patterns, the same effect emerges independently of partial blocking.

Returning now to the question raised at the beginning of this section, I want to suggest that a theoretically preferable analysis is one that involves the fewest assumptions. In this case, this means not only that stipulation should be avoided when possible (e.g., partial blocking, or blocking

when invoked as a rule), but also that ordering relations should be drawn from a source that is intrinsic to the fragment of the grammar that is in play. As a concrete example, consider that in the above examples, presupposition maximization is invoked more or less independently of the grammar of prosodic meaning. In fact, however, Schwarzschild (1999), Williams (1997), and Sauerland (2005) have proposed that some notion of presupposition maximization is an intrinsic and independently required assumption of the grammar of accent meaning. In Schwarzschild's model, for example, the constraint AVOIDF captures the observation that the amount of Given content in an utterance is usually maximized. This means that (71ii) is ordered relative to (67ii) due to an intrinsic property of the principles governing the relationship between prosodic form and meaning. An analysis that orders the forms on the basis of AVOIDF is therefore preferable to one that orders them on the basis of the number of referential possibilities that each is consistent with.

The key point is that the grammar may provide an ordering relation that derives a particular blocking effect without the need for additional assumptions. It is important to consider, however, that candidates may not be ordered along a single dimension. In an OT model like Schwarzschild's, for example, the set of constraints (which are themselves ordered) provides an ordering relation over the entire set of possible forms. This relation is richly structured, however, in the sense that it cannot be characterized by a single dimension such as presupposition maximization. In other words, AVOIDF is not the last word on the ordering of forms. In fact, it is only relevant when multiple candidates are not already ordered by more highly ranked constraints like GIVENNESS and FOC.

This suggests, first of all, that an ordering relation specified by a single structural dimension cannot be assumed to explain all cases that appear similar. It is important to determine for each example which specific relation is actually operative. It also suggests the need for a systematization of blocking analyses. In other words, the issue of overgeneralization that I just raised can be

avoided if the grammar is stated in such a way that blocking effects emerge automatically. This way, additional ordering relations may be invoked incrementally, but only when the relevant effects are not already captured by the intrinsic ordering provided by the fragment of grammar that is independently associated with the form-level contrasts being compared.

4.3 Modeling Communication

One advantage of the OT framework is that blocking effects emerge automatically. In Schwarzschild's model, for example, the form in (77ii) incurs fewer violations of AVOIDF than (77ii'), while satisfying all more highly ranked constraints equally.

- (77) i. John hit Bill, and then...
 ii. George_F hit Bill%
 H* L-L%

 ii'. George_{F||} hit Bill_F%
 H* L- H* L-L%

In that sense, it may be said that the form in (77ii') is blocked by the form in (77ii). Crucially, however, traditional OT approaches to syntax and semantics are unidirectional, in that they either provide an ordering over forms given a meaning as input, or they provide an ordering over interpretations given an input form. To the extent that such models are intended to model communication, they model either production or interpretation, but not both.

As the examples in 4.2 illustrate, however, the blocking effects that are likely to explain the relationship between prosody and pronominal reference require a consideration of the communication both from the perspective of production and that of perception. In other words, it

is necessary not only to consider all prosodic forms associated with a single referent of the pronoun, but it is necessary to compare the different ways of resolving a pronoun given an observed form. In a traditional OT model, this is formally impossible, since ordering relations only apply over outputs associated with a single input.

This is in contrast to the neo-Gricean tradition, which seeks to model communication in terms of a simultaneous consideration of the constraints associated with both production and interpretation. This is, after all, the essence of the Q- and I-principles presented above. The Q-principle captures the sense in which a speaker's choice of an utterance accommodates the needs of the hearer, while the I-principle captures the sense in which a speaker accommodates his own needs by, for example, choosing a less effortful form. In the final analysis, the Q- and I-principles are just two specific ways of ordering the various choices faced by a speaker and a hearer (and I have suggested several others). Yet they illustrate the potential for a bi-directional model of communication more generally to reduce the degrees of freedom associated with ambiguous or underspecified forms, in a sense making it possible to express meanings that are not provided for directly by the lexical semantics of the component forms.

The framework known as Bi-Directional Optimality Theory (henceforth BOT) may be viewed as an effort to capture the importance of bi-directional considerations in a way that also capitalizes on the descriptive richness and formal rigor of traditional OT syntax and semantics approaches. Like neo-Gricean accounts, the driving assumption behind BOT is that the communication problem depends on a simultaneous consideration of two perspectives. Formally, the grammar is represented as an optimal pairing of *forms* (i.e., observable utterances) and *meanings* (possible speaker intentions) through the dual optimization processes of *production*, which corresponds to the speaker's perspective, and *interpretation*, which corresponds to the hearer's

perspective. A pair consisting of a form and a meaning is called an *enrichment pair*, and the set of all such pairs is assumed to be partially ordered. Typically, the relation that determines this ordering is specified by a set of hierarchically ranked, violable constraints following the assumptions of standard OT. In principle, however, this ordering relation can come from any source. Crucially, and in contrast to standard OT, the mapping between forms and meanings in one direction of optimization is potentially influenced by the mapping between meanings and forms in the other direction. For a given meaning, for example, a particular form may not be used to express that meaning if the same form pairs with a different meaning in a more optimal way. In other words, if the pairing established by production-optimization differs from the pairing established by interpretation-optimization, then at least one of the two pairings is ruled out by the grammar. Formally, this is expressed by the principle of *Bidirectional Optimality* (Blutner 2000, Blutner et al. 2006) given in (78).

(78) *Bidirectional Optimality* (strong version)

A form-meaning pair $\langle F, M \rangle$ is called (bidirectionally) optimal if and only if:

- (i) There is no distinct pair $\langle F', M \rangle$ realized by GEN such that $\langle F', M \rangle \prec \langle F, M \rangle$ and
- (ii) There is no distinct pair $\langle F, M' \rangle$ realized by GEN such that $\langle F, M' \rangle \prec \langle F, M \rangle$ ³⁴

Since traditional OT models are intended only to establish mappings between different levels of representation, a given structural description may include a mixture of those aspects of the communicative setting that are known only to the speaker, and those that are known to both the speaker and hearer. By contrast, BOT seeks to model the way in which communication is enriched by those things a hearer cannot observe, but may infer. Thus, it imposes a much stricter division between forms and meanings. Specifically, forms consist of those aspects of the communicative setting that are directly observable by the hearer (e.g., utterances), while meanings include the range

³⁴ Where \prec is an ordering relation such that $A \prec B$ reflects the fact that A is less costly than B, or A is more harmonic/economical than B.

of possible speaker intentions that are consistent with what is observable by the hearer. In other words, meanings are those representations that can be formed by *enriching* the underspecified content of an utterance.

To see how BOT applies to a traditional example, consider that the use of *pale red* in (79a) is consistent with both sets of truth conditions in (80), yet it is generally assumed to implicate the stronger proposition in (80a).

- (79) a. *The bluffs are pale red.*
b. *The bluffs are pink.*

- (80) a. The bluffs are pale red but not pink.
b. The bluffs are pale red and possibly pink.

It is possible to derive this result using the principle in (78). Note, first of all, that I am assuming a lexical semantics in which *pink* picks out a proper subset of the objects that *pale red* does. On that assumption, there are two possible states of affairs that are (lexically) consistent with an utterance of (79a): one in which the bluffs belong to the set of things that are conventionally in the meaning of *pink*, which I will label M_p , and one in which the bluffs belong to the set of things that are pale red, but not in the conventional meaning of *pink*, which I will label as $M_{PR \wedge \sim p}$. By comparison, only one of these states of affairs is consistent with the use of (79b), namely, M_p . This means that the enrichment pairs under consideration are $\langle \text{pale red}, M_p \rangle$, $\langle \text{pale red}, M_{PR \wedge \sim p} \rangle$ and $\langle \text{pink}, M_p \rangle$, and $\langle \text{pink}, M_{PR \wedge \sim p} \rangle$.

Now, if it is assumed that a cost is associated with enrichment pairs for which the meaning is not in the lexically determined extension of the form, then $\langle \text{pink}, M_p \rangle$ is preferable to $\langle \text{pink}, M_{PR \wedge \sim p} \rangle$. I will represent this situation as $\langle \text{pink}, M_p \rangle \prec \langle \text{pink}, M_{PR \wedge \sim p} \rangle$. According to (78ii),

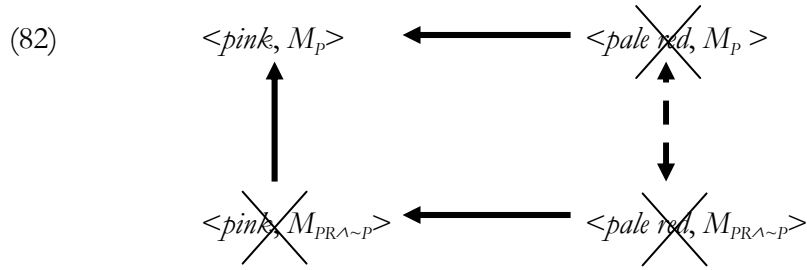
therefore, $\langle pink, M_{PR \wedge \sim P} \rangle$ is not an optimal pair, or in more conventional terms, the form *pink* is blocked from being used to convey $M_{PR \wedge \sim P}$. In practice, lexically inconsistent enrichment pairs are ruled out a priori by restrictions on the formal mechanism (*GEN*) responsible for generating all possible enrichment pairs relative to a particular common ground. The end result, however, is the same, and I include all enrichment pairs here merely for the sake of illustration.

The remaining pairs are potentially ordered in other ways. As suggested in 4.2, for example, they might be ordered based on their relative informativity. Formally, this might be stated as the ordering principle in (81).

- (81) *Use Informative Forms*: Given two sentential expressions a and b , if the set of worlds consistent with a is a proper subset of the set of worlds consistent with b , then all else being equal, a is preferable to b

Since the use of *pink* in (79b) is lexically consistent with fewer states of affairs than the use of *pale red* in (79a), then according to (78i), the pair $\langle pale\ red, M_p \rangle$ cannot be optimal on the grounds that $\langle pink, M_p \rangle \prec \langle pale\ red, M_p \rangle$. Since (81) applies to forms independently of their associated meanings, it also determines that $\langle pink, M_{PR \wedge \sim P} \rangle \prec \langle pale\ red, M_{PR \wedge \sim P} \rangle$. Notice that the same ordering results if it is assumed that *pink* is preferable to *pale red* on the basis that it is morphologically and phonologically simpler.

The situation is illustrated more clearly by the diagram in (82). Note that arrows point towards more highly ranked pairs. Crosses mark pairs that are precluded from optimality according to the definition in (78). Dashed arrows indicate pairs that are not ordered.



According to the definition in (78), $\langle \text{pink}, M_p \rangle$ clearly satisfies the conditions for bi-directional optimality since there is no pair with the same meaning and a different form that dominates it, and there is no pair with the same form and a different meaning that dominates it.

Notice, however, that $\langle \text{pale red}, M_{pR \wedge \sim p} \rangle$ is not actually an optimal form. The counterintuitive nature of outcomes like this has prompted a reformulation of the definition of bi-directional optimality (Blutner 2000; Jäger 2002) so that pairs like $\langle \text{pale red}, M_{pR \wedge \sim p} \rangle$ are permitted to be optimal. Blutner et al. (2006) give the definition in (83).

(83) *Bidirectional Optimality* (weak version)

A form-meaning pair $\langle F, M \rangle$ is called *super-optimal* if and only if:

- (i) There is no distinct pair $\langle F', M \rangle$ such that $\langle F', M \rangle \prec \langle F, M \rangle$ and $\langle F', M \rangle$ satisfies (ii)
- (ii) There is no distinct pair $\langle F, M' \rangle$ such that $\langle F, M' \rangle \prec \langle F, M \rangle$ and $\langle F, M' \rangle$ satisfies (i)

Essentially, (83) is a formal version of a partial blocking rule. Notice that $\langle \text{pale red}, M_{pR \wedge \sim p} \rangle$ in the above example meets this weaker condition, since neither of the pairs that dominates it, $\langle \text{pink}, M_{pR \wedge \sim p} \rangle$ and $\langle \text{pale red}, M_p \rangle$, are themselves optimal.

Now consider how the model might apply to the examples in (67) and (71), repeated below.

- (67) i. John hit Bill, and then
 ii. George_{||} hit him⁰%
 H* L- H* L-L⁰%

- (71) i. John hit Bill, and then
 ii. George hit him⁰%
 H* L-L⁰%

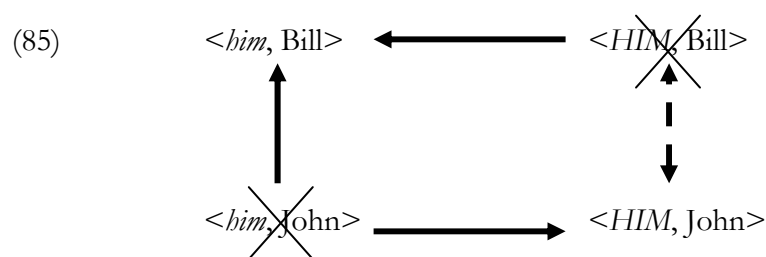
The forms in this case are the accent patterns in (67ii) and (71ii), and the meanings are the propositions that are expressed under different ways of resolving the pronoun. This gives rise to four possible enrichment pairs, which I will abbreviate as *<him, Bill>*, *<him, John>*, *<HIM, Bill>* and *<HIM, John>*. Following the analyses in 4.2, I assume that each pair is associated with a presupposition based on how the accent pattern interacts with the value of the pronoun. These presuppositions are given in (84).

- (84) a. *<him, Bill>*: $\exists x[x \text{ hit Bill}]$
 b. *<him, John>*: $\exists x[x \text{ hit John}]$
 c. *<HIM, Bill>*: $\exists x\exists y[x \text{ hit } y]$
 d. *<HIM, John>*: $\exists x\exists y[x \text{ hit } y]$

As 4.2 makes clear, there are a number of ways of thinking about the ordering between the candidates. First of all, they might be ordered based on the principle of presupposition maximization. In other words, *<him, Bill>* \prec *<HIM, Bill>* and *<him, John>* \prec *<HIM, John>* because (84a) and (84b) represent stronger presuppositions than (84c) and (84d). The candidates might also be ordered on the basis of the markedness associated with accented pronouns. In other words, *<him, Bill>* \prec *<HIM, Bill>* because *<HIM, Bill>* includes an accented pronoun that *<him, Bill>* does not, and similarly for *<him, John>* and *<HIM, John>*. In this case, the result is the same regardless of which ordering relation is invoked.

The candidates may also be ordered based on whether their associated presuppositions are actually satisfied in the context. Crucially this would mean that $\langle \textit{him}, \textit{Bill} \rangle \prec \langle \textit{him}, \textit{John} \rangle$, since the presupposition associated with the latter is not satisfied in the context of (67i/71i). Notice that this assumption also implies that $\langle \textit{HIM}, \textit{John} \rangle \prec \langle \textit{him}, \textit{John} \rangle$. Somewhat problematically, this contradicts the earlier assumption that $\langle \textit{him}, \textit{John} \rangle \prec \langle \textit{HIM}, \textit{John} \rangle$ on the basis of either presupposition maximization or the markedness associated with accented pronouns. In this case, I assume that the ordering associated with presupposition satisfaction takes priority over other ordering relations (i.e., it represents a more highly ranked constraint than either presupposition maximization or any constraint associated with accented pronoun markedness). The important result is that $\langle \textit{him}, \textit{Bill} \rangle$ and $\langle \textit{HIM}, \textit{John} \rangle$ both dominate $\langle \textit{him}, \textit{John} \rangle$, since the presupposition associated with $\langle \textit{him}, \textit{John} \rangle$ is not satisfied in the context of (67i/71ii).³⁵

The total picture is illustrated by the optimization diagram in (85).



Given the assumptions I have made here, there are two pairs that meet the definition of bi-directional optimality in (78). They are $\langle \textit{him}, \textit{Bill} \rangle$ and $\langle \textit{HIM}, \textit{John} \rangle$. Incidentally, the weak version of optimality does not make a different prediction in this case. Notice, however, that if the

³⁵ In practice, BOT models typically assume that pairs are excluded from consideration a priori if the meaning is inconsistent with the lexical extension of the associated form. This might be the right way to think about presupposition satisfaction. In other words, the ordering between $\langle \textit{him}, \textit{John} \rangle$ and $\langle \textit{HIM}, \textit{John} \rangle$ would be irrelevant, because the former enrichment pair is never actually generated. I make a slightly different assumption here for the sake of illustration.

issue of presupposition satisfaction had been ignored, or ranked below the other constraints, then $\langle \text{HIM}, \text{John} \rangle$ would have been dominated by $\langle \text{him}, \text{John} \rangle$, causing it to fail the test of optimality as defined in (78). In that case, the weaker definition in (83) would have allowed it to count as optimal.³⁶

In the above examples, the particular selection of an ordering relation did not change the final predictions of the model, though it greatly influenced the nature of the analysis. Given such a limited dataset, it hard to predict, therefore, how the different ways of construing ordering might generalize in different ways. This fact only underscores the importance of giving careful consideration to the effects of different ordering relations. In that respect, BOT provides a useful tool, since it permits the simultaneous consideration of a wide range of factors. This allows blocking effects to emerge automatically from principles that are independently associated with the particular dataset under analysis. The need for additional assumptions, such as stipulated ordering relations (i.e., markedness of accented pronouns) or a partial blocking rule (i.e., weak optimality) is thereby minimized.

4.4 Schwarzschild (1999) and Bi-Directionality

Given that the selection of a specific ordering relation is a fundamental component of analyses within the BOT framework, it remains to identify a model of prosodic meaning that provides the kind of ordering relations that might apply usefully to the relationship between prosody

³⁶ This is related to the approach taken by Beaver (2004). That proposal, by comparison, assumed an ordering between meanings (i.e., the vertical arrows) based on discourse coherence principles that constrain expressions in the same syntactic positions of neighboring utterances to corefer. The ordering between forms was assumed to follow from the intrinsic markedness of accentuation.

and pronominal reference. While there is potentially a wide range of models that yield similar results, it is argued here that the formal components of Schwarzschild's (1999) model are particularly well-suited to a general formulation of accent meaning within the BOT framework. Not only does that model have demonstrated potential to capture a wide range of traditional focus phenomena, but it stands out as a relatively rare confluence of both a formally rigorous interpretive schema (i.e., Givenness) and a precise mechanism for relating accent patterns to that schema.

One feature of Schwarzschild's model that is particularly appealing is that the principles that govern the relationship between accent patterns and the interpretive component are stated as violable, ranked constraints, following the tradition of standard OT. These constraints together define an ordering relation that is much richer in structure than the simple binary relations that are invoked for the examples in 4.2. This is of particular importance in a BOT analysis that potentially includes a rather large set of candidates within a single derivation. A system of constraints is not only more likely to identify a *unique* optimal candidate from such a large set, but it will also specify an ordered set of 'runners-up'. Unlike in standard OT, highly ranked, but sub-optimal candidates in a BOT model have a formal status as potential candidates for weak optimality.

The results of the previous chapter demonstrated the relevance of a particular notion of entailment between phrases (under existential type-shifting) for the relationship between prosody and pronominal reference. A second important feature of Schwarzschild's (1999) model, then, is that the underlying interpretive principle is a species of anaphora whose condition for antecedence is based on entailment rather than simple morpho-syntactic identity.

Schwarzschild's proposal provides a mapping between two levels of representation, but it is not actually intended as a model of communication. For one thing, the formal representations that the model assumes are not clearly divided into information that only a speaker can observe directly

(i.e., fully specified meanings, or intentions), and information that is directly observable by both the speaker and hearer (i.e., partially underspecified forms). An input in the model, for example, consists of two components: a sentence with a fully specified meaning and a discourse context, which roughly corresponds to the set of previously uttered sentences. In case the former component includes underspecified forms, then its full value is directly observable only by the speaker. By contrast, a discourse context is, by definition, mutually known.

If outputs consisted strictly of hearer-observable information, then Schwarzschild's model could be viewed as a model of production. However, an output in the model is a version of the input sentence that has been enriched with a specification of accent features for terminal nodes, and a specification of F-marking for both terminal and non-terminal nodes. Since accent features have a one-to-one correspondence with (nuclear) pitch accents in the phonological representation, they are equivalent to information that the hearer observes directly. F-features, however, have no one-to-one realization in the phonological representation and bear only an indirect correspondence with accent features. In fact, a given accent pattern may be consistent with more than one pattern of F-marking. Since there is no sense in which a hearer can observe F-marking, it is more properly construed as an underspecified part of the speaker's intention which, along with pronominal reference, a hearer must infer from directly observable aspects of the context. This is consistent with Schwarzschild's own assertion that 'the rules governing F-marking depend on what the speaker *presents* as Given' (p. 151). Since both an input and an output in the model include information that is known only by the speaker, there is no sense in which it represents either production or interpretation.

The previous chapters showed that the mapping provided by Schwarzschild's model can be usefully applied to certain cases of interaction between prosody and pronominal reference. Its application to the key examples in Chapter 3, however, raised the issue of what happens when a

not possible to differentiate between the alternative analyses in the absence of further evidence. However, I suggested that, all else being equal, a theoretically preferable analysis is one in which the relevant blocking effects follow from ordering relations that are, in some sense, intrinsic to the grammar of prosodic meaning. Finally, while Schwarzschild's (1999) model was identified as a promising source of an ordering relation, I showed how that model as currently formulated does not constitute a model of communication, and as such, does not adequately generalize to all cases of interaction between prosody and pronominal reference.

Together, these issues suggest the need for a model of prosodic meaning that is bi-directional, in the sense that it captures both how a speaker chooses a form given an intention, as well as how a hearer chooses an interpretation given a form. Bi-directional Optimality Theory provides a useful starting point in this regard. Not only does that framework model production and interpretation as distinct operations, but it allows blocking effects to emerge automatically. This latter feature addresses the problem associated with selecting between ordering relations. In other words, if relevant blocking effects emerge from ordering relations that are intrinsic to the grammar of prosodic meaning, then the data may be accounted for with the fewest number of assumptions.

In rest of this section, I propose a new model of prosodic meaning. The model is set in the BOT framework and draws heavily on the formal aspects of Schwarzschild (1999). As Schwarzschild's model is not directly compatible with BOT, however, this requires first and foremost a reorganization of formal components of that model to meet the requirements of the framework. In addition, I show how one of the constraints in Schwarzschild's model misses an important generalization, and I suggest a new constraint to replace it. Finally, I apply the new model to several key examples.

4.5.1 Theoretical Assumptions

The model I will propose borrows heavily from the major insights of Schwarzschild (1999). In particular, it preserves *Givenness* as the fundamental interpretive principle associated with nuclear accent patterns. As already mentioned, *Givenness* is assumed to be a species of anaphora that relates particular nodes in a syntactic tree to the (linguistic) contents of the discourse context. As Chapter 2 explains, this essentially means that a node that is interpreted as *Given* introduces the presupposition that it stands in a particular semantic relation to some antecedent expression in the context. The key relation is based on entailment, but since the denotation of a syntactic node in the general case is not a proposition, entailment is evaluated between two LF expressions that have been appropriately type-shifted via existential type shifting. Informally, this was defined in Chapter 2 as the result of filling any unfilled arguments of the denotation of an utterance with free variables and existentially closing the result. The ExClo of the predicate *hit*, for example, is $\exists x \exists y [x \text{ hit } y]$, which includes two existentially closed variables, one for each unfilled argument. Schwarzschild also provides a formal definition of ExClo, which is given in (87).³⁷

- (87) *Existential Type Shift: ExClo*
- a. If $\omega \in D_b$, then $\text{ExClo}(\omega) = \omega$
 - b. For any conjoinable type $\langle a, b \rangle$:
 If $\omega \in D_{\langle a, b \rangle}$, then $\text{ExClo}(\omega) = \lambda w \exists u \in D_a [\text{ExClo}(\omega(u))(w)]$
 - c. t is a conjoinable type.
 If b is a conjoinable type, then so is $\langle a, b \rangle$, for any type a .

Formally, then, the ExClo of *hit*, which is type $\langle e, \langle e, t \rangle \rangle$, is derived as in (88).

³⁷ The definitions presented here are taken directly from Schwarzschild (1999). These definitions may raise various formal issues that remain unaddressed in Schwarzschild's original proposal. Since they do not have obvious consequences for the questions that I am addressing here, I leave them for future work to address.

$$\begin{aligned}
 (88) \quad \text{ExClo}(\text{hit}) = \\
 \lambda w \exists u \in D_e [\text{ExClo}(\text{hit}(u))(w)] = \\
 \lambda w \exists u \in D_e \exists v \in D_e [\text{hit}(u)(v)(w)]
 \end{aligned}$$

The interpretation of Givenness also partly depends on the presence of F-markers. For the purposes of evaluating Givenness, F-markers get interpreted as existentially bound variables. Effectively, this means that the addition of an F-marker to a sub-tree has the effect of weakening the criterion of entailment that Givenness imposes on an antecedent relative to the node of interpretation. As explained in Chapter 2, this can be understood informally as an operation that applies to denotations that have already been existentially type-shifted. The informal definition is repeated in (89).

$$\begin{aligned}
 (89) \quad & \text{Existential F-Closure of } U: \\
 & \text{The result of replacing F-marked phrases in } U \text{ with variables and existentially closing the} \\
 & \text{result, modulo existential type shifting}
 \end{aligned}$$

Formally, Schwarzschild follows Kratzer (1991) in assuming (i) that F-markers in a particular tree are uniquely indexed, and (ii) that a special assignment function h assigns meanings to those indices. As a consequence, an expression is assumed to have two interpretations: one interpretation with respect to the assignment function g , and a second one with respect to g and h . The interpretation rule for expressions containing F-markers is given in (90).

$$\begin{aligned}
 (90) \quad & \text{i. If } \alpha \text{ is F-marked, then:} \\
 & \quad \llbracket \alpha_{f_n} \rrbracket^{g,h} = h(f_n) \\
 & \quad \llbracket \alpha_{f_n} \rrbracket^g = \llbracket \alpha \rrbracket^g \\
 & \text{ii. If } \alpha \text{ has no F-marking, then:} \\
 & \quad \llbracket \alpha_{f_n} \rrbracket^{g,h} = \llbracket \alpha \rrbracket^g \text{ if } \alpha \text{ is not complex;} \\
 & \quad \text{If } \alpha \text{ has components } \alpha_1 \dots \alpha_n, \text{ then } \llbracket \alpha \rrbracket^{g,h} \text{ is the result of applying the semantic rule} \\
 & \quad \text{for } \alpha \text{ to } \llbracket \alpha_1 \rrbracket^{g,h} \dots \llbracket \alpha_n \rrbracket^{g,h}
 \end{aligned}$$

According to (90i), for example, (91a), which includes F-marking on *Bill*, corresponds to (91b), where $h(F1)$ is the individual, not necessarily Bill, that h assigns to the index F1.

- (91) a. $\llbracket bit\ Bill_{F1} \rrbracket^{g,h}$
 b. $\llbracket bit \rrbracket^g(h(F1))$

By comparison, (92a), which instead has F-marking on *bit*, corresponds to (92b), where $h(F2)$ is the relation of type $\langle e, \langle e, t \rangle \rangle$, not necessarily *bit*, that h assigns to the index F2.

- (92) a. $\llbracket bit_{F2}\ Bill \rrbracket^{g,h}$
 b. $(h(F2))(\llbracket Bill \rrbracket^g)$

Schwarzschild points out that (93a) and (93b) will be assigned the same meanings, since h will assign a value to the entire VP node that is irrespective of the pattern of F-marking on its constituents.

- (93) a. $\llbracket bit\ Bill_{F1} \rrbracket_{F3}$
 b. $\llbracket bit_{F2}\ Bill \rrbracket_{F3}$

Givenness is then defined as a property of a node relative to some context and a particular pattern of F-marking. In Chapter 2, an informal definition of Givenness was provided. It is repeated here in (94).

- (94) *Given* (informal version):
 An utterance³⁸ U counts as *Given* iff it has a salient antecedent A and
 a. if U is type e , then A and U corefer
 b. otherwise, modulo existential type shifting, A entails the existential F-closure of U

Schwarzschild also provides a formal definition of Givenness, shown in (95), which will become important later on.

³⁸ By *utterance*, Schwarzschild means something like a syntactic constituent or node, which crucially may be a syntactic subpart of an utterance in the more traditional sense of a complete unit of speech.

- (95) *Given* (formal version)
 An utterance B counts as *Given* iff it has an antecedent A and
 a. if the semantic type of B is e, $\forall \langle w, g \rangle \in c \exists h [\llbracket A \rrbracket^g = \llbracket B \rrbracket^{g,h}]$
 b. if the semantic type of B is conjoinable:
 $\forall \langle w, g \rangle \in c \exists h [\text{ExClo}(\llbracket A \rrbracket^g)(w) \rightarrow \text{ExClo}(\llbracket B \rrbracket^{g,h})(w)]$

To briefly illustrate how the formal definition of Givenness applies, consider the VPs in (96a) and (96b) when the antecedent is assumed to be the VP *bit Bill*.

- (96) a. *bit John_{F1}*
 b. *bit John*

In order for (96a) to count as Given, it must be the case that for all world-assignment function pairs $\langle w, g \rangle$ in the context, there is some h that makes $\text{ExClo}(\llbracket \text{bit John}_{F1} \rrbracket^{g,h})(w)$ true whenever $\text{ExClo}(\llbracket \text{bit Bill} \rrbracket^g)(w)$ is true. In that case, let $\langle w', g' \rangle$ be such that $\text{ExClo}(\llbracket \text{bit Bill} \rrbracket^g)(w')$, shown expanded in (97), is true.

$$(97) \quad \lambda w \exists u \in D_c [\llbracket \text{bit Bill} \rrbracket^{g'}(u)(w)](w')$$

In contrast to (97), the value of $\text{ExClo}(\llbracket \text{bit John}_{F1} \rrbracket^{g',h})(w')$ depends on the value that is assigned to F1. This is shown in (98).

$$(98) \quad \lambda w \exists u \in D_c [\llbracket \text{bit} \rrbracket^{g'}(h(F1))(u)(w)](w')$$

Now let h' be such that it assigns to F1 the entity Bill (denoted by the letter 'b'). In that case, (98) becomes (99), which is true whenever (97) is true.

$$(99) \quad \lambda w \exists u \in D_c [\llbracket \text{bit} \rrbracket^{g'}(b)(u)(w)](w')$$

Thus, (96a) counts as Given in any context for which *bit Bill* is salient.

By contrast, (96b) does not count as Given in such a context. Since (96b) does not include F-marking, its value does not depend on the particular choice of h . In other words, the $\text{ExClo}[\llbracket \textit{hit John} \rrbracket^{g,h}]$ is just (100).

$$(100) \quad \lambda w \exists u \in D_e [\llbracket \textit{hit} \rrbracket^g(j)(u)(w)]$$

More importantly, there is some w' and g' for which (97) is true and $\text{ExClo}[\llbracket \textit{hit John} \rrbracket^{g',h'}(w')]$ is false for every value of h , namely, if w' is a world in which someone hit Bill but no one hit John. Therefore, (96b) does not count as Given in a context in which *hit Bill* is salient.

As explained in 4.4, Schwarzschild's model assumes that F-marking and accent features coexist within the representation of an output (or candidate). The model I propose departs from this assumption in order to establish the strict division between Forms and Meanings that is necessary for a bi-directional treatment. Instead, all aspects of interpretation that are assumed to be underspecified by an utterance are unified within a single representation. For the purposes of modeling accented pronoun effects, this implies that a Meaning is an ordered pair consisting of (i) a sentence that is fully specified for the F-marking status of all its nodes, and (ii) a particular *assignment* of any indices introduced by pronouns in the sentence to individuals in the discourse.

I follow Schwarzschild (and Heim & Kratzer 1998) in assuming that pronouns denote variables, and that each pronoun is therefore associated with an (natural number) index.³⁹ Sentences are interpreted with respect to functions that map indices to individuals in the domain of the

³⁹ This implies that pronouns denote individuals (i.e., are type e). I take this view primarily to preserve consistency with Schwarzschild's model. See Schwarzschild, p. 154, for a discussion of its relevance for the application of Givenness. On the assumption that Givenness could be redefined to accommodate alternative views of pronoun denotation, the choice of a denotation does not appear to have consequences for the model I present here, particularly given that the discussion is confined to free pronouns. If pronouns are assumed to denote identity functions, for example, then a Meaning would simply have to include a specification of an argument for the property or relation of the resulting sentence denotation. Similarly, if pronouns are assumed to denote non-logical functions, then a Meaning may be assumed to include a specification of such a function.

discourse. I also follow Schwarzschild (1999) in assuming that a context consists of a set of the world-assignment function pairs that are consistent with the mutual beliefs of the interlocutors. Utterances may update the context by removing such pairs from the set of mutual beliefs. The effect of an assignment in this case, then, is to remove all world-assignment function pairs for which the assignment function is inconsistent with the assignment. The effect of the assignment $[him_i=Bill]$, for example, is to remove all pairs $\langle w, g \rangle$ for which $g(i) \neq Bill$.

A Form is then everything that *is* directly observable by the hearer. This includes, first of all, a sentence that is specified for accent features on terminal nodes. Crucially, Forms do not include assignments to indices, so any pronouns occurring in a sentence that is part of a Form are essentially underspecified for reference. In addition, I assume that a form includes a representation of the discourse context⁴⁰, which I take to include the set of all sentences that have been uttered *prior* to the current utterance, along with assignments over all indices occurring in those sentences.

Schwarzschild's model assumes that a sentence paired with a selection of antecedent expressions from the context determines a pattern of F-marking and its corresponding accent pattern. At the formal level, then, the model is quite deterministic. At another level, however, the model is much more permissive. F-marking is assumed to "depend on what the speaker *presents* as Given" (p. 151). In a BOT model, the speaker is similarly assumed to freely choose an intention in the form of a Meaning. However, he is limited to expressing only those Meanings that a hearer would be able to recover from the Forms that those Meanings give rise to in production. In other words, a Meaning must converge back on itself in order to be expressible. Thus, the set of

⁴⁰ Typically, contexts are not included as parts of forms in BOT. Instead, the role of context is limited to constraining the way that enrichment pairs are generated by GEN. The constraints that I will propose, however, reference particular correspondences between expressions in a Meaning and expressions in sentences of the discourse. It is not clear at present how GEN might constrain enrichment pairs so that the constraints do not have to make explicit reference to elements of the context.

expressible Meanings is systematically constrained in BOT. This implies that the speaker cannot pick and choose just *any* antecedent(s) from the context, but must consider *all* aspects of the context that the hearer might consider relevant.

In Schwarzschild's model, Givenness is a property of a node in a sentence relative to a context and a pattern of F-marking. Since a context is part of an input in that model, nodes in a candidate representation can be thought of as including a specification for whether they have the property of being Given. As such, it is unproblematic in that model to define Givenness separately from the constraints and let the constraints simply make reference to whether or not that property is true of some node under some pattern of F-marking. In the present model, patterns of F-marking and contexts are parts of distinct structural descriptions (i.e., Meanings and Forms, respectively), so reference by a constraint to both aspects of structure amounts to a statement over correspondences. For that reason, I incorporate the definition of Givenness directly into the constraints that reference it. The constraint GIVENNESS, for example, which in Schwarzschild (1999) is stated as in (101), is somewhat trivially reformulated as in (102).

(101) GIVENNESS: If a constituent is not F-marked, it must be Given

(102) GIVENNESS: If an expression B is not F-marked, then there is some expression A in the discourse context, such that

a. if B is type e, then $\forall \langle w, g \rangle \in c \exists h [\llbracket A \rrbracket^g = \llbracket B \rrbracket^{g,h}]$

b. if B is a conjoinable type, then

$\forall \langle w, g \rangle \in c \exists h [\text{ExClo}(\llbracket A \rrbracket^g)(w) \rightarrow \text{ExClo}(\llbracket U \rrbracket^{g,h})(w)]$

Three other constraints are tentatively adopted from Schwarzschild (1999). These are given in (103) through (105).

- (103) FOC: If an F-marked node is immediately dominated by a non-F-marked node, then it contains an accent⁴¹
- (104) AVOIDF: Do not F-mark
- (105) HEADARG: A head is less prominent than its internal argument

Recall from Chapter 2 that one constraint was stated only implicitly in Schwarzschild's model. It represents the assumption that an accent on a terminal node is always accompanied by F-marking on that node. As before, I adopt this assumption in the form of the constraint in (106).

- (106) ACC→F: An accented node is F-marked.

I follow Schwarzschild (1999) in assuming that GIVENNESS, FOC and ACC→F are inviolable constraints. This implies that they dominate AVOIDF and HEADARG. AVOIDF, in turn, dominates HEADARG. The overall constraint ranking is therefore as shown in (107).

- (107) GIVENNESS, FOC, ACC→F » AVOIDF » HEADARG

4.5.2 Don't Overlook Givenness Possibilities

Despite the many advantages of recasting Schwarzschild's constraint set in a bi-directional framework, such a model does not, in fact, serve to disambiguate pronouns based on accent patterns. To see why, consider again the earlier example from Akmajian & Jackendoff (1970), repeated here in (108).

- (108) i. John hit Bill, and then...
 ii. George_{H*} hit him_{L-}%
 H* L- H* L-L₀%

⁴¹ As mentioned previously, I have restated FOC without reference to the separately defined notion of a *FOC-phrase*.

In a BOT model, establishing the reference of *him* in (108ii) is a matter of determining which Meanings, if any, can be optimally paired with the Form consisting of the utterance and context in the example in (108).⁴²

To determine whether such pairs exist, consider first that in interpretation-optimization, any viable candidate Meaning will necessarily include F-marking on *John* and *Bill*. That is because both of those nodes are accented in (108ii), and $\text{ACC} \rightarrow \text{F}$ rules out any Meanings that do not include F-marking on all accented terminal nodes. Presented in (109) is the *minimal* pattern of F-marking that would satisfy $\text{ACC} \rightarrow \text{F}$.

(109) $\text{George}_F \text{ hit } \text{him}_F$

Notice, furthermore, that the pattern of F-marking in (109) also satisfies GIVENNESS, regardless of which referent is assumed for the pronoun. To see why, consider that the conditions imposed by GIVENNESS depend on the existential F-closure of the ExClo of any non-F-marked nodes. Since *him* is F-marked, however, existential F-closure replaces it with an existentially closed variable. As a result, the reference of *him* in (109) cannot be relevant for the satisfaction of GIVENNESS. Since only the V, VP and IP nodes lack F-marking, checking whether (109) satisfies GIVENNESS is a matter of verifying that the statements in (110) are true.

- (110) a. V: $\exists x \exists y [x \text{ hit } y] \rightarrow \exists x \exists y [x \text{ hit } y]$
 b. VP: $\exists x [x \text{ hit } \text{Bill}] \rightarrow \exists y \exists x [x \text{ hit } y]$
 c. IP: $[\text{John hit Bill}] \rightarrow \exists x \exists y [x \text{ hit } y]$

FOC is also satisfied by the F-marking in (109) independently of the reference of *him*. To see why, consider that *George* and *him* are the only F-marked nodes not immediately dominated by an

⁴² Formally, this also includes a specification of assignments to indices introduced by any pronominal expressions in (108i). In this case, there are no such indices.

F-marked node. Since they are both accented, FOC is satisfied. Identifying the interpretation-optimal meaning therefore comes down to differences in violations of AVOIDF and HEADARG. Notice, however, that any candidate that includes more F-marking than (109) will necessarily incur more violations of AVOIDF. Since AVOIDF is ranked above HEADARG, any such candidate is harmonically bound by candidates like (109). Independent of the reference of *him*, then, any candidate like (109) is interpretation-optimal. As the tableau in (111) illustrates, the two ways of resolving the pronoun, represented by (111a) and (111b), give rise to identical constraint violations. Interpretation-optimization therefore fails to distinguish between the two ways of resolving the pronoun in (108ii).⁴³

(111) Tableau showing constraint violations of interpretation-optimal candidates for example (108)

Input = (108) Context: <i>John hit Bill</i> ; g Utterance: <i>George_F hit him_F⁰</i> H* L- H* L-L ⁰	GIVENNESS	FOC	ACC→F	AVOIDF	HEADARG
(a) [George _F hit him _F]; [<i>him</i> =Bill]				**	
(b) [George _F hit him _F]; [<i>him</i> =John]				**	

Production-optimization does not distinguish between the candidates either. In both (111a) and (111b), the terminal nodes *George* and *him* are F-marked, but not immediately dominated by an F-marked node. FOC therefore requires accents on *George* and *him* in any candidate Forms. If *hit* were accented, then by ACC→F, that node would have to be F-marked. Since it is not, accentuation on *hit* is ruled out. This means that (108ii) is the production-optimal form for both (111a) and

⁴³ A complete structural description of the candidates would include the assignment function h. In the statement of Givenness, however, h occurs only as an existentially bound variable. As such, its value is arbitrary for the structural description of candidate Meanings.

(111b). As a result, the enrichment pairs <108ii, 111a> and <108ii, 111b> are bidirectionally *co-optimal*. In short, the model fails to distinguish between the two ways of resolving the pronoun.

What happened, then, to the intuitive sense that the pair <108ii, 111a> should be blocked by the pair in (112), which incurs one less violation of AVOIDF?

(112)	<i>Meaning:</i>	George _F hit him; [<i>him</i> =Bill]
	<i>Form:</i>	George hit him ⁰ / ₀
		H* L-L ⁰ / ₀

One reason for this difference has to do with the fact that the present bi-directional model separates out variations in form-level descriptions (i.e., accent patterns) from variations in interpretation-level descriptions (i.e., F-marking and pronoun reference). Recall that this was motivated in part by the need to be able to compare candidates with different truth conditions directly. One consequence of this move, however, is that enrichment pairs that differ in *both* their associated Form *and* their associated Meaning are never compared directly. In other words, the enrichment pair in (112) never competes directly with <108ii, 111a>, since the two pairs do not share either a Form or a Meaning. This situation is illustrated by the optimization diagram in (113). As before, points in the diagram represent enrichment pairs taken as the intersection of column and row headings. Crosses in this case mark pairs that are ruled out by one of the inviolable constraints GIVENNESS, FOC or ACC→F. Dotted arrows indicate pairs that are not ordered by the constraint set.

(113)	<i>GEORGE hit him</i>	<i>GEORGE hit HIM</i>
a. George _F hit him _F ; [<i>him</i> =Bill]	✗	• ↑ ⋮ ↓ •
b. George _F hit him _F ; [<i>him</i> =John]	✗	
c. George _F hit him; [<i>him</i> =Bill]	•	✗
d. George _F hit him; [<i>him</i> =John]	✗	✗

Since $\langle \textit{GEORGE hit HIM}; (113a) \rangle$ and $\langle \textit{GEORGE hit him}, (113c) \rangle$ do not share a column or a row, it is not possible for one to dominate the other, and they are unordered as far as the model is concerned. This also means that each pair has the potential to satisfy the conditions for optimality independently of the other. In order to be able to compare candidates along different dimensions of underspecification simultaneously, then, the new model seems to have sacrificed the ability to distinguish between certain candidates merely on the basis of AVOIDF.

According to Schwarzschild (1999), the function of AVOIDF is to maximize the number of anaphoric links between the current utterance and the discourse, but “in a way that preserves a perfect correlation between Givenness and a lack of F-marking” (p. 160). In fact, the idea that there is a tension between the tendency to maximize anaphoric links (AVOIDF) and the need to preserve the informativity of the feature system that marks Givenness (GIVENNESS) is perhaps the most important insight of Schwarzschild’s proposal. Among other advantages, this captures the observation that speakers tend to deaccent Given material whenever possible, and that hearers tend to imbue interpretations with as much Given material as is permitted by the context. Even more importantly, however, it accounts for why Given material (such as a pronoun) is sometimes accented. In Schwarzschild’s words, this happens when “old parts are assembled in new ways. In such cases,

broad F-marking would miss the fact that some parts are old. Complete lack of F-marking would destroy the correlation with Givenness. Equilibrium is reached by F-marking just enough to preserve the correlation, and nothing more” (p. 160). On the one hand, AVOIDF serves an important function in the above derivation, since it rules out candidate Meanings with more F-marking than (111a) or (111b). Given its importance to the original model’s empirical coverage, then, it is important to consider whether AVOIDF as it is currently formulated may be missing an important generalization.

Intuitively, there is a contrast between (111a) and (111b) when considered in the context of (108i).

(108i) John hit Bill, and then...

- (111) a. George_F hit him_F; [*him*=Bill]
 b. George_F hit him_F; [*him*=John]

Roughly, it is the idea that the F-marking on *him* in (111a) is somehow superfluous, since the VP and the IP would count as Given without it. By comparison, the VP and IP in (111b) would not count as Given if *him* were left unmarked.

To see how this generalization might be captured, recall that a node that is interpreted as Given introduces a presupposition that the context includes some expression with which the Given node stands in a particular semantic relation. Specifically, the context must contain some expression that entails (by way of ExClo and F-closure) the Given node. F-markers have the effect of weakening the particular proposition that must be entailed by such an antecedent. In that sense, a pattern of F-marking on a subtree dominated by a Given node is a kind of condition on the discourse context. In other words, if a subtree dominated by a particular node has *less* F-marking, then there are *fewer* possible discourse contexts that would satisfy the condition associated with the

node. If a subtree has *more* F-marking, then there are *more* possible discourse contexts that would satisfy the condition.

Crucially, these conditions are partially ordered. Relative to the same node, in other words, some patterns of F-marking give rise to conditions that entail the conditions associated with other patterns of F-marking. The patterns of F-marking in (114), for example, are associated with the conditions in (115).

- (114) a. George hit Bill
 b. George hit Bill_F
 c. George hit_F Bill
 d. George hit_F Bill_F
- (115) *The context includes some expression A, such that ExClo(A) entails...*
 a. George hit Bill
 b. $\exists x[\text{George hit } x]$
 c. $\exists R[R(\text{Bill})(\text{George})]$
 d. $\exists x \exists R[R(x)(\text{George})]$

Notice that (115a) entails (115b), but not vice versa. Effectively, this means that the set of discourse contexts that satisfy (115a) is a proper subset of the contexts that satisfy (115b). The same may be said of (115b) and (115d), as well as (115c) and (115d). This in turn implies that (115a) is a subset of the contexts that satisfy (115d). Examples (115b) and (115c) stand in no particular relation to each other, however. The different ways of marking the elements of the VP in (114) therefore give rise to a partially ordered set given by (116) and (117), where a pattern of marking to the left of ‘◀’ is consistent with a fewer contexts.

- (116) $\{\text{George hit Bill} \blacktriangleleft \text{George hit Bill}_F; \text{George hit}_F \text{ Bill} \blacktriangleleft \text{George hit}_F \text{ Bill}_F\}$
- (117) $\{\text{George hit Bill} \blacktriangleleft \exists x[\text{George hit } x], \exists R[R(\text{Bill})(\text{George})] \blacktriangleleft \exists x \exists R[R(x)(\text{George})]\}$

One way of thinking about the constraint GIVENNESS is in terms of how it relates the conditions associated with a particular pattern of F-marking to the context. Since non-F-marked nodes are necessarily interpreted as Given, GIVENNESS constrains the set of possible contexts to those that, relative to a particular non-F-marked node, satisfy a condition *at least* as strong as the one associated with the node being evaluated. In other words, the context is *permitted* to satisfy a condition higher on the scale, but it *must* satisfy the one indicated by the pattern of F-marking on the subtree in question. In effect, GIVENNESS enforces a lower bound on the strength of the condition that must be satisfied the context.

Consider what it would mean to impose an upper bound on such a condition. This kind of constraint would say that for a particular node, the context must be such that it does not satisfy a *stronger* constraint than the one associated with the pattern of F-marking on the subtree dominated by that node. Notice that this is not the same as saying that the node is Given. In fact, this requirement assumes nothing about whether the node actually counts as Given in the context. After all, that purpose is already served by GIVENNESS. Instead, it merely requires that the context be *at least as weak* as the condition in question. For now, I will state this constraint informally as in (118)

- (118) DOGP (Don't Overlook Givenness Possibilities)⁴⁴: For a node U, it must not be the case that the context supports a stronger condition on possible antecedents than the one expressed by U⁴⁵

⁴⁴ The choice of names is intended to highlight the similarities between (118) and DOAP (Williams 1997), shown here in (i).

(i) DOAP: Don't overlook anaphoric possibilities. Opportunities to anaphorize must be seized.

DOGP operationalizes the 'seizure' of anaphoric possibilities in terms of both the total number and strength of the associated conditions on antecedents. Williams applies DOAP specifically in the context of the interpretation of accent patterns, though it has also been invoked in OT syntax to account for the relationship between pronominal reference and the selection of referring expressions (see, for example, de Hoop & de Swart (2000)).

⁴⁵ This informal statement of DOGP is trans-derivational, since it makes reference to structural descriptions that belong to alternative inputs (i.e., different patterns of F-marking). The formal statement of DOGP tries to eliminate this issue as much as possible. By restricting the set of values that h may assign to F-indices, this formulation of DOGP avoids the problem of having to operationally 'remove' F-marking from the structural description of the input as suggested by the informal statement. Since the assignments in question are based only on features intrinsic to the input being evaluated, the constraint does not actually reference alternative inputs.

Notice now that (118) distinguishes between (111a) and (111b) in the context of (108i).

(108i) John hit Bill, and then...

- (111) a. George_F hit him_F; [*him*=Bill]
 b. George_F hit him_F; [*him*=John]

If the VP is the node of evaluation, then the partially ordered sets of conditions associated with different ways of F-marking the VP are given in (119).

- (119) a. $\{\exists x[x \text{ hit Bill}] \triangleleft \exists x\exists y[x \text{ hit } y]; \exists x\exists R[R(\text{Bill})] \triangleleft \exists x\exists y \exists R[R(x)(y)] \triangleleft \exists x[P(x)]\}$
 b. $\{\exists x[x \text{ hit John}] \triangleleft \exists x\exists y[x \text{ hit } y]; \exists x\exists R[R(\text{John})] \triangleleft \exists x\exists y \exists R[R(x)(y)] \triangleleft \exists x[P(x)]\}$

Given the pattern of F-marking in (111a) and (111b), GIVENNESS states that the context must include some expression that entails a condition at least as strong as $\exists x\exists y[x \text{ hit } y]$. On that basis alone, the context *may* also include expressions that entail higher or equal elements of the set, namely, $\exists x\exists R[R(\text{Bill})]$ and $\exists x[x \text{ hit Bill}]$ in the case of (119a), and $\exists x\exists R[R(\text{John})]$ and $\exists x[x \text{ hit John}]$ in the case of (119b). Crucially, since neither $\exists x\exists y[x \text{ hit } y]$ nor the conditions lower than it on the scale depend on the value of *him*, the requirement that GIVENNESS imposes on the context does not distinguish between (111a) and (111b).

By contrast, according to DOGP, the context must *not* include an expression that would entail a stronger element on the scale than $\exists x\exists y[x \text{ hit } y]$. Since (111a) and (111b) differ with regard to higher elements of their respective scales, this means that the conditions implied by DOGP exclude different contexts. In particular, (111a) excludes contexts that include expressions whose ExClo entails $\exists x[x \text{ hit Bill}]$, while (111b) excludes contexts with expressions whose ExClo entails

$\exists x[x \text{ bit John}]$. In a context that includes a VP expression like *bit Bill*, then (111a), but not (111b) violates DOGP.

Since AVOIDF ‘dumbly’ adds up the total number of F-markers, it misses the generalization that a particular F-marker might have different consequences for different nodes that dominate it. DOGP, by comparison, evaluates the extent to which a particular F-marker is extraneous for each node separately. In that sense, DOGP constitutes a formal counterpart to GIVENNESS, while preserving the intuitive sense of maximization provided by AVOIDF.⁴⁶

The definition of Givenness provides the means to represent DOGP formally. As with GIVENNESS, (120) incorporates the formal condition for Givenness directly into the statement of the constraint.

(120) DOGP (Don’t Overlook Givenness Possibilities):

For a constituent B, there is no expression A in the discourse context such that

a. if B is type e, then $\forall \langle w, g \rangle \in c \exists h^* [\llbracket A \rrbracket^g = \llbracket B \rrbracket^{g, h^*}]$

b. if B is a conjoinable type, then $\forall \langle w, g \rangle \in c \exists h^* [\text{ExClo}(\llbracket A \rrbracket^g)(w) \rightarrow \text{ExClo}(\llbracket B \rrbracket^{g, h^*})(w)]$,
where h^* assigns to *one or more* indices F_i occurring on some α_{Fi} in B (possibly including B itself) the value $\llbracket \alpha_{Fi} \rrbracket^g$

This formal definition can be applied to the earlier example to establish that (111a) and (111b) have different constraint violations in the context of (108i). Specifically, the F-marking on *him* in (111a) and (111b) may incur either one or three violations of DOGP depending on which value is assigned to *him*.

⁴⁶ In fact, Schwarzschild (1999) initially entertains, and then ultimately rejects, a more fine-grained version of AVOIDF given in (i).

(i) NOVELTY: If a constituent is F-marked, it must not be Given.

On the one hand, (i) suggests a nice counterpart to GIVENNESS, since the two constraints are logical converses of each other. In a bi-directional model, however, NOVELTY faces the same problem that AVOIDF does. Unlike GIVENNESS, which may enforce F-marking on a Given node so that nodes dominating it may count as Given, NOVELTY applies only to nodes that are already F-marked and is therefore not sensitive to the F-marking of nodes below the node of evaluation. In other words, at the level of *him* in both (111a) and (111b), NOVELTY is violated, since *him* is Given regardless of whether it refers to Bill or John. At the level of the VP, however, NOVELTY does not apply, since the VP is not F-marked.

(108i) *John hit Bill, and then...*

- (111) a. [George_{F2} hit him_{F1}]; [*him*=Bill]
 b. [George_{F2} hit him_{F1}]; [*him*=John]

Since both John and Bill are Given in the context, DOGP is violated at the level of the node *him* for both candidates. Consider the case where *him* is assigned to Bill, for example. I assume then, that for all $\langle w, g \rangle \in c$, $\llbracket \text{Bill} \rrbracket^g = \llbracket \text{him}_{F1} \rrbracket^g$. The definition of DOGP says that h^* assigns to one or more F-marked nodes in the subtree *him*_{F1} the same value that g assigns to that node. Since there is only one F-marked node in *him*_{F1}, namely *him*_{F1}, h^* assigns to F_1 the value of $\llbracket \text{him}_{F1} \rrbracket^g$. This implies a violation of (120), however, since it is assumed that $\langle w, g \rangle \in c$, $\llbracket \text{Bill} \rrbracket^g = \llbracket \text{him}_{F1} \rrbracket^g$. An identical argument applies to the case where *him* is assigned to John and A is *John*.

The two ways of assigning values to *him* have distinct consequences for whether the VP incurs a violation of DOGP. In case *him* refers to Bill, the VP incurs a violation of DOGP. To see why, let A be *hit Bill*. I assume again that for all $\langle w, g \rangle \in c$, $\llbracket \text{Bill} \rrbracket^g = \llbracket \text{him}_{F1} \rrbracket^g$. Now consider any w' , $g' \in c$, such that $\text{ExClo}(\llbracket \text{hit Bill} \rrbracket^{g'})(w')$, shown expanded in (121), is true.

$$(121) \quad \text{ExClo}(\llbracket \text{hit Bill} \rrbracket^{g'})(w') = \lambda w \exists u \in D_e [\llbracket \text{hit Bill} \rrbracket^{g'}(u)(w)](w')$$

Since the only F-marker within the VP is F_1 , (120) says that h^* must assign to F_1 the same value that g' assigns to *him*. Relative to (111a) in other words, $h^*(F_1) = \llbracket \text{him}_{F1} \rrbracket^{g'} = \text{Bill}$. In that case, $\text{ExClo}(\llbracket \text{hit him} \rrbracket^{g', h^*})(w')$ is given in (122).

$$(122) \quad \begin{aligned} \text{ExClo}(\llbracket \text{hit him}_{F1} \rrbracket^{g', h^*})(w') &= \lambda w \exists u \in D_e [\llbracket \text{hit} \rrbracket^{g'} (\llbracket \text{him}_{F1} \rrbracket^{g', h^*})(u)(w)](w') \\ &= \lambda w \exists u \in D_e [\llbracket \text{hit} \rrbracket^{g'} (h^*(F_1))(u)(w)](w') = \lambda w \exists u \in D_e [\llbracket \text{hit} \rrbracket^{g'} (\llbracket \text{him}_{F1} \rrbracket^{g'})(u)(w)](w') \\ &= \lambda w \exists u \in D_e [\llbracket \text{hit} \rrbracket^{g'} (b)(u)(w)](w') \end{aligned}$$

Since (122) is true whenever (121) is true, DOGP is violated by the VP in case *him* refers to Bill.

In case *him* is assigned to John, however, the VP node does not incur a violation of DOGP. Suppose A is *hit Bill*. Consider once again any $w', g' \in c$, such that $\text{ExClo}(\llbracket \text{hit Bill} \rrbracket^{g'})(w')$ is true (see (121)). Then (120) says that $h^*(F1) = \llbracket \text{him}_{F1} \rrbracket^{g'} = \text{John}$. In that case, $\text{ExClo}(\llbracket \text{hit him}_{F1} \rrbracket^{g', h^*})(w')$ is given by (123).

$$(123) \quad \lambda w \exists u \in D_c \llbracket \llbracket \text{hit} \rrbracket^{g'}(j)(u)(w) \rrbracket(w')$$

Crucially, (123) is not necessarily true in $\langle w', g' \rangle$. Therefore, the presence of *hit Bill* in the context does not result in a violation of DOGP. In fact, there is no antecedent in the context that would make (120b) true, so DOGP is not violated at the level of the VP when *him* refers to John.

A similar argument would apply to show that DOGP is violated at the level of IP for (111a) based on the F-marking on *him*, but not for (111b). In short, let h^* assign F1 to Bill and F2 to some arbitrary value. Now $\text{ExClo}(\llbracket \text{hit him}_{F1} \rrbracket^{g', h^*})(w')$ is true for every $\langle w', g' \rangle$ that makes $\text{ExClo}(\llbracket \text{hit Bill} \rrbracket^{g'})(w')$ true. The same is not true if h^* assigns F1 to John.

DOGP is not violated at the level of *George* for either candidate since *George* is not coreferential with any expression in the context. In other words, no matter what value h^* assigns to F2, there is no A in the discourse context such that $h^*(F2) = \llbracket A \rrbracket^{g'}$. The final pattern of constraint violations for the two candidates, then, is as shown in the tableau in (124).

(124) Tableau showing constraint violations of interpretation-optimal candidates for example (108) for modified constraint set

Input = (108) Context: <i>John hit Bill</i> , g Utterance: <i>George</i> <i>hit</i> <i>him</i> ⁰ % H* L- H* L-L%	GIVENNESS	FOC	ACC→F	DOGP	HEADARG
(a) [George _{F2} hit him _{F1}]; [<i>him</i> =Bill]				***	
☞ (b) [George _{F2} hit him _{F1}]; [<i>him</i> =John]				*	

Whereas AVOIDF resulted in co-optimality in interpretation-optimization, the modified constraint set selects (124b) as the sole interpretation-optimal candidate. Since DOGP does not distinguish between Forms, the justification for (108b) being the production-optimal Form for (124b) still applies. In other words, the pair in (125) is bi-directionally optimal.

(125) <GEORGE *hit* HIM; [George_{F2} hit him_{F1}], [*him*=John]>

The bi-directional tableau in (126) illustrates how the new model selects (125) as the unique bi-directionally optimal candidate. As the full tableau in this case would include 8 rows and 64 columns, only a representative sample of candidates is provided. The symbol ‘☞’ indicates candidates that are (merely) production-optimal, while ‘☞’ indicates candidates that are bi-directionally optimal.⁴⁷ Grey indicates candidates that are blocked on the basis of being dominated in interpretation-optimization. Recall from the definition in (83) that a candidate cannot be (bi-directionally) optimal if it is dominated by a candidate that pairs the same Form with a different Meaning. In other words, the form *GEORGE hit HIM* is blocked from being used to express the Meaning in the first column, in spite of the fact that it is (one of the) production-optimal candidates

⁴⁷ In this case, there are no pairs that are interpretation-optimal without also being bi-directionally optimal.

for that Meaning. Notice that all remaining candidates incur at least one violation of either GIVENNESS, FOC, or ACC→F, which are assumed to be inviolable in this model.

(126) Bi-directional tableau illustrating blocking of an enrichment pair in which accented *him* in (108b) corefers with *Bill*

Forms: (Context= <i>John hit Bill</i>) ↓		GIVENNESS	FOC	ACC→F	DOGP	HEADARG		GIVENNESS	FOC	ACC→F	DOGP	HEADARG		GIVENNESS	FOC	ACC→F	DOGP	HEADARG
<i>George hit HIM</i>			*		***				*		*				*	*		
<i>GEORGE hit HIM</i>	☞				***		☞				*					*		
<i>GEORGE HIT HIM</i>				*	***	*				*	*	*				*		*
<i>GEORGE hit him</i>			*		***				*		*			☞				
Meanings ⇒	George _F hit him _F ; [<i>him</i> =Bill]						George _F hit him _F ; [<i>him</i> =John]						George _F hit him; [<i>him</i> =Bill]					

I have not yet shown that unaccented *him* in (127b) is constrained to refer to Bill.

- (127) i. John hit Bill, and then...
 ii. George hit him%
 H* L-L%

As shown by the rightmost column in (126), only Meanings for which *him* is assigned to Bill satisfy all inviolable constraints relative to (127b). Consider, first of all, that if in some candidate meaning for (127b), any of *him*, *hit* or the VP bears F-marking, then FOC would require accentuation on at least one of *hit* or *him*. Since that is not the case, then any viable candidate must not include F-marking on those nodes. Now consider the case where *him* refers to John. Since there is no F-marking on or within the VP, GIVENNESS requires that there be some antecedent A in (127a),

such that $\text{ExClo}(A)$ entails the proposition $\exists x[x \text{ hit John}]$. This is clearly not satisfied by the VP *hit Bill*, since $\text{ExClo}(\text{hit Bill}) = \exists x[x \text{ hit Bill}]$. Therefore, GIVENNESS is violated at least once when *him* is assigned to John. If *him* refers to Bill, on the other hand, GIVENNESS requires that $\text{ExClo}(A)$ entail the proposition $\exists x[x \text{ hit Bill}]$, which is clearly satisfied by the VP *hit Bill*. Thus, GIVENNESS is not violated at the level of the VP when *him* is assigned to Bill. Finally, $\text{ACC} \rightarrow \text{F}$ eliminates candidate Meanings that do not include F-marking on *George*. This leaves (128) as the only Meaning that satisfies all inviolable constraints.

(128) George_F hit him; [*him*=Bill]

It is also the case that (127ii) is the production-optimal Form relative to (128). Since *George* is F-marked but not dominated by an F-marked node, then according to FOC it must be accented. If either *hit* or *him* is accented, then $\text{ACC} \rightarrow \text{F}$ would be violated, since those nodes are not F-marked in the input. This eliminates all candidates besides (127b). The pair in (129) is therefore bi-directionally optimal in the current model.

(129) $\langle \text{GEORGE hit him}, \text{George}_F \text{ hit him}, [\text{him}=\text{Bill}] \rangle$

4.5.3 Further Applications of the Model

In the previous section, I showed how the new model successfully predicts the alternation in pronominal reference associated with Akmajian & Jackendoff's (1970) example. In this section the model is applied to two additional cases. The first of these involves examples like those discussed in Chapter 3, which involved subject pronouns whose reference depends on the entailment properties

of a clausal embedding construction. The second case involves the classic example noted by Lakoff (1971), in which utterances with two ambiguous pronouns are related by a transitive verb that is not explicitly Given in the context.

A traditional BOT analysis would include bi-directional tableaux similar to that in (126). Since the candidate sets are very large, however, it would not be particularly instructive to represent the application of the model in this way. Indeed, I could appeal to harmonic boundedness to reduce the size of the tableaux by eliminating candidates that violate highly-ranked constraints. In my opinion, however, such an analysis obscures the more intuitive aspects of the various constraints and their ranking. Instead, in the following subsections I provide informal prose analyses, which establish the optimality of candidates by way of elimination. Since the observed phenomena involve minimally paired patterns of accentuation, each analysis begins by considering a Form from the perspective of interpretation-optimization. This step identifies all candidate Meanings that are optimal interpretations for a Form. This step, in and of itself, does not guarantee bi-directional optimality, since some or all of the identified Meanings may not map onto that same Form in production-optimization. The second step, then, is to apply production-optimization to any Meanings that are identified through interpretation-optimization. If the original observed Form is returned as the production-optimal candidate, then it must be the case that the resulting pair satisfies the conditions for bi-directional optimality. If a different Form is returned, then the original pair is not a valid output of the model.

Crucially, this method of analysis identifies all bi-directionally optimal pairs that are associated with a particular Form. All other optimal pairs are, by definition, associated with distinct Forms. Since the purpose of the analysis is to distinguish between values of the pronoun based on a

particular set of observed Forms, this means that all optimal pairs not identified by this method are irrelevant to the examples being analyzed.

4.5.3.1 Experiment 2 Results

The crucial result of Experiment 2 is that participants showed a strong preference for *he* to refer to the matrix subject in examples like (130), but showed a significantly weaker preference for a matrix reading in examples like (131).

- (130) i. At the hotel check-in counter, Alex reminded Roger to ask for the executive suite.
 While ordering room service that night...
 ii. he made a request%
 H* L-L%
- (131) i. At the hotel check-in counter, Alex implored Roger to ask for the executive suite.
 While ordering room service that night...
 ii. he made a request%
 H* L-L%

As Chapter 3 shows, Schwarzschild's model predicts this outcome based on the assumption that listeners can reason by hypothesis from the values of pronouns to the outputs of production. Since a bi-directional model provides a formal mechanism for representing such inferences, it is important to show that the new model successfully predicts the interpretational differences revealed by Experiment 2 for examples like (130) and (131).

As before, I assume that the lexical semantics of English are such that an instance of imploring someone to do something and an instance of asking for something both count as an instance of making a request. In other words, I assume that the entailment relations in (132) hold.

- (132) a. $\exists x \exists y [A \text{ implored } x \text{ to do } y] \rightarrow [A \text{ made a request}]$
 b. $\exists x [A \text{ asked for } x] \rightarrow [A \text{ made a request}]$

Also as before, I follow Schwarzschild (1999) in assuming that tense is ignored for the purposes of evaluating Givenness. It follows from (132) then, that the embedded clauses in (130i) and (131i) entail the ExClo of *made a request*, as illustrated in (133).

- (133) $[\text{Roger ask for the executive suite}] \rightarrow \exists x [x \text{ made a request}]$

Crucially, the matrix clause in (130i), but not that in (131i), entails the proposition $[\text{Alex made a request}]$. In other words, the entailment in (134b) holds, but that in (134a) does not.

- (134) a. $[\text{Alex reminded Roger to ask for the executive suite}] \rightarrow [\text{Alex made a request}]$
 b. $[\text{Alex implored Roger to ask for the executive suite}] \rightarrow [\text{Alex made a request}]$

Turning first to the interpretation-optimization of (130ii/131ii), most candidates can be eliminated by considering a few constraints. ACC \rightarrow F, for example, rules out all candidates that exclude F-marking on *he*. Furthermore, candidates that include F-marking on *made, a request*, or the VP are ruled out, since FOC would require an accent on either *made* or *a request* in that case. This leaves the four candidates in (135).

- (135) a. $he_F \text{ made a request; } [him=Alex]$
 b. $he_F \text{ made a request; } [him=Roger]$
 c. $[he_F \text{ made a request}]_F; [him=Alex]$
 d. $[he_F \text{ made a request}]_F; [him=Roger]$

All candidates in (135) also satisfy GIVENNESS irrespective of the discourse context (i.e., either (130i) or (131i)). Since *he* is F-marked, GIVENNESS requires only that some antecedent entail the

proposition $\exists x[x \text{ made a request}]$. This is satisfied by the ExClo of the embedded VP in both (130i) and (131i), as well as by the ExClo of the matrix VP in (131i).

The remaining candidates are distinguished by DOGP, but in a way that crucially depends on which context is assumed. In the context of (130i), for example, the pattern of DOGP violation is as in (136).

(136) Pattern of DOGP violation for top interpretation candidates of (130ii)

Input: (130ii) <i>HE made a request</i> Context: (130i) <i>Alex reminded Roger to ask for the executive suite</i>	DOGP
(a) he_F made a request; [$he=Alex$]	*
(b) he_F made a request; [$he=Roger$]	**
(c) [he_F made a request] _F ; [$he=Alex$]	**
(d) [he_F made a request] _F ; [$he=Roger$]	**

Regardless of the reference of *he*, the F-marking on that node incurs one violation of DOGP, since either way, *he* is coreferential with some expression in the context. (136b) and (136d) also incur a violation of DOGP at the level of IP, however. That is because if *he* refers to Roger, then the ExClo of the embedded clause in (130i) entails the IP when h^* assigns $\llbracket he \rrbracket^g$ to F. In other words, [*Roger ask for the executive suite*] entails [*Roger made a request*]. Finally, (136c) incurs a violation of DOGP at the level of IP due to the F-marking on IP itself, since the F-marking on *he* is sufficient for its F-closure to be entailed by the embedded clause in (130i). (136a) is therefore interpretation-optimal for (130ii) in the context of (130i).

It is also the case that (130ii) is production-optimal relative to (136a). Consider that since *he* in (136a) is F-marked but the IP is not, then FOC requires an accent on *he*. Since there is no other

F-marking in (136a), then if additional nodes were accented, $ACC \rightarrow F$ would be violated. Thus, the pair consisting of (130ii) and (136a) is (uniquely) bidirectionally optimal in the context of (130i), and the model predicts that Alex is the only possible referent of *he* in that context.

As the table in (137) shows, the pattern of DOGP violation is slightly different in the context of (131i), so that either Alex or Roger is predicted to be a possible referent of *he*.

(137) Pattern of DOGP violation for top interpretation candidates of (131ii)

Input: (131ii) <i>HE made a request</i> Context: (131i) <i>Alex implored Roger to ask for the executive suite</i>	DOGP
(a) he_F made a request; [$he=Alex$]	**
(b) he_F made a request; [$he=Roger$]	**
(c) [he_F made a request] _F ; [$he=Alex$]	***
(d) [he_F made a request] _F ; [$he=Roger$]	***

In contrast to the previous case, all four candidates incur a violation of DOGP at the level of the IP. Because of the entailment possibilities in (138), the IP is entailed by some element of the context given that h^* assigns $\llbracket he \rrbracket^g$ to the index associated with he_F , regardless of the value associated with *he*.

- (138) a. [Alex implored Roger to ask for the executive suite] \rightarrow [Alex made a request]
 b. [Roger asked for the executive suite] \rightarrow [Roger made a request]

As before, (137c) and (137d) incur an additional violation at the level of IP due to the extra F-marking on that node. This leaves (137a) and (137b) as the two co-optimal Meanings for (131ii) in interpretation-optimization.

In production-optimization, FOC requires an accent on *he* regardless of the assignment. Since additional accents would lead to violations of $ACC \rightarrow F$, (131ii) is production-optimal for both

(137a) and (137b). The enrichment pairs <131ii, 137a> and <131ii, 137b> are therefore bi-directionally co-optimal in the context of (131i). The model therefore accords with the results of Experiment 2 in predicting that *he* in (130ii) is constrained to refer to Alex, but *he* in (131ii) is free to refer to either Alex or Roger. In contrast to Schwarzschild's model, the current model does not predict that the two ways of resolving the pronoun in (131ii) will equivalently result in infelicity. Rather, both possibilities are predicted to be legitimate readings of (131ii).

4.5.3.2 Lakoff's (1971) Example

The model also has important consequences for the well-known examples from Lakoff (1971) repeated in (139) and (140).

- (139) i. John called Bill a Republican, and then...
 ii. he insulted him%
 H* L-L%

- (140) i. John called Bill a Republican, and then...
 ii. he|| insulted him%
 H* L- H* L-L%

Lakoff points out that resolving the pronouns in such examples seems to be closely tied to the hearer's beliefs about the world. In addition to the observed alternation in the reference of the pronouns, in other words, (140ii) seems to presuppose that calling someone a Republican counts as a form of insult, whereas (139ii) requires no such belief. The exact nature of the link between prosodic form, pronominal reference and the particular beliefs that are in play in (139) and (140) are poorly understood. From an interpretation perspective, for example, it is an open question whether

the alternation in accent pattern directly constrains the reference of the pronouns, or whether that effect is indirectly mediated by the effect of the prosodic pattern on mutual beliefs.

The present model is particularly well-suited to an exploration of this question for two reasons. First of all, it has demonstrated potential to make specific predictions for the interaction between accent patterns and the reference of pronouns. In addition, the predictions of the model largely depend on what entailments are assumed to hold in a particular context, since those assumptions have important consequences for the evaluation of candidates relative to the constraints GIVENNESS and DOGP. Notice that the contrast in what is presupposed by (139ii) versus (140ii) amounts to whether or not the statement in (141) is a belief mutually shared by the interlocutors.

$$(141) \quad \forall \langle x, y \rangle [(x \text{ called } y \text{ a Republican}) \rightarrow (x \text{ insulted } y)]$$

In other words, the predictions that the model makes for the relationship between accent patterns and pronominal reference potentially depend on whether or not the interlocutors mutually believe that calling someone a Republican counts as a form of insult. This dependency can be tested by fixing whether not (141) is included in the belief set. If (141) is part of the mutual belief set, then the entailments in (142) follow by inference.

$$(142) \quad \begin{array}{ll} \text{a. } \exists x \exists y [x \text{ called } y \text{ a Republican}] \rightarrow \exists x \exists y [x \text{ insulted } y] \\ \text{b. } \exists x [x \text{ called Bill a Republican}] \rightarrow \exists x [x \text{ insulted Bill}] \\ \text{c. } \exists x [\text{John called } x \text{ a Republican}] \rightarrow \exists x [\text{John insulted } x] \\ \text{d. } [\text{John called Bill a Republican}] \rightarrow [\text{John insulted Bill}] \end{array}$$

I begin by identifying the pattern of reference that is predicted for (140ii) for a context in which (141) is included in the mutual belief set. Since *he* and *him* are accented in (140ii), the minimal

pattern of F-marking that satisfies $\text{ACC} \rightarrow \text{F}$ includes F-marking on those two terminal nodes. The two Meanings that result from such a pattern are shown in (143).

- (143) a. he_F insulted him_F ; [he =John, him =Bill]
 b. he_F insulted him_F ; [he =Bill, him =John]

Both (143a) and (143b) satisfy GIVENNESS. Due to the F-marking on *he* and *him*, the conditions imposed by GIVENNESS are the same for all non-F-marked nodes. In other words, the verb, the VP and the IP all require that there be some antecedent, the ExClo of which entails $\exists x \exists y [x \text{ insulted } y]$. Based on (142), this is satisfied by the predicate, the VP and the IP respectively, in (140i).

Both (143a) and (143b) also satisfy FOC. *He* and *him* are the only F-marked nodes not dominated by F-marking, so FOC only requires that those nodes be accented in the Form-side input, which is the case in (140ii).

The remaining candidates are distinguished by DOGP. Specifically, (143b) violates DOGP only twice, whereas (143a) violates DOGP four times. Both candidates violate DOGP twice at the level of the terminal nodes *he* and *him*, since regardless of the assignment, both *he* and *him* are coreferential with some antecedent whenever h^* assigns to indices to the same value that g does. The candidate in (143a) also violates DOGP at the level of the VP and at the level of the IP. At the level of VP, h^* assigns *him* to Bill, in which case $\text{ExClo}(\llbracket \text{insulted } \text{him}_F \rrbracket^{g, h^*})$ is entailed by the ExClo of the VP in (140i). In other words, $\exists x [x \text{ called Bill a Republican}]$ entails $\exists x [x \text{ insulted } \text{him}]$ whenever *him* is assigned to Bill, which is prohibited by DOGP. A similar argument applies to the IP. If h^* assigns either *he* to John, or *him* to Bill, or both, then it is also the case that $\text{ExClo}(\llbracket \text{he}_F \text{ insulted } \text{him}_F \rrbracket^{g, h^*})$ is entailed by the ExClo of the IP in (140i). The candidate in (143b) is therefore the interpretation-optimal Meaning for (140ii) when (141) is assumed to be in the set of mutual beliefs.

It is trivial to show that (140ii) is production-optimal for (143b). Any Form that does not include accents on *he* and *him* violates FOC, while any Form that includes an accent on *insulted* violates ACC→F. The pair in (144) is therefore bi-directionally optimal in the context of (140i) when (141) is part of the mutual belief set.

(144) <HE insulted HIM; he_F insulted him_F, [*he*=Bill, *him*=John]>

In case (141) is not in the mutual belief set, the model predicts that (139ii) is consistent with either pattern of reference. The two Meanings in (145) are optimally paired with (139ii). Both Meanings have different patterns of F-marking, but since the pronouns are associated with different values, they incur equal violations of DOGP.

(145) a. he insulted_F him; [*he*=John, *him*=Bill]
 b. [he [insulted_F him]_F]_F; [*he*=Bill, *him*=John]

Interestingly, this result implies that the accent pattern in (139ii) does not constrain the pronouns to a particular assignment. Crucially, it also implies that each assignment is uniquely associated with a particular pattern of F-marking. In practical terms, this means that (139ii) may be used to express the proposition that Bill insulted John, but *only* if it is acceptable, given the communicative goals, that the correspondence between the VPs and the IPs of the adjacent clauses be ignored.

Perhaps more importantly, this result suggests that utterances like (139ii) are ambiguous unless additional cues are present. These cues might come in one of two forms, however. On the one hand, a set of non-prosodic cues might indicate the values of the pronouns directly. According to (145), this would have consequences for the pattern of F-marking. On the other hand, a set of cues might serve to indicate which pattern of F-marking is intended. Since (145) establishes a one-

to-one correspondence between F-marking and pronominal reference, this means that such cues would indirectly specify the values of the pronouns.

4.6 Conclusion

In this chapter, I have proposed a model that relates the locations of nuclear accents in an utterance to a particular type of anaphoric presupposition. The particular features of the model were motivated by, first of all, a demonstrated need to give a formal expression to the kinds of inference that intuitively seem to govern the relationship between prosody and pronominal reference. This was shown to require a model that (i) provides distinct mechanisms for both interpretation-oriented as well as production-oriented optimization processes, and (ii) permits the simultaneous optimization of interpretive possibilities along multiple dimensions of underspecified meaning. Bi-directional Optimality Theory was then identified as a useful formal framework in both regards.

The model of focus projection proposed in Schwarzschild (1999) was identified as a promising source of an ordering relation. Since that model is incompatible with the BOT framework, however, several innovations were proposed to address this issue. First of all, the formal elements of the model were reorganized, so that Forms consist of only and all aspects of the utterance situation that are directly observable by the hearer, while Meanings instantiate values along the dimensions of meaning that the hearer cannot observe directly. In addition, the constraint responsible for maximizing anaphoric content in Schwarzschild's model (i.e., AVOIDF) was shown to miss an important generalization in the context of a bi-directional model. It was replaced with a constraint (DOGP) that is sensitive to the inherent scalar structure that is associated with the interpretation of F-markers vis-à-vis Givenness.

The primary result of the new model is that several cases of accented pronoun effects are accounted for automatically. An additional motivation for the new model is to be able to compare the effects of different ordering relations, with the goal of minimizing the number of theoretical assumptions needed for any given analysis. The new model, in fact, reveals that the key examples can be accounted for without assumptions that are external to the model of prosodic meaning itself.

There are several additional advantages of the model that are outside the scope of this dissertation, and are therefore not fully explored in the context of this proposal. For one thing, the assumption that speakers freely choose an intended Meaning implies that they are permitted to include more accentuation than is strictly called for in the context. In essence, the model freely permits ornamental, or emphatic, accentuation, in accord with the observation that speakers may opt to express (147a), which corresponds to the accent pattern in (147b), rather than (148a) in the context of (146).

(146) What did Claire drink?

(147) a. [she]_F [drank]_F [tea]_F
 b. She drank tea%
 H*L- H*L- H* L-L%

(148) a. she drank tea_F
 b. She drank tea%
 H* L-L%

Such a choice may follow from communicative goals outside the domain of information structure itself. In the general case, I assume that a speaker uses the interpretation of F-marking to structure the discourse in way that best serves the communicative goals at hand. As the present study is concerned only with the relationship of F-marking to accent patterns, and the various inferences that this relationship gives rise to, the specific characterization of those communicative goals and

their interaction with the choice of F-marking are outside the purview of this study. The assumption, however, is that these are highly ranked constraints that guide the intentions of the speaker in terms of which specific discourse contexts (either explicit or implicit) he wishes to make manifest via a pattern of F-marking. Such constraints then have the potential to interact with other constraints, either stochastically (see for example, Boersma & Hayes 2001), or via forced reranking based on context-specific factors (Pierrehumbert 1993). As an example of the latter, a specific communicative circumstance may cause a speaker to place a value on speaking emphatically. The constraints guiding the choice of F-marking would then temporarily be reranked below some constraint specifying that all words must be nuclear accented. The result is that the speaker would produce a pattern like (147) at the expense of signaling anaphoric links to the context, which may have otherwise been preferable.

Since Schwarzschild (1999) assumes that speakers freely choose a set of antecedents from the context, that model also permits ornamental accentuation. Somewhat problematically, however, the same assumption implies that a speaker is free to express (150a) in the context of (149) using the accent pattern in (150b).

(149) What did Claire drink?

- (150) a. she [drank_F tea_F]_F
 b. She drank tea⁰_%
 H* L-L⁰_%

The present model, by contrast, rules out (150a) as an interpretation of (150b) in the context of (149), since interpretation-optimization always forces the hearer to maximize the number and strength of the anaphoric relations between the utterance and the context.

In all of the applications of the model covered in this chapter, the availability of antecedents for any particular anaphoric presupposition introduced by the model was highly controlled. As the previous chapter shows, however, there may be multiple antecedents available in a context, and how an antecedent is chosen can have important consequences for other aspects of the interpretation. What this model does not provide, then, is a mechanism for determining which expressions may count as antecedents for any particular node that is marked as Given (i.e. one that is not F-marked).

Chapter 5

Conclusion

In this chapter, I provide an overview and evaluation of the approach that was used in this investigation. I begin in 5.1 by discussing the findings of the component studies in connection with the stated research goals. In Section 5.2, I discuss the implications for the findings for questions and issues beyond the stated research goals, including for example, the validity of the assumptions associated with the switching approaches, as well as the significance of bi-directional models of communication for understanding the role of underspecification. Finally, in Section 5.3, I review several issues that are not addressed by this investigation and suggest a plan for further study.

5.1 Overview of the Findings

The primary goal of this investigation was to explore the relationship between prosodic form and pronominal reference. The inspiration for this line of inquiry comes from a rather narrowly-defined, but robust phenomenon whereby specific prosodic patterns appear to covary with the preferred reference of otherwise ambiguous pronouns. I then raised the question whether such effects can be explained by a general theory of prosodic meaning, or whether it is necessary to posit additional principles that are specifically tailored to the apparent covariation between accentual status and pronominal reference. This question provided the motivation for a two-pronged empirical approach involving a consideration of the discourse factors governing pronoun accentual status in production, as well as those governing the interpretation of pronouns in perception.

In Chapter 2, I first showed how a particular class of models, referred to here as *attentional* models, predict the accentual status of a pronoun based on whether or not it refers in a way that preserves the status of its referent in an attentional model of the discourse (Kameyama 1999, Beaver 2004). I then established that the model of the meaning of accent patterns found in Schwarzschild (1999) predicts accents on pronouns independently of factors associated with attentional models. Crucially, it was shown that in contrast to attentional models, the predictions of Schwarzschild's model are entirely independent of expression type (i.e., pronoun versus non-pronoun).

Given the putative independence of the factors deemed relevant by each set of models, the next step was to identify cases where the associated predictions can be shown to diverge. Four classes of cases were identified, which together represent an independent manipulation of the contextual factors associated with each type of model. These examples were then used in a production experiment designed to empirically test each set of predictions in a way that permitted direct comparison of the extent to which pronouns were accented across the four classes of cases. The most important finding is that Schwarzschild's (1999) model successfully predicts accentuation of pronouns in its own right, independently of the discourse factors deemed necessary by attentional models. In other words, target pronouns in the experiment were accented when (i) Schwarzschild's (1999) model predicts they should be accented and (ii) attentional models predict the same pronouns should be unaccented. This effect was robust, with target pronoun accentuation rates near the experimental ceiling as estimated by two control conditions.

In a related experimental condition, attentional models predict that target pronouns should be accented, whereas Schwarzschild's model predicts optional accentuation based on a potential ambiguity with respect to information structure. While the rate of accentuation was greater than when both models predict no accentuation, it was significantly below the experimental ceiling. This

result is not consistent with a model that predicts accentuation to be obligatory. It was therefore concluded that attentional models do not account for pronoun accentual status independently of the role of information structure, and that the moderate rates are most likely attributable to the optionality associated with Schwarzschild's model. These findings, then, not only provide a conclusive answer to the question of which approach better predicts pronoun accentuation in production, but they provide strong support for the idea that a generalized approach is sufficient to account for the observed dependence between prosody and pronominal reference.

Chapter 3 addressed a related question from the perspective of interpretation. However, the class of proposals under consideration was extended to all proposals that assume a reference 'switching' effect for accents that occur on pronouns. This includes not just Kameyama (1999) and Beaver (2004), but also Solan (1983), Smyth (1994), and Clark & Parikh (2007), among others. It was shown that a particular type of inference based on Schwarzschild's (1999) model makes predictions for the reference of pronouns under a particular (i.e., narrow) accent pattern. These predictions are not only independent of the so-called switching models, but actually run counter to the notion of a reference switch in certain contexts. Two perception experiments tested listeners' preferences for the reference of pronouns in such contexts. One condition tested the preferred reference of unaccented pronouns as a way of establishing a baseline against which to evaluate the presence of a switch. A second condition tested the preferred reference of pronouns for cases where the notion of a switch conflicts with the predictions based on Schwarzschild's model. The results strongly suggest a rejection of the idea that accents on pronouns give rise to a switch from some default reference. Instead, listener preferences straightforwardly reflected, both qualitatively and quantitatively, the predicted reference according to factors based on the information structural properties of the context.

The results of the production study presented in Chapter 2 and the two perception studies in Chapter 3 provide strong support for the idea that a generalized model of the meaning of nuclear accent patterns is sufficient to account for the observed correspondence between prosodic patterns and pronominal reference. Moreover, the results show that the various switching proposals are not sufficient to explain that correspondence. These findings instead call for a much more explicit treatment of the data according to the generalized approach.

Chapter 4 directly addresses the problem of identifying a sufficiently explicit generalized model of the relationship between prosody and pronominal reference. First, it was shown that an analysis of the key examples can be explained in terms of a particular class of inferences on the part of the speaker and the hearer. This type of analysis requires that productive and interpretive processes be represented in a single model of communication. Schwarzschild's (1999) theory was identified as a promising starting point for building such a model within the framework of Bi-directional Optimality Theory. As it is formulated, however, Schwarzschild's theory was shown to be problematic, since the formal objects that it assumes are not organized in a way that permits modeling of bi-directional inferences. A new model was proposed to address these formal issues. In addition to preserving the basic insights and empirical coverage of Schwarzschild's theory, this model provides for a fully formal representation of the inferences that are required for relating prosodic patterns to pronominal reference. This required, among other modifications, that the basic formal elements of Schwarzschild's model be reorganized to meet the assumptions of the Bi-directional Optimality Theoretic framework. In addition, a new constraint was proposed to capture the intrinsic scalar structure associated with the notion of Givenness in Schwarzschild's model.

The new model was shown to account well not only for the key examples presented in Chapter 1, but also for the class of examples used in the perception experiments in Chapter 3. That

a single theory accounts both for the placement of accents in the general case, as well for a wide range of effects associated with pronominal reference, provides excellent support for the guiding hypothesis of this investigation. In other words, the overall investigation was successful in that a generalized approach was found to be not only sufficient, but also necessary, to account for the relationship between prosody and pronominal reference.

5.2 Implications of the Findings

One of the underlying assumptions of the switching approach is that pitch accents have an interpretation that is specific to their occurrence on pronouns. This is generally assumed to be in addition to their usual interpretation in a model of information structure. This assumption appears to be motivated specifically by data showing a covariation between prosody and pronominal reference. Given that the findings of this investigation point to a rejection of the switching approach, then, there is little reason to retain such an assumption.

A second key assumption underlying the various specialized proposals is that pronouns are somehow special with regard to accentuation, or that accentuation on a pronoun is somehow marked. While the justification for this assumption is not evident from the proposals themselves, it was put forward that its origins may lie with the suggestion of Ladd (1980), Selkirk (1995a), German et al. (2006) and others, that function words are inherently poor carriers of prosodic prominence and are therefore dispreferred as the locus of pitch accentuation. As discussed in Chapter 2, however, the assumption that accentability is associated with the content-function distinction is not supported by the findings of Experiment 1. In contrast to the findings of German et al. (2006), which showed that prepositions are unlikely to carry pitch accents even when the result is suboptimal from the

standpoint of information structure, pronouns in this study showed no such tendency to resist accentuation, but were accented at very high rates in three out of four conditions.

Note that this does not imply that pitch accents are not marked in a general sense. After all, if pitch accents are assumed to be morphemes (Pierrehumbert & Hirschberg 1990, *inter alia*), then the addition of a pitch accent may be equated with increased morpho-syntactic complexity, and therefore, with relative markedness. Instead, the current findings merely suggest that such an assumption is not directly relevant to the inferences associated with the relationship between prosody and pronominal reference.

Finally, Chapters 3 and 4 underscore the importance of modeling production and interpretation as distinct processes. In Chapter 4, this was given a formal expression within the framework of BOT for the case of prosody and pronominal reference specifically. While BOT has previously been applied successfully to other cases of underspecification (e.g., quantifier scope ambiguity (Blutner et al. 2006)), the relationship between prosody and pronominal reference represents a special case, since it simultaneously involves two dimensions of underspecification (i.e., pronoun ambiguity and focus projection ambiguity). Natural language utterances typically are not confined to including one type of underspecification at a time. In that sense, the present application of bi-directional modeling represents a novel and promising extension of the general framework.

5.3 Remaining Issues

5.3.1 The Role of Tune

The results of the production experiment in Chapter 2 partly addressed the role of accent type in marking pronouns. The vast majority of pitch accents occurring on pronouns in all conditions were coded as H*. While the nature of the prosodic contexts used may have masked the presence of a preceding low tone for the qualitative analysis, a set of detailed quantitative acoustic analyses revealed that whatever accent type was being produced, it is very likely that the *same* type was being used across the experimental conditions.

The analysis presented here follows Pierrehumbert & Hirschberg (1990) in assuming that the interpretation of accent placement is an independent layer upon which the interpretation of tune is overlaid. In order to more narrowly address the role of nuclear accent placement, the perception experiments in Chapter 3 used a single pitch accent type (H*), which was found to give rise to robust effects relative to pronominal reference. In that sense, the findings confirm that the use of H* is sufficient to establish the predicted covariation between pronominal reference and the interpretation of prosodic patterns. Future work will need to explore whether other accent types give rise to similar effects, as well as whether different accent types are associated with different felicity conditions independently of their effects on reference.

Finally, the present study does not address the role of phrasal tune type. The utterances produced by speakers in Experiment 1 were overwhelmingly characterized by a final L-L% boundary tune, while there was somewhat more variation in the boundaries that immediately preceded the targets. Boundary tunes are generally thought to be associated with the relationship of an utterance and its meaningful units to the mutual beliefs of the interlocutors (Pierrehumbert &

Hirschberg 1990, Steedman 2002, *inter alia*). On the view presented here, the specific effects of prosody on pronominal reference follow from the way that nuclear accent placement constrains the anaphoric properties (i.e., Givenness) associated with the surrounding sentential context. While those properties may have consequences for the specific interpretation of boundary tones, they are formally independent of the mutual beliefs themselves.⁴⁸ If there is any connection between boundary tones and pronominal reference, it is likely to be indirect at best. The issue warrants further exploration nevertheless.

5.3.2 Other Constraints on Reference

A final issue that remains unaddressed by this investigation concerns the reference of pronouns when prosody does not sufficiently constrain it. In Chapter 4, for example, it was shown that the newly proposed model predicts two optimal patterns of F-marking (shown in (152)) when both a subject and object NP are accented, and the verb is not repeated from the previous clause, as shown in (151).

- (151) i. John called Bill a Republican, and then...
 ii. he_F insulted him_F
 H* L- H* L-L%

- (152) a. he_F [insulted_F him_F]_F; [*he*=John, *him*=Bill]
 b. [he_F [insulted_F him_F]_F]_F; [*he*=Bill, *him*=John]

⁴⁸ The exception to this is found in the examples like those in 4.5, where entailment relations associated with different linguistic forms are inferentially dependent on the mutual beliefs of the interlocutors.

Since the two patterns of F-marking are associated with two distinct patterns of reference, prosody does not serve to resolve the reference of the pronouns.

In Chapter 1, I suggested that the adequacy of a generalized approach dovetails with the view of Kehler (2002), Hobbs (1979), Oehrle (1981) and others that the use of pronouns is not associated with a search for a missing referent, but that instead, pronouns are used precisely when their reference is independently determined by the structure of the local discourse. In this investigation, I have essentially argued that the interpretations associated with prosodic forms sometimes provide the structure that constrains pronominal reference in the relevant way. This leaves room for the possibility, then, that pronouns reflect other types of structure when prosodic meaning does not serve this function.

Kehler (2005) proposes a closely related view. Following Kehler (2002), he assumes that the reference of pronouns tends to reflect particular relations that hold between neighboring utterances in a discourse, or *coherence relations*. To give one example, the preference for *he* to refer to John in (153) follows from the fact that a particular *Cause-Effect* relation obtains between the first clause and the second.

(153) George narrowly defeated John, and he quickly demanded a recount.

The idea is that a speaker and hearer share the background knowledge that a vote recount is typically requested as the consequence of the outcome of a vote, and typically by the losing politician. The hearer starts from the assumption that the two clauses are related in a coherent way, and in seeking to establish this coherence, he infers that the first clause and the second clause are most likely related by the fact that the second clause describes a situation that is a result of that described by the first. The hearer then looks for a single individual who satisfies the condition of being both a politician

who lost a vote, and a person who demanded a recount. Since the first clause explicitly indicates that the individual satisfying the first condition is John, then the person satisfying the second condition must also be John. In other words, the value of the expression in the subject position of the second clause has to be John, regardless of the type of expression that is used. According to Kehler (2002), this is, in fact, the condition for using a pronoun: that the value of a particular argument slot is completely specified by the operative coherence relation, independently of the degree of specificity of the referring expression that is used.

Kehler (2005) then shows that coherence relations may serve to distinguish between patterns of F-marking that would be equally permissible under Schwarzschild's (1999) model. This may occur, for example, when the particular inferred coherence relation constrains the value of a particular argument slot. According to Kehler, for example, *him* in (154) refers to Powell if a *Parallel* relation holds between the two clauses, and to Cheney if a *Result* relation holds between the two clauses.⁴⁹

(154) Powell defied Cheney, and Bush punished him.

He further points out that, according to Schwarzschild's (1999) model, these two alternatives give rise to distinct patterns of F-marking. The two possibilities are shown in (155).⁵⁰

⁴⁹ Citing Kehler: "The Parallel construal [of example (154)] is based on establishing points of similarity and contrast among sets of corresponding entities and relations. On this reading, *and* can be paraphrased as *and similarly*, as if the passage were answering the question *who did what to whom?* On the other hand, the Result construal is characterized by a cause-and-effect interpretation between the clauses, in which *and* can be paraphrased as *and as a result*. In this case, the coherence is not based on similarity and contrast, but instead on the world knowledge that people who defy others may get punished for it" (p. 5).

⁵⁰ ToBI transcriptions are my own, inferred based on Kehler's use of capitalization to indicate stress.

- (155) Powell defied Cheney, and...
 a. Bush_F punished_F him_% (Parallel, him=Cheney)
 H* L- H* L-L%
 b. Bush_F [punished_F him]_F% (Result, him=Powell)
 H* L- H* L-L%

Kehler notes that coherence relations may also serve to distinguish between patterns of F-marking that are otherwise co-optimal candidates in Schwarzschild's model, and that this may happen independently of whether the reference of a particular argument position varies. Either pattern in (156), for example, is licensed in the context of *Powell defied Cheney, and...*, since this context entails both that someone did something to someone and that someone did something, which are requirements for the patterns in (156a) and (156b) respectively.

- (156) a. Bush_F punished_F Powell_F% (Parallel)
 H* L- H* L- H* L-L%
 b. Bush_F [punished_F Powell]_F% (Result)
 H* L- H* L-L%

Crucially, the coherence relations that Kehler presents as acting to constrain alternative patterns of F-marking are themselves not fully determined by the context. That is, they are “available readings” of the sentence. In that sense, it can be said that coherence relations introduce their own uncertainty, or underspecification, into the communication problem.

In this investigation, and in Chapter 3, in particular, I showed that prosodic form can constrain or guide the interpretation of pronouns. It may very well turn out to be the case that the different patterns of reference that were observed actually reflect differences in the particular coherence relations that are involved. However, the relevant contrasts involved in this investigation differed minimally, and only with respect to prosodic form. Thus, to the extent that any referential

preferences reflected alternative coherence relations, it was the interpretation of prosody that was acting to constrain the choice among those alternatives.

Taken together, the findings of this investigation and Kehler's observations suggest a model in which pronouns, prosodic form, and the need to establish coherence all present their own types of uncertainty and potential for ambiguity. Yet each of these factors also provides its own set of constraints, which have the potential to reduce the degrees of freedom associated with each of the others. For pronouns, the relevant constraints are the semantic features (i.e., gender, number, person) that restrict the set of possible antecedents. Prosodic form establishes anaphoric relations between sub-parts of utterances and imposes conditions on the semantic relation that must hold between them. Coherence relations, meanwhile, constrain truth-conditional possibilities by fixing the values of certain arguments or relations across utterances. In some cases, these constraints taken together may actually overdetermine the value of the speaker's specific intention. For successful communication to occur, however, the intersection of these constraints must at the very least specify a unique value for each of the dimensions of underspecification associated with the other levels of description. This view is reflected in the following quote from Kehler (2005):

"The interpretive richness we ascribe to coherence could ultimately turn out to be a purely emergent phenomenon, arising out of a speaker's use of basic linguistic tools (e.g., intonation) to manage the hearer's use of world knowledge and inference during discourse comprehension. A better understanding of this interaction holds considerable promise for ultimately explaining the quite complex empirical facts regarding a variety of discourse-dependent linguistic phenomena, including pronoun and ellipsis interpretation." (p. 17)

As the quote suggests, we may eventually want to say that the anaphoric relations introduced by prosodic form are actually a type of coherence relation, made from the same formal building blocks.

Finally, the proposal and analysis in Chapter 4 suggest that speakers and hearers can leverage the various asymmetries associated with the dual processes of production and interpretation to further reduce the degrees of freedom associated with the use of underspecified forms. This possibility follows from the mutual assumption of rationality and shared communicative goals. Future work should therefore seek an account of the role of underspecification that not only integrates the various linguistic structures involved, but it should also seek to embed such a description within a model of communication that reveals the potential for more general aspects of human behavior to enrich the information content of utterances.

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APPENDIX A: Experiment 1 Stimuli**Test Items**Baseline Condition

1. Kyle likes to play golf.
Last Sunday, he played a round with his friend Erica.
At the ninth hole, he hit the ball into the water.
Later in the round, he made a hole-in-one.
They celebrated with drinks when they got back to the clubhouse.
2. Every September, Gary spends a day fishing on Lake Michigan.
Last year, he took his sister Annie.
On the very first cast, he got a fishing hook stuck in his hand.
Later that afternoon, he tripped and fell in the water.
They managed to avoid any more accidents, but unfortunately they didn't catch any fish.
3. Maggie is a violinist for the Chicago Symphony.
Occasionally, she gives recitals with her friend Kevin, who plays the cello.
During the finale at a recent recital, she lost her place and had to start over.
A few minutes later, she broke a string.
After the recital, they talked about how to avoid such mishaps in the future.
4. Alan is a sports writer for a small newspaper in Vermont.
He shares a computer with Diane, who writes the dining column.
One morning, just before a meeting, he spilled coffee all over the monitor.
Later that morning, he dropped a jelly doughnut on the keyboard.
After that, they agreed to stop eating or drinking near the computer.
5. Anna loves Italian food.
For her birthday, she went to Casa Bella with her friend Travis.
As always, she studied the appetizer menu carefully.
When the drinks arrived, she decided to order a tomato salad.
For the main course, they both ordered the chicken parmesan.
6. While looking at his garden one morning, Aaron decided to do something about the rodent problem he'd been having.
There was a lot of work to do, so he asked his friend Carrie for help.
While inspecting the fence, he noticed a small opening surrounded by some animal tracks.
Then, in another part of the garden, he tripped over a gopher hole.
After fixing the fence, they filled in all the gopher holes they could find.
7. Last Friday, Miguel went to City Cinema to see a movie.
While waiting outside for a ticket, he ran into his old friend Jenny and decided to sit with her.
Before going into the theater, he insisted on buying popcorn.

- Then, just as the movie was starting, he needed to use the restroom.
As a result, he missed the first scene, and Jenny had to fill him in later.
8. Laura recently went shopping for a new work wardrobe.
She doesn't really like shopping, so she took her friend Brian, who used to be a fashion designer.
At one store, she bought a pair of brown pants that was on sale.
At another store, she came across a matching shirt.
After deciding not to buy the shirt, they went to a cafe to get some coffee.
9. Lori was riding her bike home from school one day when the chain suddenly came loose.
Luckily, she got help from her older brother Billy, who happened to be riding by.
As soon as the bike was fixed, though, she crashed it into a garbage can.
Then, a little further down the road, she got a flat tire.
Rather than risk another accident, Lori and Billy decided to wait for their parents to pick them up.
10. Charlie spent last summer backpacking around Europe.
In Budapest, he met up with his friend Mary.
After eating at a restaurant one night, he realized that his passport was missing.
Later that same evening, he got sick with food poisoning.
In spite of all the bad luck, Charlie and Mary had fun exploring the rest of the city.
11. Alice is an expert at Scrabble and even plays it competitively.
She practices with her neighbor Steven, who is also very good.
A few years ago, she entered the Midwest regional competition and won.
The very next year, she placed second in the national championship.
When she got a chance to compete in London, Alice invited Steven to travel with her.
12. Lucy teaches at a high school for troubled youth.
She often works closely with the vice-principal, Paul, to research crime prevention in schools.
A few years ago, she started using her own money for the research.
Then, in the fall of last year, she got a grant from the city government.
Together, Lucy and Paul plan to use the money to implement a system of hallway cameras.
13. Darren Frye is a detective with the Evanston Police Department.
He collaborates with an FBI agent named Julie Moore to investigate drug trafficking.
While working on a case one day, he began to suspect that the evidence had been tampered with.
A few days after that, he discovered an unusual record in the police file.
The incident was later investigated, and an officer was charged with accepting a bribe.
14. Kara is a sophomore journalism major at Northwestern.
She spends a lot of time on the phone with Sam, who's a junior at Yale.
Last fall, she spent too much time on the phone and failed several exams.
Then, at the end of the quarter, she got a 'D' in Chemistry.

After that, they decided to spend less time on the phone.

15. Pamela is famous for cooking with unusual ingredients.
She usually cooks with her brother Michael, who is also an inventive cook.
While making dinner one evening, she decided to experiment by putting cinnamon in the ravioli.
Then, when no one was looking, she poured vanilla into the stew.
When the ingredients were revealed, the whole family had a good laugh.
16. After retiring from law, Peter Novak decided to take up archaeology as a hobby.
Every weekend, he volunteers for an archaeologist named Renee Sanchez.
While assisting with a dig one Saturday, he uncovered a flint arrowhead.
Then, a little further underground, he discovered a gold coin.
That night, the whole crew celebrated their new treasures with champagne.
17. Nancy is a senior in high school and has recently started applying to colleges.
Ever since middle school, she has wanted to go to the University of Denver with her best friend Carlos.
During her junior year, she became interested in journalism.
Then, after the fall college fair, she decided to apply to Northwestern.
She and Carlos have vowed to stay friends no matter which school they decide to attend.
18. Dan likes to go skiing regardless of the weather conditions.
He usually meets up with his friend Keisha on the slopes.
One day, during a blinding snowstorm, he almost ran into a tree.
Then, just as the storm was passing, he missed a turn and skied off the trail.
Luckily, nobody got hurt, but they both decided it was time to call it a day.
19. Walter runs a small French bistro in Lincoln Park.
He mostly works alone, but occasionally hires Liz to help out on the weekends.
During a particularly busy Friday night, he ruined a whole batch of onion soup.
Then, just as things were slowing down, he dropped a tray full of desserts.
Luckily, they didn't run out of anything, and hardly any of the customers ordered dessert anyway.
20. Maria is a student at Northwestern and lives in Rogers Park.
She often rides the El with her linguistics TA, Scott, who lives nearby.
While waiting on the platform one blustery morning, she accidentally let go of her hat and watched it blow away in the wind.
Then, just as the train was approaching, she dropped a glove onto the track.
She never got her hat back, but luckily, a CTA worker was able to retrieve the glove.
21. Every weekend, Heather goes Latin dancing in the city.
On her birthday, she took along her friend Tom.
While learning a new tango step, she lost her footing and ran into a table.
Then, during a mambo number, she backed into a chair.

- They finally decided to skip the dancing and just have drinks instead.
22. Last Saturday, Ellen decided it was time to do the laundry.
At the laundromat, she ran into her neighbor Nick and decided to combine her load with his to save money.
As the clothes were coming out of the washer, she found a key that had been missing for months.
Then, when the clothes had finished drying, she discovered a \$20 bill.
Since they weren't sure whose money it was, they decided to spend it on a nice dinner for two.
23. Michael works in the shoe department at Macy's.
He occasionally works overtime in the stockroom with a woman named Emma.
During an inventory check one night, he noticed that some of the counts were wrong.
Later that night, he discovered that a crate was missing.
They reported the missing shoes to their supervisor, who eventually fired some of the delivery personnel.
24. Peggy Simms has been shopping for a new house for several months.
Whenever she finds one she likes, she takes her grandson Jeffrey to see it.
In one neighborhood, she found a great three-bedroom house with a view of the mountains.
At home later that evening, she couldn't stop talking about the size of the yard.
The very next day, she called the realtor to make a bid on the house.
25. Judy Kafka is a history professor at NYU.
At conferences, she often debates a Harvard professor named Peter Madden.
At a recent conference, she won the debate decisively.
As a result of the publicity, she got an article published in Journal of the Americas.
Later on, a publisher offered them a joint book deal.
26. One day, Darrell decided to bake some wild huckleberry pies.
He asked his friend Beth to help him find a good berry patch near his cabin.
After a few hours of picking, he had filled an entire bucket with berries.
Then, on the way back to the cabin, he noticed a bear lurking in the distance.
Not wanting to take any chances, he and Beth threw down their berries and hurried home.
27. Kenny really likes to drink coffee.
Twice a week, he goes to Starbucks to drink coffee and study with his friend Jennifer.
At last Friday's study session, he ordered a large mocha latte.
Then, as part of a store promotion, he got a free cappuccino.
The extra caffeine helped him get through all the physics problems he needed to do.
28. Greg Barnes used to be really serious about physical fitness.
A few years ago, he even trained for an amateur bodybuilding contest along with his friend Claire.
On the first day of the competition, he lifted 300 pounds for the first time.

Then, in the semifinal round, he broke a state record.
After such strong a finish, he vowed to train even harder for next year's competition.

29. Karen Heinz does a lot of solo gear testing for Backpacker Magazine.
She has an ongoing challenge with another tester named Dennis, to see who can find the most unusual spot in the wilderness.
Recently, she hiked across a ten thousand-year-old lava flow.
The very next week, she camped in the middle of an alpine bog.
After that, they decided the next challenge should take place in the desert.
30. Every holiday season, Omar gets really out of shape.
This year, he decided to stay fit by training for a triathlon with his girlfriend Heidi.
During the fall quarter, he lifted weights every day at the gym.
After the winter break, he joined the running club.
By the spring quarter, they were ready to start swimming and biking.
31. Ken has been a huge baseball fan since he was a kid.
Last season, he went to every Cubs game with his wife Jill.
In the third inning of a game against the Brewers, he almost got hit by a wild throw to first base.
Then, in the fifth inning, he caught a foul ball.
After that, they decided to start taking gloves to every game.
32. Since Emily lives alone, her house sometimes feels empty.
She told this to her brother Ryan, who decided that she really needed a pet.
That same day, she went to the pound to look at dogs and cats.
Later that week, she decided to adopt a puppy.
Not only does Emily's house feel less lonely now, but she sees a lot more of her brother.

Shift Condition

1. Erica likes to play golf.
Last Sunday, she played a round with her friend Kyle.
At the ninth hole, she hit the ball into the water.
Later in the round, he made a hole-in-one.
They celebrated with drinks when they got back to the clubhouse.
2. Every September, Annie spends a day fishing on Lake Michigan.
Last year, she took her brother Gary.
On the very first cast, she got a fishing hook stuck in her hand.
Later that afternoon, he tripped and fell in the water.
They managed to avoid any more accidents, but unfortunately they didn't catch any fish.
3. Kevin is a violinist for the Chicago Symphony.
Occasionally, he gives recitals with his friend Maggie, who plays the cello.

- During the finale at a recent recital, he lost his place and had to start over.
A few minutes later, she broke a string.
After the recital, they talked about how to avoid such mishaps in the future.
4. Diane is a sports writer for a small newspaper in Vermont.
She shares a computer with Alan, who writes the dining column.
One morning, just before a meeting, she spilled coffee all over the monitor.
Later that morning, he dropped a jelly doughnut on the keyboard.
After that, they agreed to stop eating or drinking near the computer.
5. Travis loves Italian food.
For his birthday, he went to Casa Bella with his friend Anna.
As always, he studied the appetizer menu carefully.
When the drinks arrived, she decided to order a tomato salad.
For the main course, they both ordered the chicken parmesan.
6. While looking at her garden one morning, Carrie decided to do something about the rodent problem she'd been having.
There was a lot of work to do, so she asked her friend Aaron for help.
While inspecting the fence, she noticed a small opening surrounded by some animal tracks.
Then, in another part of the garden, he tripped over a gopher hole.
After fixing the fence, they filled in all the gopher holes they could find.
7. Last Friday, Jenny went to City Cinema to see a movie.
While waiting outside for a ticket, she ran into her old friend Miguel and decided to sit with him.
Before going into the theater, she insisted on buying popcorn.
Then, just as the movie was starting, he needed to use the restroom.
As a result, he missed the first scene, and Jenny had to fill him in later.
8. Brian recently went shopping for a new work wardrobe.
He doesn't really like shopping, so he took his friend Laura, who used to be a fashion designer.
At one store, he bought a pair of brown pants that was on sale.
At another store, she came across a matching shirt.
After deciding not to buy the shirt, they went to a cafe to get some coffee.
9. Billy was riding his bike home from school one day when the chain suddenly came loose.
Luckily, he got help from his older sister Lori, who happened to be riding by.
As soon as the bike was fixed, though, he crashed it into a garbage can.
Then, a little further down the road, she got a flat tire.
Rather than risk another accident, Billy and Lori decided to wait for their parents to pick them up.
10. Mary spent last summer backpacking around Europe.
In Budapest, she met up with her friend Charlie.

After eating at a restaurant one night, she realized that her passport was missing.
 Later that same evening, he got sick with food poisoning.
 In spite of all the bad luck, Charlie and Mary had fun exploring the rest of the city.

11. Steven is an expert at Scrabble and even plays it competitively.
 He practices with his neighbor Alice, who is also very good.
 A few years ago, he entered the Midwest regional competition and won.
 The very next year, she placed second in the national championship.
 When she got a chance to compete in London, Alice invited Steven to travel with her.
12. Paul teaches at a high school for troubled youth.
 He often works closely with the vice-principal, Lucy, to research crime prevention in schools.
 A few years ago, he started using his own money for the research.
 Then, in the fall of last year, she got a grant from the city government.
 Together, Paul and Lucy plan to use the money to implement a system of hallway cameras.
13. Julie Moore is a detective with the Evanston Police Department.
 She collaborates with an FBI agent named Darren Frye to investigate drug trafficking.
 While working on a case one day, she began to suspect that the evidence had been tampered with.
 A few days after that, he discovered an unusual record in the police file.
 The incident was later investigated, and an officer was charged with accepting a bribe.
14. Sam is a sophomore journalism major at Northwestern.
 He spends a lot of time on the phone with Kara, who's a junior at Yale.
 Last fall, he spent too much time on the phone and failed several exams.
 Then, at the end of the quarter, she got a 'D' in Chemistry.
 After that, they decided to spend less time on the phone.
15. Michael is famous for cooking with unusual ingredients.
 He usually cooks with his sister Pamela, who is also an inventive cook.
 While making dinner one evening, he decided to experiment by putting cinnamon in the ravioli.
 Then, when no one was looking, she poured vanilla into the stew.
 When the ingredients were revealed, the whole family had a good laugh.
16. After retiring from law, Renee Sanchez decided to take up archaeology as a hobby.
 Every weekend, she volunteers for an archaeologist named Peter Novak.
 While assisting with a dig one Saturday, she uncovered a flint arrowhead.
 Then, a little further underground, he discovered a gold coin.
 That night, the whole crew celebrated their new treasures with champagne.
17. Carlos is a senior in high school and has recently started applying to colleges.
 Ever since middle school, he has wanted to go to the University of Denver with his best friend Nancy.
 During his junior year, he became interested in journalism.

- Then, after the fall college fair, she decided to apply to Northwestern.
She and Carlos have vowed to stay friends no matter which school they decide to attend.
18. Keisha likes to go skiing regardless of the weather conditions.
She usually meets up with her friend Dan on the slopes.
One day, during a blinding snowstorm, she almost ran into a tree.
Then, just as the storm was passing, he missed a turn and skied off the trail.
Luckily, nobody got hurt, but they both decided it was time to call it a day.
19. Liz runs a small French bistro in Lincoln Park.
She mostly works alone, but occasionally hires Walter to help out on the weekends.
During a particularly busy Friday night, she ruined a whole batch of onion soup.
Then, just as things were slowing down, he dropped a tray full of desserts.
Luckily, they didn't run out of anything, and hardly any of the customers ordered dessert anyway.
20. Scott is a student at Northwestern and lives in Rogers Park.
He often rides the El with his linguistics TA, Maria, who lives nearby.
While waiting on the platform one blustery morning, he accidentally let go of his hat and watched it blow away in the wind.
Then, just as the train was approaching, she dropped a glove onto the track.
He never got his hat back, but luckily, a CTA worker was able to retrieve the glove.
21. Every weekend, Tom goes Latin dancing in the city.
On his birthday, he took along his friend Heather.
While learning a new tango step, he lost his footing and ran into a table.
Then, during a mambo number, she backed into a chair.
They finally decided to skip the dancing and just have drinks instead.
22. Last Saturday, Nick decided it was time to do the laundry.
At the laundromat, he ran into his neighbor Ellen and decided to combine his load with hers to save money.
As the clothes were coming out of the washer, he found a key that had been missing for months.
Then, when the clothes had finished drying, she discovered a \$20 bill.
Since they weren't sure whose money it was, they decided to spend it on a nice dinner for two.
23. Emma works in the shoe department at Macy's.
She occasionally works overtime in the stockroom with a man named Michael.
During an inventory check one night, she noticed that some of the counts were wrong.
Later that night, he discovered that a crate was missing.
They reported the missing shoes to their supervisor, who eventually fired some of the delivery personnel.
24. Jeffrey Simms has been shopping for a new house for several months.

- Whenever he finds one he likes, he takes his granddaughter Peggy to see it.
In one neighborhood, he found a great three-bedroom house with a view of the mountains.
At home later that evening, she couldn't stop talking about the size of the yard.
The very next day, he called the realtor to make a bid on the house.
25. Peter Madden is a history professor at NYU.
At conferences, he often debates a Harvard professor named Judy Kafka.
At a recent conference, he won the debate decisively.
As a result of the publicity, she got an article published in Journal of the Americas.
Later on, a publisher offered them a joint book deal.
26. One day, Beth decided to bake some wild huckleberry pies.
She asked her friend Darrell to help her find a good berry patch near her cabin.
After a few hours of picking, she had filled an entire bucket with berries.
Then, on the way back to the cabin, he noticed a bear lurking in the distance.
Not wanting to take any chances, he and Beth threw down their berries and hurried home.
27. Jennifer really likes to drink coffee.
Twice a week, she goes to Starbucks to drink coffee and study with her friend Kenny.
At last Friday's study session, she ordered a large mocha latte.
Then, as part of a store promotion, he got a free cappuccino.
The extra caffeine helped them get through all the physics problems they needed to do.
28. Claire Barnes used to be really serious about physical fitness.
A few years ago, she even trained for an amateur bodybuilding contest along with her friend Greg.
On the first day of the competition, she lifted 150 pounds for the first time.
Then, in the semifinal round, he broke a state record.
After such strong finishes, they vowed to train even harder for next year's competition.
29. Dennis Heinz does a lot of solo gear testing for Backpacker Magazine.
He has an ongoing challenge with another tester named Karen, to see who can find the most unusual spot in the wilderness.
Recently, he hiked across a ten thousand-year-old lava flow.
The very next week, she camped in the middle of an alpine bog.
After that, they decided the next challenge should take place in the desert.
30. Every holiday season, Heidi gets really out of shape.
This year, she decided to stay fit by training for a triathlon with her boyfriend Omar.
During the fall quarter, she lifted weights every day at the gym.
After the winter break, he joined the running club.
By the spring quarter, they were ready to start swimming and biking.
31. Jill has been a huge baseball fan since she was a kid.
Last season, she went to every Cubs game with her husband Ken.

In the third inning of a game against the Brewers, she almost got hit by a wild throw to first base.

Then, in the fifth inning, he caught a foul ball.

After that, they decided to start taking gloves to every game.

32. Since Ryan lives alone, his house sometimes feels empty.
He told this to his sister Emily, who decided that he really needed a pet.
That same day, he went to the pound to look at dogs and cats.
Later that week, she decided to adopt a puppy.
Ryan decided not to get a pet for himself, but he really likes to play with Emily's puppy.

Focus Condition

1. Kyle likes to play golf.
Last Sunday, he played a round with his friend Erica.
At the ninth hole, he cheered when Erica made a hole-in-one.
Later in the round, he made a hole-in-one.
They celebrated with drinks when they got back to the clubhouse.
2. Every September, Gary spends a day fishing on Lake Michigan.
Last year, he took his sister Annie.
On the very first cast, he accidentally rocked the boat and made Annie trip and fall in the water.
Later that afternoon, he tripped and fell in the water.
They managed to avoid any more accidents, but unfortunately they didn't catch any fish.
3. Maggie is a violinist for the Chicago Symphony.
Occasionally, she gives recitals with her friend Kevin, who plays the cello.
During the finale at a recent recital, she panicked when Kevin broke a string.
A few minutes later, she broke a string.
After the recital, they talked about how to avoid such mishaps in the future.
4. Alan is a sports writer for a small newspaper in Vermont.
He shares a computer with Diane, who writes the dining column.
One morning, just before a meeting, he got upset when Diane dropped a jelly doughnut on the keyboard.
Later that morning, he dropped a jelly doughnut on the keyboard.
After that, they agreed to stop eating or drinking near the computer.
5. Anna loves Italian food.
For her birthday, she went to Casa Bella with her friend Travis.
At first, she was surprised that Travis decided to order a tomato salad.
When the drinks arrived, she decided to order a tomato salad.
For the main course, they both ordered chicken parmesan.

6. While looking at his garden one morning, Aaron decided to do something about the rodent problem he'd been having.
There was a lot of work to do, so he asked his friend Carrie for help.
While inspecting the fence, he looked up just as Carrie tripped over a gopher hole.
Then, in another part of the garden, he tripped over a gopher hole.
After fixing the fence, they filled in all the gopher holes they could find.
7. Last Friday, Miguel went to City Cinema to see a movie.
While waiting outside for a ticket, he ran into his old friend Jenny and decided to sit with her.
Before going into the theater, he got a little impatient when Jenny needed to use the restroom.
Then, just as the movie was starting, he needed to use the restroom.
As a result, he missed the first scene, and Jenny had to fill him in later.
8. Laura recently went shopping for a new work wardrobe.
She doesn't really like shopping, so she took her friend Brian, who used to be a fashion designer.
After finding a great pair of pants on sale, she was glad that Brian immediately came across a matching shirt.
At another store, she came across a matching shirt.
After deciding which shirt to buy, they went to a cafe to get some coffee.
9. Lori was riding her bike home from school one day when the chain suddenly came loose.
Luckily, she got help from her older brother Billy, who happened to be riding by.
As soon as the bike was fixed, though, she started to cry when Billy got a flat tire.
Then, a little further down the road, she got a flat tire.
Rather than risk another accident, Lori and Billy decided to wait for their parents to pick them up.
10. Charlie spent last summer backpacking around Europe.
In Budapest, he met up with his friend Mary.
After eating at a restaurant one night, he felt responsible when Mary got sick with food poisoning.
Later that same evening, he got sick with food poisoning.
In spite of all the bad luck, Charlie and Mary had fun exploring the rest of the city.
11. Alice is an expert at Scrabble and even plays it competitively.
She practices with her neighbor Steven, who is also very good.
A few years ago, she felt proud when Steven placed second in the national championship.
The very next year, she placed second in the national championship.
When she got a chance to compete in London, Alice invited Steven to travel with her.
12. Lucy teaches at a high school for troubled youth.
She often works closely with the vice-principal, Paul, to research crime prevention in schools.
A few years ago, she started developing several new programs after Paul got a grant from the city government.

- Then, in the fall of last year, she got a grant from the city government.
Together, Lucy and Paul plan to use the money to implement a system of hallway cameras.
13. Darren Frye is a detective with the Evanston Police Department.
He collaborates with an FBI agent named Julie Moore to investigate drug trafficking.
While working on a case one day, he began to suspect corruption when Julie discovered an unusual record in the police file.
A few days after that, he discovered an unusual record in the police file.
The incident was later investigated, and an officer was charged with accepting a bribe.
 14. Kara is a sophomore journalism major at Northwestern.
She spends a lot of time on the phone with Sam, who's a junior at Yale.
Last fall, she wasn't too worried when Sam got an 'D' in Chemistry.
Then, at the end of the quarter, she got a 'D' in Chemistry.
After that, they decided to spend less time on the phone.
 15. Pamela is famous for cooking with unusual ingredients.
She usually cooks with her brother Michael, who is also an inventive cook.
While making dinner one evening, she didn't notice when Michael poured vanilla into the stew.
Then, when no one was looking, she poured vanilla into the stew.
When the ingredients were revealed, the whole family had a good laugh.
 16. After retiring from law, Peter Novak decided to take up archaeology as a hobby.
Every weekend, he volunteers for an archaeologist named Renee Sanchez.
While assisting with a dig one Saturday, he started to dig faster after Dr. Sanchez discovered a gold coin.
Then, a little further underground, he discovered a gold coin.
That night, the whole crew celebrated their new treasures with champagne.
 17. Nancy is a senior in high school and has recently started applying to colleges.
Ever since middle school, she has wanted to go to the University of Denver with her best friend Carlos.
During her junior year, she was pretty disappointed when Carlos decided to apply to Northwestern.
Then, after the fall college fair, she decided to apply to Northwestern.
She and Carlos have vowed to stay friends no matter which school they decide to attend.
 18. Dan likes to go skiing regardless of the weather conditions.
He usually meets up with his friend Keisha on the slopes.
One day, during a blinding snowstorm, he started skiing more slowly after Keisha missed a turn and skied off the trail.
Then, just as the storm was passing, he missed a turn and skied off the trail.
Luckily, nobody got hurt, but they both decided it was time to call it a day.
 19. Walter runs a small French bistro in Lincoln Park.

He mostly works alone, but occasionally hires Liz to help out on the weekends.
During a particularly busy Friday night, he almost lost his cool when Liz dropped a tray full of desserts.
Then, just as things were slowing down, he dropped a tray full of desserts.
Luckily, they didn't run out of anything, and hardly any of the customers ordered dessert anyway.

20. Maria is a student at Northwestern and lives in Rogers Park.
She often rides the El with her linguistics TA, Scott, who lives nearby.
While waiting on the platform one blustery morning, she watched helplessly as Scott dropped a glove onto the track.
Then, just as the train was approaching, she dropped a glove onto the track.
Luckily, a CTA worker was able to retrieve the gloves for them.
21. Every weekend, Heather goes Latin dancing in the city.
On her birthday, she took along her friend Tom.
While learning a new tango step, she tried not to laugh when Tom lost his footing and backed into a chair.
Then, during a mambo number, she backed into a chair.
They finally decided to skip the dancing and just have drinks instead.
22. Last Saturday, Ellen decided it was time to do the laundry.
At the laundromat, she ran into her neighbor Nick and decided to combine her load with his to save money.
As the clothes were coming out of the washer, she got a little jealous when Nick discovered a \$20 bill.
Then, when the clothes had finished drying, she discovered a \$20 bill.
Since they weren't sure whose money it was, they decided to spend it on a nice dinner for two.
23. Michael works in the shoe department at Macy's.
He occasionally works overtime in the stockroom with a woman named Emma.
During an inventory check one night, he couldn't believe it when Emma discovered that a crate was missing.
Later that night, he discovered that a crate was missing.
They reported the missing shoes to their supervisor, who eventually fired some of the delivery personnel.
24. Peggy Simms has been shopping for a new house for several months.
Whenever she finds one she likes, she takes her grandson Jeffrey to see it.
In one neighborhood, she knew she had found the right house when Jeffrey couldn't stop talking about the size of the yard.
At home later that evening, she couldn't stop talking about the size of the yard.
The very next day, she called the realtor to make a bid on the house.
25. Judy Kafka is a history professor at NYU.

At conferences, she often debates a Harvard professor named Peter Madden.
 At a recent conference, she openly disapproved of the fact that Peter got an article published in Journal of the Americas.
 As a result of the publicity, she got an article published in Journal of the Americas.
 Later on, a publisher offered them a joint book deal.

26. One day, Darrell decided to bake some wild huckleberry pies.
 He asked his friend Beth to help him find a good berry patch near his cabin.
 After a few hours of picking, he started to get nervous when Beth noticed a bear lurking in the distance.
 Then, on the way back to the cabin, he noticed a bear lurking in the distance.
 Not wanting to take any chances, he and Beth threw down their berries and hurried home.
27. Kenny really likes to drink coffee.
 Twice a week, he goes to Starbucks to drink coffee and study with his friend Jennifer.
 At last Friday's study session, he was hardly surprised when, as a reward for frequent purchases, Jennifer got a free cappuccino.
 Then, as part of a store promotion, he got a free cappuccino.
 The extra caffeine helped them get through all the physics problems they needed to do.
28. Greg Barnes used to be really serious about physical fitness.
 A few years ago, he even trained for an amateur bodybuilding contest along with his friend Claire.
 On the first day of the competition, he was proud when Claire broke a state record.
 Then, in the semifinal round, he broke a state record.
 After such strong finishes, they vowed to train even harder for next year's competition.
29. Karen Heinz does a lot of solo gear testing for Backpacker Magazine.
 She has an ongoing challenge with another tester named Dennis, to see who can find the most unusual spot in the wilderness.
 Recently, she felt outdone after hearing that Dennis camped in the middle of an alpine bog.
 The very next week, she camped in the middle of an alpine bog.
 After that, they decided the next challenge should take place in the desert.
30. Every holiday season, Omar gets really out of shape.
 This year, he decided to stay fit by training for a triathlon with his girlfriend Heidi.
 During the fall quarter, he was impressed that Heidi joined the running club.
 After the winter break, he joined the running club.
 By the spring quarter, they were ready to start swimming and biking.
31. Ken has been a huge baseball fan since he was a kid.
 Last season, he went to every Cubs game with his wife Jill.
 In the third inning of a game against the Brewers, he got a little jealous when Jill caught a foul ball.
 Then, in the fifth inning, he caught a foul ball.
 After that, they decided to start taking gloves to every game.

32. Since Emily lives alone, her house sometimes feels empty.
 She told this to her brother Ryan, who decided that she really needed a pet.
 That same day, she was inspired when Ryan decided to adopt a puppy.
 Later that week, she decided to adopt a puppy.
 Not only does Emily's house feel less lonely now, but she sees a lot more of her brother.

Shift+Focus Condition

1. Erica likes to play golf.
 Last Sunday, she played a round with her friend Kyle.
 At the ninth hole, she made a hole-in-one.
 Later in the round, he made a hole-in-one.
 They celebrated with drinks when they got back to the clubhouse.
2. Every September, Annie spends a day fishing on Lake Michigan.
 Last year, she took her brother Gary.
 On the very first cast, she tripped and fell in the water.
 Later that afternoon, he tripped and fell in the water.
 They managed to avoid any more accidents, but unfortunately they didn't catch any fish.
3. Kevin is a violinist for the Chicago Symphony.
 Occasionally, he gives recitals with his friend Maggie, who plays the cello.
 During the finale at a recent recital, he broke a string.
 A few minutes later, she broke a string.
 After the recital, they talked about how to avoid such mishaps in the future.
4. Diane is a sports writer for a small newspaper in Vermont.
 She shares a computer with Alan, who writes the dining column.
 One morning, just before a meeting, she dropped a jelly doughnut on the keyboard.
 Later that morning, he dropped a jelly doughnut on the keyboard.
 After that, they agreed to stop eating or drinking near the computer.
5. Travis loves Italian food.
 For his birthday, he went to Casa Bella with his friend Anna.
 For his appetizer, he decided to order a tomato salad.
 When the drinks arrived, she decided to order a tomato salad.
 For the main course, they both ordered chicken parmesan.
6. While looking at her garden one morning, Carrie decided to do something about the rodent problem she'd been having.
 There was a lot of work to do, so she asked her friend Aaron for help.
 While inspecting the fence, she tripped over a gopher hole.
 Then, in another part of the garden, he tripped over a gopher hole.
 After fixing the fence, they filled in all the gopher holes they could find.

7. Last Friday, Jenny went to City Cinema to see a movie.
While waiting outside for a ticket, she ran into her old friend Miguel and decided to sit with him.
Before going into the theater, she needed to use the restroom.
Then, just as the movie was starting, he needed to use the restroom.
As a result, he missed the first scene, and Jenny had to fill him in later.
8. Brian recently went shopping for a new work wardrobe.
He doesn't really like shopping, so he took his friend Laura, who used to be a fashion designer.
After buying a great pair of pants at one store, he came across a matching shirt.
At another store, she came across a matching shirt.
After deciding which shirt to buy, they went to a cafe to get some coffee.
9. Billy was riding his bike home from school one day when the chain suddenly came loose.
Luckily, he got help from his older sister Lori, who happened to be riding by.
As soon as the bike was fixed, though, he rode over a nail and got a flat tire.
Then, a little further down the road, she got a flat tire.
Rather than risk another accident, Billy and Lori decided to wait for their parents to pick them up.
10. Mary spent last summer backpacking around Europe.
In Budapest, she met up with her friend Charlie.
After eating at a restaurant one night, she got sick with food poisoning.
Later that same evening, he got sick with food poisoning.
In spite of all the bad luck, Charlie and Mary had fun exploring the rest of the city.
11. Steven is an expert at Scrabble and even plays it competitively.
He practices with his neighbor Alice, who is also very good.
A few years ago, he placed second in the national championship.
The very next year, she placed second in the national championship.
When she got a chance to compete in London, Alice invited Steven to travel with her.
12. Paul teaches at a high school for troubled youth.
He often works closely with the vice-principal, Lucy, to research crime prevention in schools.
A few years ago, he got a grant from the city government.
Then, in the fall of last year, she got a grant from the city government.
Together, Paul and Lucy plan to use the money to implement a system of hallway cameras.
13. Julie Moore is a detective with the Evanston Police Department.
She collaborates with an FBI agent named Darren Frye to investigate drug trafficking.
While working on a case one day, she began to suspect corruption when she discovered an unusual record in the police file.
A few days after that, he discovered an unusual record in the police file.
The incident was later investigated, and an officer was charged with accepting a bribe.

14. Sam is a sophomore journalism major at Northwestern.
He spends a lot of time on the phone with Kara, who's a junior at Yale.
Last fall, he spent too much time on the phone and got a 'D' in Chemistry.
Then, at the end of the quarter, she got a 'D' in Chemistry.
After that, they decided to spend less time on the phone.
15. Michael is famous for cooking with unusual ingredients.
He usually cooks with his sister Pamela, who is also an inventive cook.
While making dinner one evening, he poured vanilla into the stew.
Then, when no one was looking, she poured vanilla into the stew.
When the special ingredient was revealed, the whole family had a good laugh.
16. After retiring from law, Renee Sanchez decided to take up archaeology as a hobby.
Every weekend, she volunteers for an archaeologist named Peter Novak.
While assisting with a dig one Saturday, she discovered a gold coin.
Then, a little further underground, he discovered a gold coin.
That night, the whole crew celebrated their new treasures with champagne.
17. Carlos is a senior in high school and has recently started applying to colleges.
Ever since middle school, he has wanted to go to the University of Denver with his best friend Nancy.
During his junior year, he got interested in journalism and decided to apply to Northwestern.
Then, after the fall college fair, she decided to apply to Northwestern.
She and Carlos have vowed to stay friends no matter which school they decide to attend.
18. Keisha likes to go skiing regardless of the weather conditions.
She usually meets up with her friend Dan on the slopes.
One day, during a blinding snowstorm, she missed a turn and skied off the trail.
Then, just as the storm was passing, he missed a turn and skied off the trail.
Luckily, nobody got hurt, but they both decided it was time to call it a day.
19. Liz runs a small French bistro in Lincoln Park.
She mostly works alone, but occasionally hires Walter to help out on the weekends.
During a particularly busy Friday night, she dropped a tray full of desserts.
Then, just as things were slowing down, he dropped a tray full of desserts.
Luckily, they didn't run out of anything, and hardly any of the customers ordered dessert anyway.
20. Scott is a student at Northwestern and lives in Rogers Park.
He often rides the El with his linguistics TA, Maria, who lives nearby.
While waiting on the platform one blustery morning, he dropped a glove onto the track.
Then, just as the train was approaching, she dropped a glove onto the track.
Luckily, a CTA worker was able to retrieve the gloves for them.
21. Every weekend, Tom goes Latin dancing in the city.
On his birthday, he took along his friend Heather.

While learning a new tango step, he lost his footing and backed into a chair.

Then, during a mambo number, she backed into a chair.

They finally decided to skip the dancing and just have drinks instead.

22. Last Saturday, Nick decided it was time to do the laundry.
At the laundromat, he ran into his neighbor Ellen and decided to combine his load with hers to save money.
As the clothes were coming out of the washer, he discovered a \$20 bill.
Then, when the clothes had finished drying, she discovered a \$20 bill.
Since they weren't sure whose money it was, they decided to spend it on a nice dinner for two.
23. Emma works in the shoe department at Macy's.
She occasionally works overtime in the stockroom with a man named Michael.
During an inventory check one night, she discovered that a crate was missing.
Later that night, he discovered that a crate was missing.
They reported the missing shoes to their supervisor, who eventually fired some of the delivery personnel.
24. Jeffrey Simms has been shopping for a new house for several months.
Whenever he finds one he likes, he takes his granddaughter Peggy to see it.
In one neighborhood, he knew he had found the right house and couldn't stop talking about the size of the yard.
At home later that evening, she couldn't stop talking about the size of the yard.
The very next day, he called the realtor to make a bid on the house.
25. Peter Madden is a history professor at NYU.
At conferences, he often debates a Harvard professor named Judy Kafka.
At the end of a recent debate, he openly bragged that he got an article published in Journal of the Americas.
As a result of the publicity, she got an article published in Journal of the Americas.
Later on, a publisher offered them a joint book deal.
26. One day, Beth decided to bake some wild huckleberry pies.
She asked her friend Darrell to help her find a good berry patch near her cabin.
After a few hours of picking, she noticed a bear lurking in the distance.
Then, on the way back to the cabin, he noticed a bear lurking in the distance.
Not wanting to take any chances, he and Beth threw down their berries and hurried home.
27. Jennifer really likes to drink coffee.
Twice a week, she goes to Starbucks to drink coffee and study with her friend Kenny.
At last Friday's study session, as a reward for frequent purchases, she got a free cappuccino.
Then, as part of a store promotion, he got a free cappuccino.
The extra caffeine helped them get through all the physics problems they needed to do.

28. Claire Barnes used to be really serious about physical fitness.
A few years ago, she even trained for an amateur bodybuilding contest along with her friend Greg.
On the first day of the competition, she broke a state record.
Then, in the semifinal round, he broke a state record.
After such strong finishes, they vowed to train even harder for next year's competition.
29. Dennis Heinz does a lot of solo gear testing for Backpacker Magazine.
He has an ongoing challenge with another tester named Karen, to see who can find the most unusual spot in the wilderness.
Recently, he thought he had won after he camped in the middle of an alpine bog.
The very next week, she camped in the middle of an alpine bog.
After that, they decided the next challenge should take place in the desert.
30. Every holiday season, Heidi gets really out of shape.
This year, she decided to stay fit by training for a triathlon with her boyfriend Omar.
During the fall quarter, she made the first move when she joined the running club.
After the winter break, he joined the running club.
By the spring quarter, they were ready to start swimming and biking.
31. Jill has been a huge baseball fan since she was a kid.
Last season, she went to every Cubs game with her husband Ken.
In the third inning of a game against the Brewers, she caught a foul ball.
Then, in the fifth inning, he caught a foul ball.
After that, they decided to start taking gloves to every game.
32. Since Ryan lives alone, his house sometimes feels empty.
He told this to his sister Emily, who decided that he really needed a pet.
That same day, he decided to adopt a puppy.
Later that week, she decided to adopt a puppy.
Not only does Ryan's house feel less lonely now, but he sees a lot more of his sister.

Control Items

Deaccenting Condition

1. Ian and Lewis are both fascinated by ancient cultures.
Recently, they went to a museum exhibit about ancient architecture.
In one part of the exhibit, they saw an interesting replica of a Roman temple.
At first they thought it was a replica of a Mayan temple.
Later on, a tour guide explained the difference to them.
2. Karen, Tyler and Pauline always visit their grandmother on her birthday.
This year they wanted to give her some balloons, too.
Their mother suggested that they buy the balloons from an on-line florist.
Karen, however, thought they should use a local florist.

In the end, they took their mother's advice and ordered the balloons on-line.

3. Recently, the Brookfield Zoo was given a large donation.
The only requirement was that the money be spent on habitats for endangered species.
Originally, zoo officials planned to build a habitat for the red-fronted African parrot they had just acquired.
Then, a team of experts identified the bird as a common Peruvian parrot.
As a result, the zoo had to give back some of the money.
4. When Sam and Pat got married, they received a lot of gifts.
They started sending thank-you notes as soon as they got back from their honeymoon.
First, Sam wrote a note thanking the Harrisons for a crystal platter they had gotten from them.
Pat wrote one thanking the Bates family for a silver platter.
After the notes were sent, Pat and Sam realized that they had thanked the wrong people for each of the gifts.
5. Susan Lamm was recently called to court for her suspected involvement in an arson case.
Based on the testimony of friends, she was able to prove her innocence.
The police report stated that the arsonist used a plastic lighter to start the fire.
Susan, however, always carries a silver lighter for her cigarettes.
The jury was convinced that if Susan had started the fire, she would have used her own lighter.
6. Energon is a non-profit organization dedicated to reducing energy consumption.
Its does this by providing policy assessments to legislators.
In its latest assessment, Energon showed that recent oil shortages resulted in greater fuel efficiency.
The assessment also predicted that future oil shortages would lead to further gains.
As a result of the findings, Congress is considering a bill to eliminate the current cap on oil prices.
7. At a party recently, Jodie met several interesting people but couldn't remember their names.
There was one woman in particular that she hoped to meet again.
Based on their conversation, Jodie thought the woman did research on evolutionary genetics.
Jodie's friend Mike suspected that she had met Claire, who works on cellular genetics.
She realized that she had probably been confused about the woman's research.
8. Jane works at an IT consulting firm in downtown Chicago.
Last summer, she was late for work a lot.
The problem was that her old bicycle kept breaking down.
This summer, Jane bought a new bicycle, which is both faster and more reliable.
Now she's the first one at the office every morning.
9. Angela was recently invited to a fund-raising dinner for a local politician.
She wanted to look her best, so she went shopping for some new jewelry.

At the jewelry store, she was immediately drawn to some sapphire necklaces.
After seeing the selection of ruby necklaces, however, she changed her mind.
At the dinner, Angela looked stunning and was complimented by nearly everyone.

10. The Kelvins are a funk rock band that plays in Chicago.
Their manager, Sam Leeds, runs a music shop on the West Side.
When the band was first starting out, they met Sam while shopping for an electric violin.
He convinced them that an acoustic violin would sound better in small venues.
Their new sound became a hit, and they've been working with Sam ever since.
11. Every year, the city of St. Cloud sponsors a dog show.
Unlike most dog shows, the one in St. Cloud allows unregistered breeds to be entered.
In the past few years, the show has been dominated by a particular toy poodle.
This year, a new variety of standard poodle is expected to take the prize.
The organizers are hoping that the change will revive interest in the show.
12. Every year, Jason's boss Nikki throws a company party at her house.
Jason and his coworkers have become pretty competitive about the gifts they take for the hostess.
This year, Jason took Nikki some nice white wine.
Vera took her an expensive bottle of red wine.
To their surprise, everyone at the party had taken either wine or flowers.
13. On June 15th, the Furniture Factory will be going out of business.
As a result, they are offering discounts on their entire stock.
Fabric sofas are being discounted by as much as 50%.
All leather sofas come with free delivery.
The day before the store closes, the remaining items will be discounted even further.
14. Devon and Jessie threw a huge party for their friend Casey's birthday.
After the party, it took them a whole day to pick up the trash in Jessie's apartment.
First they picked up all the paper cups.
Then they put the plastic cups in a recycling bag.
By the time they were done, they had filled over twelve garbage bags.
15. Every spring, Betty spends a week at her cabin in Montana.
This spring, the weather has been especially cold there.
Usually, Betty takes cotton socks to wear on her morning run.
This year, she's also planning to pack several pairs of wool socks.
She's hoping that she won't have to spend her whole vacation indoors.
16. On Wednesday, Jamie finished her last final exam of the quarter.
She decided to spend the rest of the week watching movies at home.
The first movie she watched was an animated thriller by the director Evan Frost.
That got boring, so she switched to a live-action thriller.
By the end of the week, she had watched nearly every movie in the video store.

No Deaccenting Condition

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The first movie she watched was an animated musical by the director Evan Frost.
That got boring, so she switched to a live-action thriller.
By the end of the week, she had watched nearly every movie in the video store.

Filler Items

1. Judy and Kelly went shopping for a couch for their living room.
They had no trouble picking a design, but couldn't agree on a color.
At the advice of the salesperson, they flipped a coin.
Kelly won the toss, so they went with a tan covering.
Once they got the couch home, however, they realized that Judy's choice would have been much better.
2. Hannah's bike was stolen recently, so she decided to buy a new one.
Her friend Raymond suggested that she buy a mountain bike.
At first, Hannah was worried about getting one that was too heavy.
Raymond explained that the newer models are actually very light.
In the end, she decided to take Raymond's advice.
3. Sam likes to read fishing magazines during his morning bus commute.
Occasionally, he reads a flyfishing magazine called Rocky Mountain Fly.
Last Monday, he stopped at a bookstore to pick up the latest issue.
He wanted to read it right away, but decided to wait until he got home.
Unfortunately, he left the magazine on the bus and had to buy another copy.
4. The Martinez family goes bowling every Sunday evening.
Usually, they have a lot of fun together.
Occasionally, the two older children get too competitive and start to argue.
When that happens, they're not allowed to bowl with the rest of the family.
The younger kids are always happy to bowl the extra frames.
5. Tracy and her two roommates spend all of their free time entering sweepstakes.
They've promised to share whatever prizes they win.
So far, they've won two new computers and a trip for four to Paris.
They plan to take the trip together over spring break.
Unfortunately, they haven't figured out how to divide two computers between three people.

6. Steve, Roger and Hank are prisoners at the Dixon state correctional facility.
In 2004, they started a weekly book club.
By 2005, the club had grown to over fifty members.
Now the club is divided into three groups, each led by one of the founding members.
When Steve is released next January, he plans to start book clubs at other prisons.
7. Triton is a small town in northern Oregon.
Unfortunately for the Triton Gazette, very little happens there.
Last year, the paper's biggest story was about a sinkhole created by a broken water main.
The editor is hoping for at least one good story this year.
If the paper's circulation doesn't improve, it will go out of business.
8. When Jan was a child, her father planted a walnut tree in their backyard.
She used to play in the tree almost every day.
Jan still lives in the same house, but the walnut tree is dying of a disease.
If it can't be cured soon, it will have to be cut down.
If that happens, Jan wants to plant a new one in its place.
9. Gareth Jenkins writes novels about politics in the Soviet era.
Before he begins each novel, he goes through a specific routine to avoid writer's block.
First, he goes to a spa for a two-hour massage.
Then he takes a long walk through the countryside.
By the time he finishes his walk, his mind is clear, and he's ready to write.
10. Of all the piano composers, Andy used to like to play Scarlatti the best.
Occasionally, he would play all of the Scarlatti sonatas in a row without getting up.
For awhile, he actually refused to play anything else.
When that happened, Andy's piano teacher took some action to get him to branch out.
Now Andy only wants to play Beethoven.
11. On Sunday, Maggie and Terry will be having a yard sale.
They've lived in the same house for fifteen years, so they have a lot of stuff to get rid of.
Maggie is eager to sell Terry's collection of antique car posters.
She's also hoping to sell some furniture that's been in storage for years.
They plan to spend the money they make on a trip to Costa Rica.
12. Larry runs a small internet company out of his home.
Last April, he waited until the last minute to file his taxes.
The night before they were due, he still couldn't find several important receipts.
When midnight rolled around, he finally gave up.
From now on, he plans to hire an accountant to handle his taxes.
13. The butcher shop on Clark Street has the best smoked meat in town.
The bacon is actually made on-site by the owner.
The smoked duck comes from an organic farm just outside the city.

Around November, they even start selling whole smoked turkeys.
Surprisingly, the shop is best known for its selection of cooking spices.

14. Darla likes to make her own videos and post them on YouTube.
Her first video was a parody of acceptance speeches at the Academy Awards.
She also made a documentary about hazing that got a lot of attention from the press.
At one point, a local TV news producer even offered her an internship.
She turned down the job but is thinking about majoring in journalism.
15. Sheila is a comedy actor and lives in Chicago.
For now, she is mostly working without pay.
Once she gets some experience, though, she plans to move to New York.
There, she'll have a better chance of finding a job that pays.
Once that happens, she'll finally be able to join an actors union.
16. On April 12th, Quinn will turn forty years old.
Her brother Sean is planning a huge surprise party for her.
Everybody will be at the party, including Quinn's two kids, Grady and Liam.
The biggest challenge will be to make sure Grady doesn't spill the beans.
He's only five and still has a lot of trouble keeping secrets.

APPENDIX B: Experiment 2 Test Stimuli

Test Items

Matrix/Embedded Context

1. Before the main course was served, the hostess made Sharon slurp the soup.
When the desserts arrived, she used bad manners.
a. The hostess used bad manners during dessert.
b. Sharon used bad manners during dessert.
2. At the beginning of the bus tour, the guide allowed the teenager to hang out of the window.
Towards the end of the tour, he did something careless.
a. The teenager did something careless near the end of the tour.
b. The guide did something careless near the end of the tour.
3. Last weekend, Max helped Lewis carry out old Mrs. Siegel's trash.
Yesterday, he did something neighborly.
a. Max did something neighborly yesterday.
b. Lewis did something neighborly yesterday.
4. When the Confederate troops attacked, the general commanded the colonel to order a retreat.
On the fifth day of battle, he made a bad decision.
a. The colonel made a bad decision on the fifth day of battle.
b. The general made a bad decision on the fifth day of battle.
5. At the house party, Tanya cajoled Paula into embarrassing Tom.
At school the next day, she did something mean.
a. Tanya did something mean at school the next day.
b. Paula did something mean at school at school the next day.
6. During the Nortox trial, Anna blackmailed Karen into lying under oath.
After the trial ended, she broke the law.
a. Karen broke the law after the trial ended.
b. Anna broke the law after the trial ended.
7. Yesterday, Wanda made the babysitter forbid the kids to play in the street.
This morning, she imposed some rules.
a. Wanda imposed some rules this morning.
b. The babysitter imposed some rules this morning.
8. During Monday's planning meeting, Maggie appointed Diane to choose a venue for the presidential luncheon.
The day after the luncheon, she made an important decision.

- a. Diane made an important decision the day after the luncheon.
 - b. Maggie made an important decision the day after the luncheon.
9. At the figure skating qualifier, Stacy hired Erica to bribe the judges.
During the championship competition, she did something dishonest.
- a. Stacy did something dishonest during the championship.
 - b. Erica did something dishonest during the championship.
10. At the blackjack table, Hannah tricked Judy into swindling the other players.
Later on, at the poker table, she did something underhanded.
- a. Judy did something underhanded at the poker table.
 - b. Hannah did something underhanded at the poker table.
11. At the restaurant, Paul convinced Alan to sweet-talk their way out of the bill.
At the coffee shop, he was very persuasive.
- a. Paul was very persuasive at the coffee shop.
 - b. Alan was very persuasive at the coffee shop.
12. Early in the campaign, Carrie obstructed Laura from meddling in the other candidates' political dealings.
Later in the campaign, she interfered.
- a. Laura interfered later in the campaign.
 - b. Carrie interfered later in the campaign.
13. During the math exam, Jenny recruited Alice to steal the answer sheet from Mr. Baker's desk.
Later on, in biology class, she tried to cheat on the test.
- a. Jenny tried to cheat on the biology test.
 - b. Alice tried to cheat on the biology test.
14. While working the lunch shift, Kevin made Hank drop a tray full of desserts.
During the dinner shift, he caused a disaster.
- a. Hank caused a disaster during the dinner shift.
 - b. Kevin caused a disaster during the dinner shift.
15. Before the first committee meeting, Claire directed Jane to organize the new members.
At a later meeting, she took charge.
- a. Claire took charge at a later meeting.
 - b. Jane took charge at a later meeting.
16. At the hotel check-in counter, Alex implored Roger to ask for the executive suite.
While ordering room service that night, he made a request.
- a. Roger made a request.
 - b. Alex made a request.
17. In the first half of the comedy routine, Steve hypnotized Andrew into doing a chicken dance.
During the second half, he amused the audience.

- a. Steve amused the audience during the second half of the routine.
 - b. Andrew amused the audience during the second half of the routine.
18. On Friday morning, Brian frightened Scott into taking the little girl's lunchbox.
Later that day, he acted like a bully.
- a. Scott acted like a bully later that day.
 - b. Brian acted like a bully later that day.
19. After the birthday party, Dirk helped his little brother write thank-you notes to the guests.
Later that day, he did something nice.
- a. Dirk did something nice.
 - b. Dirk's little brother did something nice.
20. While the Arches project was underway, Courtney appointed Ellen to pick the design of the new media center.
During a later project, she made a bad choice.
- a. Ellen made a bad choice during a later project.
 - b. Courtney made a bad choice during a later project.
21. When the burning house started to collapse, Mike helped Harry rescue the girl trapped inside.
The next day, during a routine emergency call, he did something heroic.
- a. The next day, Mike did something heroic during a routine emergency call.
 - b. The next day, Harry did something heroic during a routine emergency call.
22. At the first dorm meeting, Susan directed Beth to tell the new students where to put their garbage.
At the second meeting, she gave an instruction.
- a. Beth gave an instruction at the second meeting.
 - b. Susan gave an instruction at the second meeting.
23. When the voting scandal was uncovered, the judge ordered the governor to insist on a recount.
In a later scandal, he made a demand.
- a. The judge made a demand in a later scandal.
 - b. The governor made a demand in a later scandal.
24. After the appetizers were served, the waiter made Harvey eat the pasta with his fingers.
When the second round of drinks came, he showed bad etiquette.
- a. Harvey showed bad etiquette during the second round of drinks.
 - b. The waiter showed bad etiquette during the second round of drinks.
25. At the party on Friday, Janet goaded her younger sister into drinking 15 vodka shots.
The very next night, she did something irresponsible.
- a. Janet did something irresponsible on Saturday.
 - b. Janet's younger sister did something irresponsible on Saturday.

26. While at the Taste of Chicago, Cora helped Maddie give a ride to a group of senior citizens. During the Blues Festival, she did something nice.
 - a. Maddie did something nice during the Blues Festival.
 - b. Cora did something nice during the Blues Festival.
27. At the awards banquet, Neil tried to cajole Linus into embarrassing Rebecca. At work the next day, he did something unkind.
 - a. Neil did something unkind at work the next day.
 - b. Linus did something unkind at work the next day.
28. During the investigation, Ewan hired Vince to bribe the police. After the investigation was dropped, he did something illegal.
 - a. Vince did something illegal after the investigation was dropped.
 - b. Ewan did something illegal after the investigation was dropped.
29. While shopping at the street fair, Jill convinced Heidi to haggle over the price of the rug. As they were checking into the hotel, she was very persuasive.
 - a. Jill was very persuasive at the hotel.
 - b. Heidi was very persuasive at the hotel.
30. When the cocaine shipment was discovered, Cyrus tried to blackmail Alvin into tampering with the evidence. A few years later, during another bust, he did something illegal.
 - a. Alvin did something illegal during a drug bust a few years later.
 - b. Cyrus did something illegal during a drug bust a few years later.
31. While loading the truck, Ollie made Sid drop a container of toxic waste. Later that day, he created a hazard.
 - a. Ollie created a hazard later that day.
 - b. Sid created a hazard later that day.
32. At the car dealership, Luanne implored Kylie to ask for an itemized invoice. Later, while shopping for a TV, she made a request.
 - a. Kylie made a request while shopping for a TV.
 - b. Luanne made a request while shopping for a TV.

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a. Dirk did something nice.
b. Dirk's little brother did something nice.
20. While the Arches project was underway, Courtney inspired Ellen to pick the design of the new media center.
During a later project, she made a bad choice.

- a. Ellen made a bad choice during a later project.
 - b. Courtney made a bad choice during a later project.
21. When the burning house started to collapse, Mike made Harry rescue the girl trapped inside. The next day, during a routine emergency call, he did something heroic.
- a. The next day, Mike did something heroic during a routine emergency call.
 - b. The next day, Harry did something heroic during a routine emergency call.
22. At the first dorm meeting, Susan allowed Beth to tell the new students where to put their garbage. At the second meeting, she gave an instruction.
- a. Beth gave an instruction at the second meeting.
 - b. Susan gave an instruction at the second meeting.
23. When the voting scandal was uncovered, the judge convinced the governor to insist on a recount. In a later scandal, he made a demand.
- a. The judge made a demand in a later scandal.
 - b. The governor made a demand in a later scandal.
24. After the appetizers were served, the waiter saw Harvey eat the pasta with his fingers. When the second round of drinks came, he showed bad etiquette.
- a. Harvey showed bad etiquette during the second round of drinks.
 - b. The waiter showed bad etiquette during the second round of drinks.
25. At the party on Friday, Janet discouraged her younger sister from drinking 15 vodka shots. The very next night, she did something irresponsible.
- a. Janet did something irresponsible on Saturday.
 - b. Janet's younger sister did something irresponsible on Saturday.
26. While at the Taste of Chicago, Cora saw Maddie give a ride to a group of senior citizens. During the Blues Festival, she did something nice.
- a. Maddie did something nice during the Blues Festival.
 - b. Cora did something nice during the Blues Festival.
27. At the awards banquet, Neil tried to discourage Linus from embarrassing Rebecca. At work the next day, he did something unkind.
- a. Neil did something unkind at work the next day.
 - b. Linus did something unkind at work the next day.
28. During the investigation, Ewan advised Vince to bribe the police. After the investigation was dropped, he did something illegal.
- a. Vince did something illegal after the investigation was dropped.
 - b. Ewan did something illegal after the investigation was dropped.
29. While shopping at the street fair, Jill counted on Heidi to haggle over the price of the rug.

- As they were checking into the hotel, she was very persuasive.
- a. Jill was very persuasive at the hotel.
 - b. Heidi was very persuasive at the hotel.
30. When the cocaine shipment was discovered, Cyrus tried to discourage Alvin from tampering with the evidence.
A few years later, during another bust, he did something illegal.
- a. Alvin did something illegal during a drug bust a few years later.
 - b. Cyrus did something illegal during a drug bust a few years later.
31. While loading the truck, Ollie saw Sid drop a container of toxic waste.
Later that day, he created a hazard.
- a. Ollie created a hazard later that day.
 - b. Sid created a hazard later that day.
32. At the car dealership, Luanne reminded Kylie to ask for an itemized invoice.
Later, while shopping for a TV, she made a request.
- a. Kylie made a request while shopping for a TV.
 - b. Luanne made a request while shopping for a TV.

APPENDIX C: Experiment 3 Test Stimuli

Test Items

Matrix/Embedded Context

1. Before the pretrial hearing, Jill persuaded Heidi to forge a signature.
After the trial was over, she did something dishonest.
a. Jill did something dishonest after the trial was over.
b. Heidi did something dishonest after the trial was over.
2. On Friday morning, Brian scared Scott into taking the little girl's lunch money.
Later that day, he acted like a bully.
a. Scott acted like a bully later that day.
b. Brian acted like a bully later that day.
3. During the hypnotism routine, Daniel compeled Nick to do a triple backflip.
During the juggling number, he impressed the audience.
a. Daniel impressed the audience during the juggling number.
b. Nick impressed the audience during the juggling number.
4. At the restaurant, Ellen talked Mary into finagling a free appetizer.
At the bar later on, she was very persuasive.
a. Mary was very persuasive at the bar.
b. Ellen was very persuasive at the bar.
5. As the class was letting out, Lucy reminded Nicole to write a thank-you note to their teacher.
At lunch that day, she did something thoughtful.
a. Lucy did something thoughtful at lunch that day.
b. Nicole did something thoughtful at lunch that day.
6. Early in the campaign, Greg prevented Walt from obstructing the other candidates' media coverage.
Later in the campaign, he interfered.
a. Walt interfered later in the campaign.
b. Greg interfered later in the campaign.
7. During the corruption scandal, Ken allowed Peter to destroy the incriminating files.
In a later case, he did something risky.
a. Ken did something risky in the later case.
b. Peter did something risky in the later case.
8. At the prom party, Jodie got Vera to humiliate Frank.
At school the next day, she did something mean.

- a. Vera did something mean at school the next day.
 - b. Jodie did something mean at school the next day.
9. During the activity fair, Lucy instructed Nicole to organize the volunteers.
At a different event, she took charge.
- a. Lucy took charge.
 - b. Nicole took charge.
10. During the orientation meeting, the head RA advised the assistant RA to teach the freshmen how to save money.
On the first day of classes, she shared some useful tips.
- a. The assistant RA shared some useful tips on the first day of classes.
 - b. The head RA shared some useful tips on the first day of classes.
11. At the dinner party, the hostess made Vivian slurp the soup.
During dessert, she used bad manners.
- a. The hostess used bad manners during dessert.
 - b. Vivian used bad manners during dessert.
12. At the bachelor party, Jeff allowed Ryan to jump off the roof.
Later that night, he did something thoughtless.
- a. Ryan did something thoughtless later that night.
 - b. Jeff did something thoughtless later that night.
13. On Sunday, Miguel helped Travis move old Mrs. Watkin's couch.
Later in the week, he did something neighborly.
- a. Miguel did something neighborly later in the week.
 - b. Travis did something neighborly later in the week.
14. During the trial, Darrell blackmailed Sean into lying under oath.
A month after the trial, he broke the law.
- a. Sean broke the law a month after the trial.
 - b. Darrell broke the law a month after the trial.
15. Just before the fall project review, Jodie motivated Vera to reinvent several design features.
During the spring review, she really impressed the executive board.
- a. Jodie really impressed the executive board during the spring review.
 - b. Vera really impressed the executive board during the spring review.
16. At the blackjack table, Janet tricked Angie into swindling the other players.
Later on, at the poker table, she did something underhanded.
- a. Angie did something underhanded at the poker table.
 - b. Janet did something underhanded at the poker table.
17. At last year's career fair, Derek Jeter inspired Rick to volunteer for a soup kitchen on the weekends.

- At this year's fair, he did something admirable.
a. Derek Jeter did something admirable at this year's citizenship fair.
b. Rick did something admirable at this year's citizenship fair.
18. A few years ago, the storeowner convinced the cashier to invest in cheap real estate.
Recently, he made a huge mistake.
a. The cashier made a huge mistake recently.
b. The storeowner made a huge mistake recently.
19. During the game last Friday, Jeremy pressured Ethan to find out who Katie was dating.
When the subject of homecoming came up, he acted meddlesome.
a. Jeremy acted meddlesome about homecoming.
b. Ethan acted meddlesome about homecoming.
20. When the burning house started to collapse, Mike helped Harry rescue a girl trapped inside.
The next day, during a routine emergency call, he did something heroic.
a. The next day, Harry did something heroic during a routine emergency call.
b. The next day, Mike did something heroic during a routine emergency call.
21. When the voting scandal was uncovered, the judge ordered the governor to insist on a recount.
In a later scandal, he made a demand.
a. The judge made a demand in a later scandal.
b. The governor made a demand in a later scandal.
22. While preparing the annual report, Ewan persuaded Vince to overstate the company's earnings.
Later on, during a board meeting, he did something shady.
a. Vince did something shady during a board meeting.
b. Ewan did something shady during a board meeting.
23. While shopping for a new TV, Freddy talked Trevor into haggling for a better price.
Later on, at the car dealership, he was very persuasive.
a. Freddy was very persuasive at the car dealership.
b. Trevor was very persuasive at the car dealership.
24. Towards the end of the reception, Ollie reminded Sid to thank the guests as they left.
At the next day's event, he did something considerate.
a. Sid did something considerate the next day.
b. Ollie did something considerate the next day.
25. Two weekends ago, the mom made the babysitter forbid the kids to play in the street.
Last weekend, she imposed some rules.
a. The mom imposed some rules last weekend.
b. The babysitter imposed some rules last weekend.

26. While investigating a shooting, the detective allowed the lieutenant to approach the gang members.
Later in the investigation, she did something unwise.
a. The lieutenant did something unwise.
b. The detective did something unwise.
27. In the philosophy discussion section, Cyrus got Alvin to embarrass the undergrads.
During lecture the next day, he did something cruel.
a. Cyrus did something cruel during lecture the next day.
b. Alvin did something cruel during lecture the next day.
28. After the entrees were served, the waiter made the customer eat the pasta with his fingers.
When the second round of drinks came, he used bad etiquette.
a. The customer used bad etiquette when the second round of drinks came.
b. The waiter used bad etiquette when the second round of drinks came.
29. While skiing at Aspen, Claire allowed her sister to venture off the designated trail.
Later that afternoon, she did something careless.
a. Claire did something careless later that afternoon.
b. Claire's sister did something careless later that afternoon.
30. A few years ago, Jenny helped Alice find homes for the hurricane victims.
Recently, she did something generous.
a. Alice did something generous recently.
b. Jenny did something generous recently.
31. At the Sox game, Carrie urged Laura to ask the man next to them about his disability.
At a restaurant that night, she tried to pry.
a. Carrie tried to pry at the restaurant that night.
b. Laura tried to pry at the restaurant that night.
32. At the hotel check-in counter, Alex implored Roger to ask for the executive suite.
Then, while waiting for room service that night, he made a request.
a. Roger made a request.
b. Alex made a request.

Embedded Only Context

1. Before the pretrial hearing, Jill persuaded Heidi to forfeit the right to an attorney.
After the trial was over, she did something dishonest.
a. Jill did something dishonest after the trial was over.
b. Heidi did something dishonest after the trial was over.
2. On Friday morning, Brian scared Scott into giving up the lunch money.
Later that day, he acted like a bully.
a. Scott acted like a bully later that day.
b. Brian acted like a bully later that day.

3. During the hypnotism routine, Daniel compeled Nick to bark like a dog.
During the juggling number, he impressed the audience.
 - a. Daniel impressed the audience during the juggling number.
 - b. Nick impressed the audience during the juggling number.
4. At the restaurant, Ellen talked Mary into ordering liver and onions.
At the bar later on, she was very persuasive.
 - a. Mary was very persuasive at the bar.
 - b. Ellen was very persuasive at the bar.
5. As the class was letting out, Lucy reminded Nicole to pick up a handout.
At lunch that day, she did something thoughtful.
 - a. Lucy did something thoughtful at lunch that day.
 - b. Nicole did something thoughtful at lunch that day.
6. Early in the campaign, Greg prevented Walt from getting any media attention.
Later in the campaign, he interfered.
 - a. Walt interfered later in the campaign.
 - b. Greg interfered later in the campaign.
7. During the corruption scandal, Ken allowed Peter to access the incriminating files.
In a later case, he did something risky.
 - a. Ken did something risky in the later case.
 - b. Peter did something risky in the later case.
8. At the prom party, Jodie got Vera to humiliate herself.
At school the next day, she did something mean.
 - a. Vera did something mean at school the next day.
 - b. Jodie did something mean at school the next day.
9. During the activity fair, Lucy instructed Nicole to hand out flyers.
At a different event, she took charge.
 - a. Lucy took charge.
 - b. Nicole took charge.
10. During the orientation meeting, the head RA advised the assistant RA to save money by taking the shuttle.
On the first day of classes, she shared some useful tips.
 - a. The assistant RA shared some useful tips on the first day of classes.
 - b. The head RA shared some useful tips on the first day of classes.
11. At the dinner party, the hostess made Vivian sit on a rickety old stool.
During dessert, she used bad manners.
 - a. The hostess used bad manners during dessert.
 - b. Vivian used bad manners during dessert.

12. At the bachelor party, Jeff allowed Ryan to fall off the roof.
Later that night, he did something thoughtless.
 - a. Ryan did something thoughtless later that night.
 - b. Jeff did something thoughtless later that night.
13. On Sunday, Miguel helped Travis move some furniture.
Later in the week, he did something neighborly.
 - a. Miguel did something neighborly later in the week.
 - b. Travis did something neighborly later in the week.
14. During the trial, Darrell blackmailed Sean into admitting to the love affair.
A month after the trial, he broke the law.
 - a. Sean broke the law a month after the trial.
 - b. Darrell broke the law a month after the trial.
15. Just before the fall project review, Jodie motivated Vera to pay the company's overdue bills.
During the spring review, she really impressed the executive board.
 - a. Jodie really impressed the executive board during the spring review.
 - b. Vera really impressed the executive board during the spring review.
16. At the blackjack table, Janet tricked Angie into revealing her cards.
Later on, at the poker table, she did something underhanded.
 - a. Angie did something underhanded at the poker table.
 - b. Janet did something underhanded at the poker table.
17. At last year's career fair, Derek Jeter inspired Rick to consider going to college.
At this year's fair, he did something admirable.
 - a. Derek Jeter did something admirable at this year's citizenship fair.
 - b. Rick did something admirable at this year's citizenship fair.
18. A few years ago, the storeowner convinced the cashier to accept a payraise.
Recently, he made a huge mistake.
 - a. The cashier made a huge mistake recently.
 - b. The storeowner made a huge mistake recently.
19. During the game last Friday, Jeremy pressured Ethan to admit his feelings for Katie.
When the subject of homecoming came up, he acted meddlesome.
 - a. Jeremy acted meddlesome about homecoming.
 - b. Ethan acted meddlesome about homecoming.
20. When the burning house started to collapse, Mike helped Harry escape from under a fallen roof beam.
The next day, during a routine emergency call, he did something heroic.
 - a. The next day, Harry did something heroic during a routine emergency call.
 - b. The next day, Mike did something heroic during a routine emergency call.

21. When the voting scandal was uncovered, the judge ordered the governor to step down.
In a later scandal, he made a demand.
a. The judge made a demand in a later scandal.
b. The governor made a demand in a later scandal.
22. While preparing the annual report, Ewan persuaded Vince to forfeit his stake in the company.
Later on, during a board meeting, he did something shady.
a. Vince did something shady during a board meeting.
b. Ewan did something shady during a board meeting.
23. While shopping for a new TV, Freddy talked Trevor into buying a 60-inch plasma-screen.
Later on, at the car dealership, he was very persuasive.
a. Freddy was very persuasive at the car dealership.
b. Trevor was very persuasive at the car dealership.
24. Towards the end of the reception, Ollie reminded Sid to feed the parking meter.
At the next day's event, he did something considerate.
a. Sid did something considerate the next day.
b. Ollie did something considerate the next day.
25. Two weekends ago, the mom made the babysitter stay off the phone during the day.
Last weekend, she imposed some rules.
a. The mom imposed some rules last weekend.
b. The babysitter imposed some rules last weekend.
26. While investigating a shooting, the detective allowed the lieutenant to read the case file.
Later in the investigation, she did something unwise.
a. The lieutenant did something unwise.
b. The detective did something unwise.
27. In the philosophy discussion section, Cyrus got Alvin to embarrass himself.
During lecture the next day, he did something cruel.
a. Cyrus did something cruel during lecture the next day.
b. Alvin did something cruel during lecture the next day.
28. After the entrees were served, the waiter made the customer pick up the used plates.
When the second round of drinks came, he used bad etiquette.
a. The customer used bad etiquette when the second round of drinks came.
b. The waiter used bad etiquette when the second round of drinks came.
29. While skiing at Aspen, Claire allowed her sister to get lost.
Later that afternoon, she did something careless.
a. Claire did something careless later that afternoon.
b. Claire's sister did something careless later that afternoon.

30. A few years ago, Jenny helped Alice get a new business off the ground. Recently, she did something generous.
 - a. Alice did something generous recently.
 - b. Jenny did something generous recently.
31. At the Sox game, Carrie urged Laura to explain the recent doctor visits. At a restaurant that night, she tried to pry.
 - a. Carrie tried to pry at the restaurant that night.
 - b. Laura tried to pry at the restaurant that night.
32. At the hotel check-in counter, Alex implored Roger to stop rearranging their luggage. Then, while waiting for room service that night, he made a request.
 - a. Roger made a request.
 - b. Alex made a request.

APPENDIX D: Experiments 2 and 3 Control and Filler Items**Filler Items**Group 1

1. Last May, Sara entered her friend Robert in a sweepstakes.
As a result, he won a brand new computer.
 - a. Robert won a brand new computer in a sweepstakes.
 - b. Sara won a brand new computer in a sweepstakes.
2. Last Sunday, Sheila played a round of golf with Justin.
At the ninth hole, she made a hole-in-one.
 - a. Justin made a hole-in-one at the ninth hole.
 - b. Sheila made a hole-in-one at the ninth hole.
3. Once a month, Julie goes fishing with her brother Gary.
The last time they went, she tripped and fell in the water.
 - a. Julie tripped and fell in the water while fishing.
 - b. Gary tripped and fell in the water while fishing.
4. Angela is a violinist and often performs at weddings with a cellist named Joe.
At one wedding, she broke a string in the middle of a piece and almost ruined the ceremony.
 - a. Joe broke a string and almost ruined the ceremony.
 - b. Angela broke a string and almost ruined the ceremony.
5. At work, Adam shares a computer with an accountant named Kristin.
One day, she spilled coffee all over the keyboard.
 - a. Kristin spilled coffee all over the keyboard.
 - b. Adam spilled coffee all over the keyboard.
6. Recently, Derek discovered a raccoon living under his house.
It was startled by the glare of the flashlight.
 - a. Derek was startled by the glare of the flashlight.
 - b. The raccoon was startled by the glare of the flashlight.
7. Last weekend, Michelle asked Keith to help her shop for a new work outfit.
Within minutes, he found a suit that was perfect for her.
 - a. Keith quickly found a suit that fit Michelle.
 - b. Michelle quickly found a suit that fit Keith.
8. While touring Budapest with his friend Leah, Doug had his passport stolen.
That same night, he got food poisoning.
 - a. Leah got food poisoning in Budapest.
 - b. Doug got food poisoning in Budapest.

Group 2

1. Last fall, Rachel was granted early admission to Northwestern.
Her friend Amy was turned down by three different schools.
 - a. Amy was turned down by three schools.
 - b. Amy was granted early admission to Northwestern.
2. While working at Starbuck's one night, Sandra spilled coffee all over Todd.
He had to stay late to clean up the mess.
 - a. Todd spilled coffee all over a coworker.
 - b. Todd had to clean up some spilled coffee.
3. Over spring break, Shana stayed at home with her family.
Her friend Becky got to go backpacking in southern Utah.
 - a. Becky went backpacking in Utah over spring break.
 - b. Becky stayed at home with her family.
4. On Wednesdays, Mark gets a ride home from school with Cindy.
On most days, though, she has to go straight to her job at the bookstore.
 - a. Cindy gets a ride home from her friend sometimes.
 - b. Cindy works at a bookstore after school.
5. Inside the burned-out building, the police detective found a propane blowtorch.
Later on, the fire inspector found evidence that gasoline was used.
 - a. The fire inspector found evidence that gasoline was used to start the fire.
 - b. The fire inspector found a propane blowtorch in the burned-out building.
6. When their income tax returns came in the mail, Liz bought a new guitar, and Phillip bought an iPod.
She also bought a Blackberry with her quarterly paycheck bonus.
 - a. Liz bought an iPod with her income tax return.
 - b. Liz bought a Blackberry with her paycheck bonus.
7. At last year's state fair rodeo, a Nebraskan won the calf roping competition, and a Texan took second place.
This year, the Nebraskan won the bronc riding competition.
 - a. A Nebraskan won the bronc riding competition.
 - b. A Nebraskan took second in the calf roping competition.
8. At the embassy party, George met the Saudi foreign minister, and Rhonda met a representative of Macao.
Rhonda was also introduced to several U.N. ambassadors.
 - a. Rhonda met the Saudi foreign minister.
 - b. Rhonda met several U.N. ambassadors.

Group 4

1. At last month's checkers tournament, Maria took first place, and Betty took second place.
This month, Betty took first place.
a. Betty took first place in this month's checkers tournament.
b. Maria took first place in this month's checkers tournament.
2. While Tony and Josh were studying in the library, Tony thought of a great research topic.
At the gym a few hours later, Josh thought of a great research topic.
a. Tony thought of a great research topic at the gym.
b. Josh thought of a great research topic at the gym.
3. Last night, Kyle and Aaron played a prank by pouring hot sauce into the beef stew.
While making dessert, Aaron played a prank.
a. Aaron played a prank while making dessert.
b. Kyle played a prank while making dessert.
4. When Bill went skiing with David, he lost his balance and almost ran into a tree.
Then, because of a blinding snowstorm, David almost ran into a tree.
a. Bill almost ran into a tree because of a snowstorm.
b. David almost ran into a tree because of a snowstorm.
5. As a result of playing too much Xbox with Victor last fall, Brent failed chemistry.
Then, in the spring quarter, Victor failed philosophy.
a. Victor failed philosophy in the spring quarter.
b. Victor failed chemistry in the spring quarter.
6. While volunteering for an archaeology professor one weekend, Melanie discovered a Spanish coin.
Later that same weekend, the professor discovered a whole chest full of coins.
a. The professor discovered a Spanish coin.
b. The professor discovered a chest full of coins.
7. As Melissa and Kathryn were waiting for the train, Melissa dropped her hat onto the track.
When a gust of wind came up, Kathryn dropped a glove onto the track.
a. A gust of wind caused Kathryn to drop her glove.
b. A gust of wind caused Kathryn to drop her hat.
8. While Detective Frye and Detective Palmer were investigating a murder, Detective Frye received a strange phone call.
After the suspect was in custody, Detective Palmer received a strange email.
a. Detective Palmer received a strange phone call.
b. Detective Palmer received a strange email.

Group 5

1. At the field museum, the Mayan masks are located near the mummies.
Over the past week, they attracted far more visitors.

- a. The Mayan masks attracted more visitors over the past week.
 - b. The mummies attracted more visitors over the past week.
- 2. Vijay and Franz used to own a candy store on Foster.
Now he works as a loan officer at a bank.
 - a. Franz now works as a loan officer at a bank.
 - b. Vijay now works as a loan officer at a bank.
- 3. At the zoo, Polly works as a veterinarian, and April works as a docent.
Unfortunately, she doesn't get along with the zoo administrators.
 - a. Polly doesn't get along with the zoo administrators.
 - b. April doesn't get along with the zoo administrators.
- 4. As wedding gifts, Yuri bought a crystal platter, and Cory bought a silver platter.
He was worried that the newlyweds wouldn't like it.
 - a. Cory was worried that the newlyweds wouldn't like his gift.
 - b. Yuri was worried that the newlyweds wouldn't like his gift.
- 5. At this year's dog show in Rockford, the beagle won second prize, and the poodle won third prize.
Last year, it took best in show.
 - a. The beagle took best in show last year.
 - b. The poodle took best in show last year.
- 6. At the furniture store, Pam decided to buy a leather couch and Gail decided to buy an oak dresser.
After talking with a clerk, she found out that it was on sale.
 - a. Gail found out that the oak dresser was on sale.
 - b. Pam found out the the leather couch was on sale.
- 7. To get ready for their trip to Aspen, Amanda and Brenda packed several pairs of wool socks.
When they got there, she couldn't find them.
 - a. Amanda couldn't find the wool socks.
 - b. Brenda couldn't find the wool socks.
- 8. At Home Depot, Brad and Carrie talked to three different salespeople.
They didn't know very much about tools.
 - a. The salespeople didn't know very much about tools.
 - b. Brad and Carrie didn't know very much about tools.

Group 6

- 1. Near the town of Cloudville, a rancher recently discovered oil and a farmer opened a coal mine.
A few weeks later, an energy company did, too.
 - a. An energy company discovered oil.
 - b. An energy company opened a coal mine.

2. Evan is late for work a lot because his car keeps breaking down, and because he often loses his keys.
Last Tuesday, he did it again.
 - a. Evan lost his keys again last Tuesday.
 - b. Evan's car broke down again last Tuesday.
3. At the jewelry store, Danielle bought a pair of earrings, and Tara put a necklace on layaway.
At another store, Naomi did the same thing.
 - a. Naomi bought a pair of earrings.
 - b. Naomi put a necklace on layaway.
4. For the potluck banquet, Raymond brought a cake, and Vincent brought a tray of sushi.
Samantha brought the same thing.
 - a. Samantha brought a tray of sushi to the banquet.
 - b. Samantha brought a cake to the banquet.
5. After the party, Chad cleaned up the trash, and Matthew washed the dishes.
Sophie did, too.
 - a. Sophie cleaned up the trash.
 - b. Sophie washed the dishes.
6. After finals were over, Christy stayed at home watching movies, and Emma went out partying.
Seth decided to do it, too.
 - a. Seth decided to go out partying.
 - b. Seth decided to stay at home and watch movies.
7. A few weeks ago, Abigail's bike got stolen, and Darren got mugged on the same day.
Ron had the same thing happen last Friday.
 - a. Ron's bike was stolen last Friday.
 - b. Ron got mugged last Friday.
8. After church lets out, the McGuires are going bowling, and the Johnsons are going to the batting cages.
The Garcias probably will, too.
 - a. The Garcias will probably go to the batting cages.
 - b. The Garcias will probably go bowling.

Practice items

1. Bart was riding his bike home from school one day when his tire went flat.
At home that evening, he repaired the tire with a patch kit.
 - a. Bart repaired a flat tire with a patch kit.
 - b. Bart bought a new tire for the bike.
2. Last Friday, Doris was awarded a promotion at work.
To celebrate, she treated several of her friends to a steak dinner.

- a. Doris was treated to a steak dinner by her boss.
 - b. Doris celebrated her promotion with some friends.
3. For his birthday, Caleb wanted either a new sleeping bag or a new frame pack. In the end, his parents bought him a new tent and a pair of boots.
- a. Caleb got a tent and a pair of boots for his birthday.
 - b. Caleb got a sleeping bag and a frame pack for his birthday.
4. Next month, Elaine is moving to New Orleans with her boyfriend Gerard. She's planning to study at a prominent cooking school there.
- a. Gerard is planning to open a cooking store in New Orleans.
 - b. Elaine is planning to study cooking in New Orleans.