Accessibility is no Alternative to Alternatives

Michael Wagner & Jeffrey Klassen

McGill University

Abstract

Linguistic constituents that encode salient information are often prosodically reduced. Recent studies have presented evidence that higher contextual accessibility of referents results in lower prosodic prominence. Accounts of reduction in terms of accessibility set out to explain a range of phenomena that include those that are in the domain of linguistic theories of focus and givenness. The tacit assumption is that more general and independently motivated accessibility factors will be able to supplant the more specialized grammatical accounts of prosodic prominence. This paper reviews previous results and finds that existing accessibility accounts cannot explain a range of data easily captured by the alternatives theory of focus, and that various experimental studies motivating the accessibility view actually fail to distinguish between the two accounts. New experimental data is presented that teases apart the effects of accessibility and linguistic focus.

Keywords: accessibility, repetition, focus, givenness, contrast

1. Contextual Effects on Prosodic Prominence

Context affects the prosody of utterances in complex ways. One important contextual effect is that new information tends to be acoustically prominent and old informa-

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* Corresponding Address: Michael Wagner, McGill Linguistics, 1085 Dr. Penfield Avenue, Montréal, QC H3A 1A7, Canada. chael@mcgill.ca

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tion tends to be acoustically reduced. There are (at least) two contrasting perspectives on this phenomenon in the literature: Accessibility accounts attribute these contextual effects on the prosody of referential expressions to the degree of prior activation of referents, or of the linguistic material used to refer to them. The accessibility view is the perspective typically taken in the psycholinguistic literature on contextual effects on prosody. Linguistic theories of focus and givenness, on the other hand, view these reductions effects as a way of grammatically encoding anaphoric relations with antecedents in the discourse. While the two approaches aim at providing explanations for an overlapping set of phenomena, they differ in the nature of the explanation they provide, in the linguistic examples that hypotheses are typically tested on, and in the methodology used to test these hypotheses. A substantial portion of the work in both traditions does not discuss insights from the other side. There are studies that discuss predictions from both domains (e.g., Breen et al., 2010), but to our knowledge no study has yet compared the two types of theories directly. This paper reviews both types of approaches and reports experiments that tease apart their predictions.

2. Accessibility

Chafe (1974) related the prosodic prominence of linguistic expressions to whether or not a constituent was already in the ‘conscience’ of a speaker. Similarly, the choice of the form of referring expressions (e.g., pronoun vs. full noun phrase) has been argued to depend on whether the referent is the ‘focus of attention of the discourse participants’ (Grosz, 1977, 67). Clark and Haviland (1977) propose that both prosodic prominence and the form of referential expression, along with other linguistic choices made in

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1Note that this use of the word ‘focus’ in the literature on attention is unrelated to the notion of ‘focus’ as it used in linguistic work, a notion we will define below. It is the linguistically ‘given’ material that tends to be attentionally in ‘focus,’ whereas it is novel information that tends to be linguistically ‘focused.’
conversations, depends on the ‘given-new contract’ between speaker and audience.

In line with these ideas, one of the first experimental studies of the prosodic effects of accessibility (Terken, 1984) reports evidence that words that refer to previously mentioned topical referents tend to remain unaccented, and concludes: ‘speakers used accentuation to signal to the listener the degree of availability of the information conveyed: an accented expression signals to the listener that he cannot easily map the expression onto the information it refers to in the context; an unaccented expression signals to the listener that he can map the expression directly onto the intended information, since the information at that point in the utterance may be supposed to be maximally activated due to the preceding context.’ This interpretation is supported by later results from a picture verification task, that showed that both marking a constituent as given that isn’t and failing to mark a constituent as given that is increases processing cost (Terken and Nooteboom, 1987).

The literature on accessibility is mostly concerned with the choice of the form of referring expression from a scale of options that differs in the degree of accessibility they impose on their referents. Ariel (1988, 1990, 2001), for example, propose an articulated hierarchy of degrees of accessibility of referents and a hierarchy of linguistic forms to match (indefinite NP < definite NP < proper name < pronoun). Similar hierarchies have been proposed in Allerton (1978), Prince (1981), Givón (1983), and Gundel et al. (1993). Choosing a pronoun or ellipsis can be seen as one end on a scale of reduction, with accented full noun phrases on the other end. An unaccented or prosodically reduced full noun phrase can be seen as an intermediate degree of reduction.2

Accessibility approaches vary with respect to the cognitive mechanism assumed to

2Apart from the likelihood of the accentuation status (arguably a categorical distinction), there is also evidence that prosodic prominence is gradiently adjusted depending on degrees of accessibility. Brennan (1995), for example, found that pronouns are phonetically longer when their antecedents are not salient in the context, and Fowler et al. (1997) found that the same factors that favour the choice of pronouns over proper names also have an effect on the degree of prominence among proper names.
be responsible for accessibility effects, ranging from pragmatic theories in terms of discourse reference to low-level facilitation accounts of repetition in production planning. Yet they share the attractive assumption that independently motivated processing-related factors will account for referential choice and prosodic prominence. Linguistic theories of accent placement, on the other hand, view prosodic prominence placement as a grammatical tool that allows speakers to encode anaphoric relations to contextual antecedents.

3. The Alternatives-Based Theory of Focus

The alternatives theory of focus is one such anaphoric theory of prosodic prominence placement. The basic intuition behind focus theory is the idea that a shift in prosodic prominence within a constituent is always anaphoric and requires a salient linguistic antecedent. A prominence shift requires an antecedent that constrasts in substitutions of the prosodically prominent part and should be identical otherwise. We can refer to the antecedent as an alternative, and the alternatives-based focus theory in Rooth (1985) attributes a central role to such alternatives in explaining prosodic focus and other phenomena. Consider the following example:

(1) Who stole the bicycle?
    JOHN stole the bicycle.

According to the alternatives theory of focus, pronouncing the sentence with main prominence on the subject requires that alternatives to the sentence are contextually salient which vary in the choice in of subject. In the present example, these alternatives are made salient by the question, in fact, the standard theory of what questions mean

\footnote{Some researchers assume that there is a default location for placing prosodic prominence. See Wagner (2005b) and references therein for a discussion.}
involves precisely such alternative sets (Hamblin, 1973). The idea of using alternatives to account for prosodic focus can be traced to early work describing contextual effects on prosody (Paul, 1880; Halliday, 1967; Chomsky, 1971), and was elaborated in some detail already in Jackendoff (1972).

The crucial ingredient of the formalization of alternatives theory in Rooth (1985) is that the semantic denotation of every expression involves two parts: The literal meaning of the expression, and a set of alternatives. Certain operators such as only, but also the operator involved in prosodic focus, are sensitive to this second part of the meaning, to the alternative sets of a constituent. The alternative set of a constituent depends on which, if any, constituents within it are marked as focused (orthographically indicated by an index ‘F’). An alternative set for a constituent is created by substituting any focus-marked constituents within it by alternatives. If there is no F-marker, then the alternative set only consists of the constituent itself.

Alternatives theory assumes that prosodic focus involves a focus-sensitive operator \( \sim \). The \( \sim \)-operator takes the alternative set of the constituent it attaches to as its argument and introduces an anaphoric requirement that there has to be an antecedent in the discourse structure for the alternative set.

(2) \( \sim [\text{JOHN}_F \text{ stole the bicycle.}] \)

Alternatives:

\{ John stole the bicycle, Bill stole the bicycle, ... \}

Linguistic constituents in the scope of \( \sim \) that are F-marked are said to be ‘focused,’ while all material in the scope of \( \sim \) that is not F-marked is said to be marked as ‘given.’ Prosodic prominence in the scope of \( \sim \) is determined by this F-marking: Focused material within the scope of \( \sim \) has to be more prominent than non-focused
material (Rooth, 1992b; Truckenbrodt, 1995). Focus theory makes predictions about the relative prominence of constituents in an expression (Wagner, 2005b).

We make two assumptions that go beyond the original theory of focus, following (Wagner, 2005b,a). We assume that every focus operator ~ needs to bind at least one focus-marked constituent, so that every instance of marking a constituent as given necessarily requires there to be at least one constituent in the scope of ~ that is F-marked. This assumption is necessary, since otherwise repetition of a word should be a sufficient condition for prosodic reduction, contrary to fact, as we will see. Furthermore, we assume that finding an antecedent for the variable introduced by ~ requires a contextually salient linguistic antecedent. As a reviewer points out, this is not explicit in Rooth’s theory, but it seems like a natural assumption to make.

Prosodic focus-marking usually seems to be obligatory when possible. This can be captured in alternatives-theory by assuming that the requirement for an antecedent that the focus operator introduces is a presupposition or a conventional implicature. Marking a presupposition is generally obligatory when possible. For example, it is infelicitous to say *A sun is rising*, at least outside of astronomic or science fiction contexts, since the uniqueness presupposition encoded in the alternative *the sun* is satisfied (based on our world knowledge there is only one relevant sun that could be rising), and because the presupposition can be encoded it has to be encoded (Heim, 1991). Hence, *A sun is rising* is odd and *The sun is rising* is preferred—even though *sun* may very well encode new information in the current discourse. By the same token, focus theory predicts that anaphoric deaccentuation is predicted to be obligatory when possible (unless an alternative contrast is made).

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4 We follow the argument in Wagner (2005b,a) that marking focus and marking givenness can both be achieved by using an alternatives-based focus operator like ~—as opposed to other theories that posit that there is both focus-marking and givenness-marking.

5 Rooth (1992a), on the other hand, allows for instances of ~ in which no constituent in its scope carries an F-mark.
One important aspect of focus theory is that the $\sim$-operator takes syntactic scope, and which scope it takes affects the presupposition that it introduces. From the point of view of focus theory, an utterance can thus vary along the following dimensions: i) An utterance can contain no focus operator, one focus operator, or several focus operators; ii) when there is a focus operator, it can take different scope relative to linguistic material in the utterance, e.g., it could scope over the entire sentence or only over the VP, excluding the subject, depending on where it attaches in the syntactic structure; iii) for each focus operator, there has to be one or more focus-marked constituent in the scope of the operator, but which one it is can vary. We assume that $\sim$ is always introduced in the position that has the broadest possible scope given the potential antecedents in the context. For the purpose of the examples relevant for this paper, this means that $\sim$ takes scope at the sentence level, since in our materials there are always alternatives at the level of full sentences that can be used for focus antecedence.

Could the effects that focus theory set out to explain be accounted for in terms of accessibility? In some way, focus theory is also a theory of accessibility of sorts: The focus operator requires there to be a certain type of antecedent, and it is plausible to assume that the more salient and accessible the antecedent is in the context, the more likely it is that a speaker encodes the focus presupposition that effectively acts as an anaphor to it. But it is the accessibility of the antecedent that provides a contrasting focus alternative that is crucial, not the accessibility of the constituent or its referent itself. According to focus theory, repetition of a constituent alone should not sufficient for leaving a constituent unaccented.

4. Teasing apart the Theories

One crucial property of focus theory that a word can only be reduced for focus reasons if there is at least one other word or constituent that is focus-marked, and both
are in the scope of a focus operator. So in order to say *red bicycle* with emphasis on *red* it is not sufficient for the word *bicycle* or a referent that is a bicycle to be salient; it is necessary that there be a linguistic antecedent of the form *x bicycle*, where *x* is an alternative to *red*, so the linguistic context in which *bicycle* occurs is crucial. More generally, focus theory is not a theory about the accessibility of a particular (repeated or accessible) linguistic expression or its referent *itself*, but rather about the contextual accessibility of a formally related contrasting alternative that includes that constituent. When comparing focus theory to the accessibility approach, it is important to keep in mind that different studies make different assumptions about which particular factors contribute to accessibility. In the following, we will review some of the evidence that has been used to motivate accessibility-based accounts of prosodic prominence, and discuss how focus theory fares in accounting for these effects.

4.1. Grammatical and Thematic Role

Centering theory (Grosz et al., 1983, 1995) models the effect of accessibility by positing a discourse representation which ranks salient discourse referents from most central to least central. Several potential referents might be active to varying degrees. Using an (unaccented) pronoun to refer to one of the referents in an utterance requires that referent to be the highest on the list, that is, the most highly activated one that fits the features of the pronoun (e.g., the most salient female individual that is neither speaker nor addressee can be the referent of the pronoun *she*). A central claim of this approach is that referents introduced in argument slots with particular thematic roles are intrinsically more salient than others. Grosz et al. (1995) summarize evidence based on pronoun resolution in perception that the grammatical role that a referent was introduced with affects its centrality to the discourse, and argue for a hierarchy of grammatical roles (*subject > object(s) > other*). This work has impacted a broad range of studies on accessibility. Smyth (1994), Brennan (1995), Arnold (1998), and Arnold
(2001) expanded on it and showed that grammatical role in addition to thematic role has an effect on pronoun resolution.

Grammatical role and thematic role have also been argued to affect the prosodic realization of linguistic expressions (Brennan, 1995; Dahan et al., 2002; Watson, 2010). Brennan (1995), for example, discusses production evidence that pronouns are phonetically shorter when their antecedent is a subject compared with when their antecedent is an object. Dahan et al. (2002) report that referents introduced as themes are more salient than those introduced as goals. In this study, sentences with an accented target word were played in different contexts:

(3)   a. Antecedent in Theme Position: High Accessibility of *candle*:
Put the candle above the triangle.
Now put the CANDLE above THE SQUARE.

b. Antecedent in Goal Position: Low Accessibility of *candle*:
Put the necklace above the candle.
Now put the CANDLE above THE SQUARE.

The claim is that when *the candle* is introduced in theme position it should be less prominent than introduced in goal position. Intuitively, accenting *the candle* in the target instruction sounds more felicitous in (3-a) than in (3-b). Dahan et al. (2002) found evidence confirming this intuition based on eye movement data: Listeners are more likely to look at a competitor (*candy*) in (3-a) than in (3-b). We will refer to the effect of the salience of an antecedent for particular grammatical or thematic roles as

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6We’re assuming that the word *square* carried an accent in the target sentence even if it is not orthographically marked as such in the paper, because otherwise, the overall sentence should have sounded infelicitous, since there is no reason not to accent the word in this context. From the point of view of the eye-tracking study, the accentual status of *square* should not matter, since the dependent variable was eye-movements time-locked to the offset of the word *candle*.
An alternative interpretation of this data would attribute the effect to linguistic focus. The sequences differ in which kind of contrast can be marked. In (4-a), the theme would be part of the given material, while a double contrast can be marked in (4-b):

\[
\begin{align*}
(4) \quad & \text{a. Put the candle below the triangle.} \\
& \text{Now, } \sim\text{[put the candle above the [SQUARE]}_F]\text{].} \\
& \text{b. Put the necklace below the candle.} \\
& \text{Now, } \sim\text{[put the [CANDLE]}_F\text{ above the [SQUARE]}_F\text{].}
\end{align*}
\]

The fact that the referent of *candle* is referred to in both preceding contexts is not sufficient under focus theory to justify reducing the prominence of the word. Focus theory predicts that speakers reduce *candle* in (4-a) but not in (4-b), since only in the former case is there an appropriate antecedent to mark focus. The predictions of accessibility and focus are thus the same in this case, and this type of evidence can hence not be used to distinguish between the two explanations. A simple change in word order in the example in (5) pits the predictions of focus theory and those of thematic accessibility directly against each other:

\[
\begin{align*}
(5) \quad & \text{a. Put the candle below the triangle.} \\
& \text{Now, } \sim\text{[put the [SQUARE]}_F\text{ above the [CANDLE]}_F\text{].} \\
& \text{b. Put the necklace below the candle.} \\
& \text{Now, } \sim\text{[put the [SQUARE]}_F\text{ above the candle].}
\end{align*}
\]

Focus theory predicts *candle* will be less prominent in (5-b) than in (5-a), while thematic accessibility predicts the opposite. Our intuition regarding this example clearly sides with focus theory, and we will see experimental evidence supporting this intuition in
4.1.1. Predictability, Repetition, and Focus

Nooteboom and Terken (1982) directly manipulated the predictability of certain discourse referents. The idea underlying the experiment was that a more predictable referent should be more accessible, and this should be reflected in the prosodic realization of the expression referring to it. A particular letter on the screen was manipulated to be more or less likely to be referred to. There was indeed an effect of predictability, but there was a much stronger effect of linguistic context: When the letter was referred to in a previous statement, it was much less likely to be accented than otherwise, independent of its predictability. They conclude that while that while the predictability of the encoded information may matter, what seems to be more important is the accessibility of the linguistic form conveying that information.

Centering theory and other accessibility approaches were not originally designed to model the salience of linguistic material but rather that of their referents, and yet the notion of a linguistic antecedent has proved essential in order to account for prosodic prominence, not just in Nooteboom and Terken (1982), who even report a gradient effect such that more repetitions lead to greater reduction. Further evidence that repetition is important comes from Baumann (2006), who reports on an experiment in which a referent was made salient either by an auditory linguistic stimulus or a visual stimulus in the form of a picture. The auditory linguistic antecedent had a much stronger effect on the prosodic realization of the referring expressions and was much more frequently deaccented. Similarly, Baumann and Riester (2012) argue for the importance of the distinction between referential given (the activation of the referent)

\footnote{In fact, Terken and Hirschberg (1994), a widely-cited accessibility-based paper, already showed a related finding which conflicts directly with the basic expectations of thematic accessibility, to be discussed in more detail below.}
and lexical givenness (the activation of the linguistic materia), the latter of has a greater effect on prosodic prominence.

That repetition should have a facilitating effect seems plausible since repetition is a known factor in language processing and processing in other cognitive domains. For example, repetition priming (see Forster and Davis, 1984, and references therein) effects have been extensively studied in work on both language processing and face recognition. Various studies indeed found repetition effects on prosody, (Brown, 1983; Terken, 1984; Baumann, 2006; Lam and Watson, 2010; Watson, 2010). However, in at least some of these studies the manipulation of repetition was arguably confounded with linguistic focus. Lam and Watson (2010, 1140), for example, manipulated both predictability and repetition, similar to Nooteboom and Terken (1982), in a production experiment that elicited the following types of sequences of sentences:

(6) a. Repeated noun
   The axe is shrinking . . . The axe is flashing.

   b. Non-repeated noun
   The penguin is shrinking . . . The axe is flashing.

The finding was that repeated words are reduced in prominence compared to non-repeated words, while there was only a marginal effect of predictability. The two conditions in (6) differ in which antecedents are available for focus-marking. In (6-a), there is an antecedent of the form the axe is x-ing, which can be marked by the focus-marking in (7-a), while this marking would not be possible in (6-b) since there is no appropriate antecedent. In (6-b), a double contrast can be marked, which in turn is impossible in (6-a).

(7) a. ∼[The axe is [flashing] F ]

   b. ∼[The [axe] F is [flashing] F ]
Since focus makes the same prediction as repetition in this case, it is not possible to
tell which factor the observed reduction is due to. An account based on production-
facilitation as in Lam and Watson (2010) would presumably predict repetition-based
facilitation effects even in cases in which the repeated material cannot be part of the
non-F-marked *given* material in the scope of a focus operator, and we test this predic-
tion in both Experiments 1 and 2.

The potential for confounding cuts both ways: Breen et al. (2010) report evidence
for prosodic effects of focus, but many of the effects attributed to focus could also be
due to repetition. Is there any clear evidence for pure repetition effects? The standard
references usually cited for repetition effects do not provide enough information to tell
whether the repetition and focus effects were correlated. The effects in Nooteboom
and Terken (1982), for example, are consistent with a repetition effect, but could also
be a focus effect. Similarly, in a classic study on the effects of repetition, Fowler and
Housum (1987) looked at data in a corpus with monologues from the Prairie Home
Companion and annotated whether or a not a word was repeated or not. Since the
data were not annotated for focus structure, it’s not possible to evaluate to what degree
the observed effects are attributable to repetition or focus-marking.

However, Bard et al. (2000) found evidence in their corpus study for a repetition
effect that does not reduce to givenness, and so did at least two experimental studies.
Wagner et al. (2010) examined various factors affecting prosodic prominence. Using the
focus-sensitive operator *only*, the alternatives relevant for the evaluation of the truth
condition of the sentence were carefully controlled for. In two conditions *only* operated
over alternatives of two arguments, thus both were focused. The context manipulated
whether the words used in the context were repeated or not:

(8)   a. Repeated:

      [...] Grandma didn’t give a scarf to Maryanne, and she didn’t give either a
bunny or a scarf to John.

~Grandma only gave a bunny\textsubscript{F} to Maryanne\textsubscript{F}.

b. Not Repeated:

[...] Grandma picked one present and gave it to her favorite grandchild.

~Grandma only gave a bunny\textsubscript{F} to Maryanne\textsubscript{F}.

The results showed a reduced duration for the target words when they were repeated. A second study that found a repetition effect that is not confounded by focus is Kahn and Arnold (2012). The experiment included sequences of sentences consisting of a subject (e.g., a windmill, a tomato, or a candle) and one out of four actions (rotating, shrinking, expanding, and fading). Neither nouns nor predicates were repeated in the three instructions, but speakers heard auditory primes that either included or didn’t include the nouns they were just about to speak. From the point of view of focus theory it should be possible to mark a double focus in these cases since both the subject and the VP contrast, independent of whether the participants were primed with the nouns beforehand or not:

\begin{align*}
(9) & \quad a. \quad \sim[\text{The windmill}]\textsubscript{F} \text{ shrinks}\textsubscript{F}. \\
& \quad b. \quad \sim[\text{The tomato}]\textsubscript{F} \text{ rotates}\textsubscript{F}. \\
& \quad c. \quad \sim[\text{The candle}]\textsubscript{F} \text{ fades}\textsubscript{F}.
\end{align*}

So focus structure alone cannot explain any differences in this case due to the priming manipulation. And yet there was an effect such that when the target noun was played to the speaker beforehand the target word was shorter. Both studies thus found an effect on the duration of the target word due to repetition that cannot be accounted for in terms of focus.

That repetition would have an effect on prominence seems plausible, since a production plan might still be active from the previous occurrence at the time of planning,
and this could have an effect on articulation. Bard et al. (2000) and Bell et al. (2009) argued that givenness and predictability effects are a result of speaker-internal facilitation processes, such as the speed of lexical retrieval rather than an attempt to optimally design an utterance for the listener. Frank and Jaeger (2008) provide evidence for phonetic and phonological length effects of predictability in contractions, and propose that this is a reflex of an optimal use of resources in production planning (cf. Jaeger, 2010, for more discussion and references). While these authors used corpus evidence to argue their case, Lam and Watson (2010) and Kahn and Arnold (2012) present laboratory evidence in favor of a facilitating effect of repetition in production. A nice argument that some accessibility effects are the result of the production processes is presented in Gahl et al. (2012), who found evidence that high lexical neighborhood density correlates with decreased duration. This points to an effect in terms of production-facilitation, since high neighborhood density increases rather decreases difficulty in perception, so any effect based on the speaker’s assessment of the needs of the listener would predict lengthening instead of shortening.

In sum, there is good reason to believe that repetition has an effect, above and beyond the effect to linguistic focus marking. But in various previous studies that argued in favor of such effects, there was arguably a confound with the effects of linguistic focus. The experiments in this study manipulate and cross both factors in the same experiment, thus testing for both types effects, and allowing for a comparison of the differences in effect size between the two types of factors.

4.2. Focus and Parallelism

One previous influential study on prosodic reflexes of accessibility, Terken and Hirschberg (1994), already provides results that speak to the question whether repetition or focus is behind contextual effects on prosody. Terken and Hirschberg (1994) set out to test the effect of accessibility on the prosodic realization of referring expres-
sions. The experiment investigated realizations of arguments in subject, object and PP-argument position (the paradigms below only illustrates the examples looking at direct object position), and each target word in each utterance was annotated by two annotators for whether it was accented or not. Consider the rendition of the word *ball* in the last sentence in the following paradigms:

(10) Given, Same Thematic Role
    a. The cone touches the ball.
       The cross touches the ball.
       The diamond touches the ball.
       The star touches the ball.
    b. Given, Different Thematic Role
       The ball touches the cone.
       The ball touches the cross.
       The ball touches the diamond.
       The star touches the ball.
    c. New
       The cone touches the square.
       The cross touches the square.
       The diamond touches the square.
       The star touches the ball.

Averaged accentedness-scores were determined (a higher score reflects a higher chance that an accent was annotated). The results for subject/object cases are summarized in Table 1.

The results showed that *the ball* was more likely to remain unaccented only when there was a previous mention of *the ball* in the same argument slot. There was no effect


Table 1: Accentedness scores from Terken and Hirschberg (1994). A higher number reflects a higher rate of accentuation of the target word according to the scores of two annotators.

<table>
<thead>
<tr>
<th>Position in Context</th>
<th>Position in Target Utterance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Subject</td>
</tr>
<tr>
<td>Subject</td>
<td>2.1</td>
</tr>
<tr>
<td>Object</td>
<td>3.3</td>
</tr>
<tr>
<td>New</td>
<td>3.3</td>
</tr>
</tbody>
</table>

of repetition when the referring expression was repeated in a position other than in the one it was originally introduced in. The central finding was that a referring expression remains unaccented when it was co-referent with an antecedent with the same thematic role as the current referring expression.\(^8\)

The hypothesis offered in Terken and Hirschberg (1994) in light of these results is framed in terms of accessibility: ‘We may speculate that such antecedents are made accessible from the current expression by virtue of this property-sharing.’ The idea, based on related proposals from the literature on pronominalization (Kameyama, 1986), is that a target word is accessible only if its antecedent shared the properties of thematic role (cf. Smyth, 1994; Arnold, 1998, 2001, 2010). The observed prosodic effect here can therefore in principle be accommodated with such a richer notion of accessibility. However, evoking parallelism as a factor influencing accessibility does not yet explain why there are such parallelism effects. There is nothing in the accessibility theory itself that would lead to this prediction, even though it is a recurring observation in the accessibility literature that such effects exist.

Furthermore, accessibility theory does not give a reason why parallelism should trump thematic role accessibility. Not only is the effect of parallelism apparently stronger than the effect of the thematic roles, the effect of the thematic role of the

\(^8\)Note that the study does not tease apart grammatical role vs. thematic role, so either interpretation would be valid.
antecedent was altogether absent in Terken and Hirschberg (1994). In other words, the experiment showed no evidence for the most basic accessibility effect, namely that referents introduced with the thematic role of an agent or with in the grammatical position of the subject should be more accessible and hence expression referring to them should be less likely to be accented compared to referents that were introduced with the thematic role of patient as grammatical objects—in fact, the opposite was the case.\(^9\)

Consider now the predictions of focus theory. Given the context, one possible focus-marking for (10-a) is the one in which only the subject is marked as focused, which encodes the presupposition that there is a salient antecedent of the form \(x \text{ touches the ball}\) where \(x\) is an alternative to \(the \text{ star}\), as in (11-a). In fact, this is the only possible focus presupposition that can be encoded here. Clearly, there is no salient antecedent of the form \(the \text{ star touches } x\) where \(x\) would be a non-identical alternative to \(\text{ ball}\) that would justify the focus-marking in (11-b)—all other propositions salient in the context have \(\text{ ball}\) in direct object position. Similarly, there is no salient alternative of the form \(the \ x \text{ touches the } y\) where \(x\) is an alternative to \(\text{ star}\) and \(y\) is an alternative to \(\text{ ball}\) as would be required for (11-c)—while there is an alternative to \(\text{ star}\), there isn’t for \(\text{ ball}\).

(11)  
\begin{align*}
\text{a. } & \sim[[\text{The star}]_F \text{ touches the ball}] \\
\text{b. } & \sim[[\text{The star touches [the ball]}_F] \\
\text{c. } & \sim[[\text{The star}]_F \text{ touches [the ball]}_F]
\end{align*}

In other words, the only feasible focus-marking is that in (11-a), which is the one which will lead to a prosodically reduced unaccented realization of \(\text{ ball}\). The situation is very

\(^9\)The effect in the opposite direction might have phonological reasons: Post-focal prosodic reduction is much stronger than pre-focal reduction (cf. Wagner, 2005b, and references therein). Our experimental results reported below show a similar asymmetry based on two different thematic roles.
different when thematic roles between context and target sentences are switched, as in (10-b). Here, there are salient antecedents such that both the star and the ball are replaced by alternatives, such that an alternative of the form \( x \) touches the \( y \) emerges, e.g.: The ball touches the cone. The focus-markings in which either only the subject or the object are accented are ruled out, however, since there is neither an antecedent of the form \( x \) touches the ball nor of the form The star touches \( x \). The correct prediction is thus that both the star and the ball should be accented. The prediction focus theory makes for the condition (10-b) is thus identical to the prediction for the control condition in (10-c): The only focus-marking for which the required salient antecedent is present is (11-c). These predictions are exactly borne out by the data in Terken and Hirschberg (1994), who however do not consider an explanation in terms of focus theory. Parallelism effects are a straightforward prediction of focus theory.

Let’s now turn to a second parallelism effect observed in Terken and Hirschberg (1994). When the antecedent was in the same surface position (in this case, sentence-finally), the target word can be deaccented even though it does not have the same thematic role:

\[(12) \quad \text{Effect of Surface Position}\]

\[\text{a. Object Antecedent, Target PP}\]

The cone touches the ball.

The cross touches the ball.

The diamond touches the ball.

The star pushes the square against the ball.

\[\text{b. PP antecedent, Target Object}\]

The cone pushes the rectangle against the ball.

The cross pushes the line against the ball.

The diamond pushes the triangle against the ball.
The star touches the ball.

Terken and Hirschberg (1994) interpret this effect as a consequence of sharing the surface-position with the antecedent, but adding parallelism in surface position to the list of factors affecting accessibility (in addition to thematic role or the antecedent, and sharing thematic role or grammatical role with the antecedent). Focus theory predicts these effects without additional stipulations.¹⁰ Let’s first consider what focus theory says about the case in which a PP object serves as an antecedent for a direct object in (12-b). The context clearly does not contain an antecedent of the form The star touches x, so the focus-marking in (11-b) is ruled out, and there should also be no antecedent of the form x touches y where y is an alternative to ball. The case is less clear with x touches the ball. While there is no direct antecedent for this focus-marking, if something is pushed against the ball this entails that something touches the ball, in the case of the closest antecedent that would be the triangle. Prosodic focus-marking of such an antecedent inferred by a ‘bridging’ inference are amply discussed in the literature on linguistic focus (cf. Schwarzchild, 1999). So one rendition in the experiment may have been placing an accent on the star and none within the VP touches the ball.

More likely, though, speakers may have pronounced this sentence with an accent on touches, and no accent on the ball. This pronunciation evokes a contrast between the two actions touches and push the triangle against. That these could be contrasted seems plausible, especially since these are two of the possible actions that were part of the alternative actions used in the experiment. The focus-marking to express this contrast would be the following:

(13) ～[The star [.touches] F the ball]

¹⁰There still may be a pure phonological effect of position in addition to the focus effect. For such a phonological effect on prosodic prominence see Wagner (2012).
Let’s finally turn to the case in which a direct object served as an antecedent for the deaccentuation of a PP object in (12-a). Again, in this example *pushes the square against* might be contrasted with *touch*. The focus-marking would be:

(14)  ~[The star [pushes the square against]_F the ball]

This focus structure requires alternatives of the form *x-es the ball* to be salient in the context. Note that for the focus structure in (14) a non-standard constituent structure is needed, since only syntactic constituents can be F-marked. The sequence *push the square against* as a whole is treated as a constituent for the purposes of focus-marking. This raises interesting syntactic questions. Such a non-standard constituent structure is at least independently motivated by the fact that *push the square against* can act as a constituent for other purposes. For example, *touch* and *push the star against* can be coordinated:

(15)  The star first touched and then pushed the square against the ball.

To recapitulate: Terken and Hirschberg (1994) report that their study “explored the possibility that accessibility is a major factor governing the use of deaccentuation.” And yet their findings failed so show evidence one of the central predictions of the accessibility-based view: There was no effect of immediately preceding previous mention of a discourse participant, except in cases where the linguistic antecedent had the same thematic role or was in the same surface position as in the antecedent, nor was there any indication that different thematic roles lead to different degrees of accessibility. The observed of parallelism are unexpected by—even if not incompatible with—accessibility theory. In order to account for the these effects, Terken and Hirschberg (1994) posited

---

11 This type of construction is often referred to as ‘right-node raising,’ following Ross (1967).
that accessibility increases if features or surface position are shared between antecedent and referring expression (cf. Smyth, 1994). This amounts to stipulating that parallelism contributes to accessibility. Focus theory, on the other hand predicts the observed parallelism effects without additional stipulations.

Let’s consider again why it might be that when saying the star touches the ball after just having said the diamond touches the ball, it is practically obligatory in English to shift prominence to the subject and deaccent touches the ball. Under the focus account, the reason is that there is a contrasting alternative of the form x touches the ball. Under the predictability explanation of parallelism in Arnold (1998) it would have to be because we expect the VP touches the ball given the prior sentence. This is a very different intuition: The predictability account holds that speakers deaccent the VP because they find its content predictable, while focus theory instead requires that there be a contrasting antecedent of the form x touches the ball.

4.3. Interim Summary: Two Types of Theories

Two types of theories were outlined, accessibility theories and focus theory. We focused on prior evidence for accessibility, and made the point that time and again, the two types of accounts actually make similar predictions. To our knowledge there has been no attempt in the prior literature to try to explain the data originally used to motivate focus theory in terms of accessibility. Consider the following example:

(16) a. What are you upset? Well, he chose John over Sue.
   b. He chose John over Sue?
      Yes, he chose John over Sue.

The prominence pattern in the two responses in (16) are similar in that both John and Sue can and usually will receive some prominence and carry an accent. Although these two referential expressions encode given information in (b), a rendition with an unac-
cented Sue and main prominence on John seems infelicitous. A property distinguishing the alternatives theory of focus from accessibility approaches is that it makes the notion of contrast between linguistic expressions central to the understanding of prosodic prominence. In absence of a contrast, that is, in both examples in (16), a prominence shift is therefore not expected from the point of view of focus theory. Accessibility theory, on the other hand, needs to add further stipulations, maybe: A highly accessible word is only reduced when there is other material in the sentence that is not as accessible and henceforth not reduced. There is no intrinsic theoretical motivation within the accessibility approach why any material in the sentence other than the constituent whose accessibility is in question should matter. One could imagine an account in terms of the relative conditional probability of constituents. However, to our knowledge, no such an account has been developed, at least not to the point that its predictions could be compared to those of focus theory.

Papers set within the framework of accessibility theory often use examples involving contrastive focus or prosodic question-answer congruence in their exposition of contextual effects on prosody. These make for effective illustrations that everyone has strong intuitions about. Consider (Watson, 2010):

(17)  a. Who angered Cheri?

      Brian angered Cheri.

   b. Did Cheri babysit Otto?

      No, Brian babysat Otto.

The constituents angered Cheri and babysat Otto are repeated in these contexts, so arguably the repetition account could explain this shift in prosodic prominence to the subject. However, repetition alone fails to make correct predictions for simple variations on these examples. In the following two dialogues, both Brian and Cheri are salient,
and *Brian* should be more salient because it’s in subject position, at least according to the thematic accessibility. Furthermore, in both dialogues *angered Cheri* is made salient. So why does prominence fall where it does in these two examples?

\[(18)\]

a. Who angered Brian’s girlfriend Cheri?

   BRIAN angered Cheri.

b. Did Brian anger Cheri?

   Yes, Brian angered ChERI.

Focus theory straightforwardly accounts for the difference. An antecedent for focus marking on the subject only exists in (18-a), but not in (18-b), where shifting prosody is dispreferred and requires accommodating that the question *Who angered Cheri* is relevant. Another problem for accessibility approaches is that deciding whether an alternative is suitable requires pragmatic reasoning (Wagner, 2006; Büring, 2008; Katzir, 2013). Consider the following example (from an experiment reported in Wagner, 2010):

\[(19)\]

a. No Antecedent

   My friend Mary has pretty high standards when it comes to food and drink. So guess what she brought for last night’s dinner: A good wine.

b. Antecedent for ‘wine’, but no real alternative to ‘good wine’: My friend Mary knows everything about French wine, and has pretty high standards when it comes to food and drink. So guess what she brought for last night’s dinner: A good wine.

c. Antecedent for ‘wine’, alternative contrasting with ‘good wine’: My friend Mary is a bit of a snob, and despises bad wine, and also bad food. So guess what she brought for last night’s dinner: A GOOD wine.
Wagner (2010) reports that speakers in a production study systematically shift prominence to the adjective in cases in which there is a contextually salient mutually exclusive alternative, as in (19-c). Speakers do not shift prominence in cases like (19-b), where there is an antecedent for ‘wine,’ but no pragmatically plausible contrast to ‘good wine,’ at least according to the stereotypes about wine. Similarly, a corpus study on German reported in Riester (2013) shows evidence that prominence shifts to an adjective only occur when a relevant contrastive alternative is salient or implied. This type of effect can be accounted for by the alternatives theory of focus since it has recourse to the notion of ‘alternative’ in the first place, while it is unclear how such effects would be handled in terms of predictability or accessibility.

For the purposes of this paper, we will continue to focus on a narrower set of examples, examples of the very kind that have been used to motivate the accessibility approach. The precise mechanism that is assumed to underlie accessibility effects will not be central to our argument. Our main question is whether the factors that have been related to accessibility exert an influence on prosodic prominence once linguistic focus is controlled for.

5. Experiment 1

The first experiment is closely modelled after a production study reported in Watson and Arnold (2005) and Watson (2010). This study involved a set of conditions in which accessibility theory and focus theory arguably make similar predictions. The first goal was to replicate the effects observed there. Second, we wanted a baseline for the interpretation of Experiment 2, in which we tease apart the predictions of the two types of theories.
5.1. Materials and Predictions

Participants were recorded on a sequence of three instructions on each trial. They were asked to imagine them as instructions for a game, saying them as naturally as possible, as though they were telling them to somebody who has to follow the instructions. The materials were designed to parallel the materials in Watson and Arnold (2005) and Watson (2010). As in the original study, the target word always appeared in theme position of a ditransitive imperative instruction, and was followed by a prepositional goal. We manipulated whether the target word (e.g., bed in our example below) was repeated twice, once, or not at all in the previous instructions. We also manipulated whether the previous instances of the word were in the same thematic position as the antecedent or whether they were in a different position. The sentences were displayed as text on separate lines to the participant. The participant was given time to familiarize herself with the sentences, and then asked to produce the sentence as if given instructions to someone else, and to speak as naturally as possible, as if in a conversation. We recorded the participants with a Logitech Headset microphone. An example item:

(20) Example Item, Experiment 1

a. 2 Repetitions, Antecedent in Same Position
   Move the bed above the flag.
   Now, move the bed above the house.
   Now, move the bed above the pineapple.

b. 1 Repetition, Antecedent in Same Position
   Move the piano above the flag.
   Now, move the bed above the house.
   Now, move the bed above the pineapple.

c. 2 Repetitions, Antecedent in Different Position
   Move the piano above the bed.
   Now, move the house above the bed.
Now, move the bed above the pineapple.

d. **1 Repetition, Antecedent in Different Position**
Move the piano above the flag.
Now, move the house above the bed.
Now, move the bed above the pineapple.

e. **No Antecedent for Reduction**
Move the piano above the flag.
Now, move the house above the bell.
Now, move the bed above the pineapple.

In Experiment 1 the target was always in theme position, and the antecedent was either in theme position (‘Same’) or in goal position (‘Different’). The terminology ‘Same’ and ‘Different’ is deliberately neutral with respect to the position of the antecedent and the target, which will become important when comparing the results between Experiment 1 and Experiment 2, where the target word is always in goal position. The materials for this study consisted of 35 items similar to those in (20). No content words were repeated throughout the course of the experiment, other than those that were deliberately repeated within a trial as part of the manipulation of the experiment.

The materials of Experiment 1 are parallel to those used in Watson and Arnold (2005) and Watson (2010), except that we added condition (c) in which the target word was mentioned twice in goal position in the first two instructions. The predictions of the accessibility theory, which the original study set out to test, is that the prominence of the target word should decrease with more repetition, and furthermore that an antecedent in theme position should lead to greater reduction than an antecedent in goal position, since the former will make the referent more accessible. Accessibility theory predicts the four original conditions to form a prominence scale, as proposed in Watson (2010):
It is not obvious where exactly to fit the added condition in our design with two repetitions in goal position. The prediction of accessibility theory is that two repetitions will lead to greater reduction than a single repetition, and also that two repetitions in goal position should lead to less reduction than two repetitions in the theme position. It is not clear whether in this case the target word should be more or less reduced than in the 1-Theme case—this would depend on the size of the repetition effect compared to the size of the positional effect, which in principle Experiment 1 could help establish.

The predictions of focus theory are very different from those for repetition accessibility, and quite similar to those for thematic accessibility. For three of the five conditions there is an antecedent for double focus-marking of the form ‘move X to Y’ where both X and Y are alternatives to the words used in the previous instruction in the respective positions. Only in the two conditions where the target word is repeated in the same syntactic condition is the situation different. The most recent and salient antecedent provides a more specific antecedent of the form ‘move the bed above the X’, where X is an alternative to the word in goal position in the previous statement.\textsuperscript{12}

The focus structures for the target sentence are as follows:

\begin{enumerate}
\item \textbf{2 Repetitions, Different Position}
  \begin{itemize}
  \item Move the piano above the \textbf{bed}.
  \item Now, move the house above the \textbf{bed}.
  \item Now, \textemdash[move [the \textbf{bed}]\textsubscript{F} above [the pineapple]\textsubscript{F}]\textemdash.
  \end{itemize}
\item \textbf{1 Repetition, Different Position}
  \begin{itemize}
  \item Move the piano above the \textbf{flag}.
  \item Now, move the house above the \textbf{bed}.
  \end{itemize}
\end{enumerate}

\textsuperscript{12}I assume that just as for antecedent for pronouns that recency is an important factor for choosing between potential focus-antecedents (Clark and Sengul, 1979).
Now, ∼[move [the bed] above [the pineapple]].

c. **2 Repetitions, Same Position**
   Move the **bed** above the flag.
   Now, move the **bed** above the house.
   Now, ∼[move the **bed** above [the pineapple]].

d. **1 Repetition, Same Position**
   Move the piano above the flag.
   Now, move the **bed** above the house.
   Now, ∼[move the **bed** above [the pineapple]].

e. **No Antecedent**
   Move the piano above the flag.
   Now, move the house above the bell.
   Now, ∼[move [the bed] above [the pineapple]].

Focus theory therefore predicts the target word to be accented and hence prominent in all conditions except (c) and (d), which are the conditions in which the target word occurs in the same position as the antecedent. Note, however, that these two conditions are also expected to show reductions of the target word from the point of view of accessibility theory: They are the cases in which the antecedent is introduced in theme position, which is highest in accessibility, and the target word should hence be most reduced. In other words, Experiment 1 is not ideal to tease apart the effects of accessibility and focus theory since the predictions of the two accounts are too closely aligned. If we find higher reduction in (c) and (d), this might be due to either factor. However, the focus theory predicts no reduction in conditions (a) and (b) compared to the control condition (e), while accessibility predicts at least some reduction in condition in (a) and (b) due to repetition, but less reduction than in (c), in which both repetition and thematic role of the antecedent contribute to accessibility. The sentences in (a,b) intuitively differ from (e), even though focus theory does not distinguish them. There might be prosodic correlates that highlight the shift in position of the repeated
word in (a) and (b), even if the basic prominence relations are similar. We will see some evidence for such an effect in the data. Finally, we can test with this experiment whether there is an effect of one vs. two repetitions. Table 2 summarizes the relevant factors the experiment looks at.

5.2. Methods

We recorded 42 native speakers of North American English, using a set of Matlab scripts developed in our lab based on the Psychtoolbox. The experiment was run latin-square, such that every participant encountered only one condition from each item, but an equal number of trials from each of the five conditions. The Matlab script ordered the trials pseudo-randomly such that no item was ever repeated and a condition could maximally occur twice in a row. We recorded a total of $42 \times 35 = 1470$ sets of instructions.\footnote{We aimed for 40 participants and accidentally ran two more than planned.} We excluded cases where the file was not properly recorded or participants deviated from the scripted instructions, which left 1446 utterances or about 98% of the trials.

The data were then forced-aligned using the prosodylab forced-aligner (Gorman et al., 2011), which annotates speech segment-by-segment and word-by-word. For each utterance, a phonetic transcription was extracted from the CMU dictionary of North

<table>
<thead>
<tr>
<th>Position</th>
<th>Repetition Accessibility # of Repetitions</th>
<th>Thematic Accessibility Salience of Antecedent</th>
<th>Focus Theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Different</td>
<td>High (2)</td>
<td>Medium (Goal)</td>
<td>Contrastive</td>
</tr>
<tr>
<td>b. Different</td>
<td>Medium (1)</td>
<td>Medium (Goal)</td>
<td>Contrastive</td>
</tr>
<tr>
<td>c. Same</td>
<td>High (2)</td>
<td>High (Theme)</td>
<td>Given</td>
</tr>
<tr>
<td>d. Same</td>
<td>Medium (1)</td>
<td>High (Theme)</td>
<td>Given</td>
</tr>
<tr>
<td>e. No Antecedent</td>
<td>Low (0)</td>
<td>Low (No Antecedent)</td>
<td>Contrastive</td>
</tr>
</tbody>
</table>

Table 2: Experiment 1: Relevant Factors for the prominence of the target word. Accessibility theory predicts more reduction of the target word for higher accessibility; the focus theory predicts reduction for the Given condition and no reduction for the Contrastive conditions.
Figure 1: Experiment 1: Mean duration, mean maximum pitch, and mean of the mean intensity of the target word plotted by Position and Repetition. Error bars show standard errors of the mean.

American English, and this transcription was then forced-aligned to the acoustic file based on acoustic models trained on data from our lab, with the use of the HMM-based speech recognition software HTK (Young et al., 2006). Acoustic measures were extracted for words of interest using Praat (Boersma and Weenink, 1996), most importantly for each of the target words in the target sentences. Since the target sentences in each of the five conditions were identical within an item, effects of syntactic and phonological context of the word are controlled for.

5.3. Results

Both accessibility theory and focus theory predict a reduction of the target word in the condition in which its syntactic position is the same as that of the antecedent. Accessibility theory further predicts that the target should be reduced to a greater extent with more repetitions. Figure 1 illustrates the mean values for duration, maximum pitch, and mean intensity for the target word in the five conditions.

We first tested whether there was a significant effect of the position of the antecedent using a mixed model regression,$^{14}$ with Position as a fixed effect, and Item

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$^{14}$We used the lmer function of the lme4 R package (Bates and Maechler, 2010). Mixed regression
Table 3: Experiment 1: Linear mixed effects model of centered measures of the target word with fixed effect Position with random effects and random slopes for Item and Participant. Model: lmer(dv~Position+(Position|Item)+(Position|Participant)) and Participant as random effects. The random effects included a random slope for Position. Table 3 summarizes the model. Just as predicted by both theories, there was a highly significant effect of the position of the antecedent for all acoustic measures, such that the target word was significantly more reduced when there was an antecedent in the same syntactic position (the theme position) compared to the control condition without antecedent, but not when the antecedent was in a different position (the goal position). Contrary to the predictions of the accessibility theory, there was no significant increase in reduction between the control condition with No Antecedent and the condition with an antecedent in Goal position, the Different condition. In fact, there was a significant shift in the opposite direction for pitch—the maximum pitch was increased in this case compared with the control condition.

The model excludes the factor Repetition, because this factor is actually too closely correlated with Position to lead to meaningful results. Note that repetition is 0 for only those cases in which there was no antecedent. Even after centering Repetition and models can control for participant and item random effects at the same time, and have therefore been argued to be more appropriate for statistical analyses in linguistic experimental studies than conventional ANOVA analyses (Baayen et al., 2008).

For this and all other models reported in this paper the contribution of the random effects was significant or close to significant, as tested by model comparisons with simpler models with one or the other random effect dropped. We included maximal random effects irrespective of whether their contribution reached significance. See Barr et al. (2013) for a rationale why this is the appropriate analysis for data of this kind. Adding or dropping one of the random effects did not affect the qualitative outcome of the model.
Table 4: Experiment 1: Linear mixed effects model Position, Repetition and their interaction as fixed effects, with random effects including slopes for Item and Participant. Model: lmer(dv ~ Position*Repetition+(Position*Repetition|Item)+(Position*Repetition|Participant)

defining orthogonal contrasts for Position, the correlation between the factors is too high to allow for statistical inferences.¹⁶ Nevertheless, even the comparisons in Table 3 allow us to draw one conclusion about repetition: In the condition Different, there is no reduction in any of the acoustic parameters. This is unexpected if there is an effect of reduction purely based on repetition.

By looking at the subset of data that excludes the control condition we can test whether there was a difference between one and two repetitions. In this subset, Position and Repetition are orthogonal to each other. The number of repetitions was found to have an effect in Nooteboom and Terken (1982).¹⁷ Table 4 summarizes the model. There was a significant difference for all acoustic measures in the expected direction between Same and Different, and no effect for repetition, nor an interaction. In other words, the number of repetitions had no effect on the acoustic prominence of the target word.

In order to further address the question whether there was a repetition effect we can look at the data differently, by binning together conditions with the same focus.

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¹⁶For what it’s worth, the model with both factors shows an effect for intensity for Position and no significant effects for the other acoustic parameters, and no effects whatsoever for Repetition.

¹⁷Watson and Arnold (2005) and Watson (2010) do not report any inferential statistics beyond than error bars, which similarly suggest no effect of repetition. According to additional information provided by the authors the effect of repetition was also not significant in the original study, although it did have an effect on the choice of a pronoun over a full noun phrase.
Figure 2: Experiment 1: Mean duration, mean maximum pitch, and mean of the mean intensity of the target word plotted by Focus and Repetition. Error bars show standard errors of the mean.

<table>
<thead>
<tr>
<th>MaxIntensity</th>
<th>Duration</th>
<th>MaxPitch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimate</td>
<td>SE</td>
<td>t</td>
</tr>
<tr>
<td>Intercept</td>
<td>75.50</td>
<td>0.87</td>
</tr>
<tr>
<td>Repetition</td>
<td>-0.03</td>
<td>0.13</td>
</tr>
</tbody>
</table>

Table 5: Experiment 1: Linear mixed effects model for Repetition on the subset of data only comprising Contrast target words, with random effects intercepts and slopes for Item and Participant. Model: lmer(dv∼Repetition+(Repetition|Item)+(Repetition|Participant))

structure. Remember that the control condition with no antecedent and the condition Different are indistinguishable from the point of view of focus theory. Figure 2 shows the means for this way of pooling the data.

Focus and Repetition are also somewhat confounded, however: The level Given only exists with 1 or 2 repetitions, while Contrast also as 0 repetitions. A clean and unconfounded test for a repetition effect can be made by looking at the subset of data only comprising the Contrast cases. Three levels of repetition (0-2) were observed in this subset. We ran mixed models within this subset of Repetition as a fixed and random slopes and intercepts for Item and Participant. The results are summarized in Table 5.

As observed earlier, there was an unexpected effect on pitch comparing No Antecedent and Different, which emerges here as a significant contribution of Repetition
to the model. This effect goes in the opposite direction from the one predicted by accessibility: The target word is pronounced with higher pitch when repeated, resulting presumably in greater prominence. This boost in pitch might give us a clue why there was no reduction effect due to repetition on other acoustic dimensions. The fact that the target word is repeated in a different syntactic position from that in the immediately preceding sentence, which is otherwise structurally very similar, and this might be a reason to put additional contrastive emphasis on the word. This ‘anti-parallelism’ effect is not predicted by either accessibility theory or focus theory, but if real, it would counteract any effect of repetition in the condition *Different*.

So far, we have only looked at the acoustics of the target words. However, we might find an effect of repetition in other places, for example in the words leading up to the repeated words. Arnold et al. (2012) find that determiners are shorter before anticipated words, an effect they plausibly attribute to production facilitation (for a similar effect, see Kahn & Arnold, this volume). We tested whether there such was an effect on the determiner preceding the repeated target word.

Figure 3 summarizes the means. The only measure for which there might be an effect is duration. The effect indeed approached significance, as illustrated in Table
Table 6: Experiment 1: Linear mixed effects model for the measures of the determiner preceding the
target word: Fixed effect Position with random effects and slopes for Item and Participant. Model:
lmer(dv~Position+(Position|Item)+(Position|Participant).

\[
\begin{array}{ccccccc}
\text{MaxIntensity} & \text{Duration} & \text{MaxPitch} \\
\hline
\text{Estimate} & \text{SE} & \text{t} & \text{Estimate} & \text{SE} & \text{t} & \text{Estimate} & \text{SE} & \text{t} \\
\text{Intercept} & -2.18 & 0.81 & -2.68 & -0.18 & 0.00 & 36.38 & 10.07 & 9.01 & 1.12 \\
\text{Different} & -0.31 & 0.27 & -1.17 & -0.01 & 0.00 & -1.76 & 1.48 & 3.10 & 0.48 \\
\text{Same} & -1.14 & 0.27 & -0.53 & -0.01 & 0.00 & -1.89 & -1.19 & 2.48 & -0.48 \\
\end{array}
\]

6.18

5.4. Discussion

The results of Experiment 1 replicates an effect on prominence found in Watson and
Arnold (2005)/Watson (2010): When the antecedent is in the same (theme) position,
the target word is less prominent than when it is in a different position (goal). This is as
predicted by the accessibility account in terms of thematic roles, and this is indeed how
the results were interpreted in these studies. Watson and Arnold (2005) conclude that
the results show evidence for the theory of ‘Discourse focus’ outlined in Ariel (1990).
This model relates the choices in referential of noun phrases to the degree of activation
of the respective referents. The more activated a referent is, the more ‘in focus’ it is,
and hence the more accessible. Watson (2010) also relates these findings to degrees of
cognitive accessibility, while noting that factors other than thematic accessibility might
play a role.

This apparent effect of thematic accessibility, however, is also predicted by the alter-
natives theory of focus. The target statement contrasts with the preceding statements
in the choice of the goal, and it is possible that it is this contrast that is signalled by

18 In this case, the model did not converge unless we centered the dependent variables. We generally
left the dependent variables uncentered in the other models whenever the inferential statistics were
virtually identical to those for the centered model, since it makes the model output easier to interpret.
prosodic prominence, rather than the accessibility of the antecedents. Since both the alternatives theory of focus and accessibility theory make the same prediction, it is not possible to take this result as supporting either theory.

Various aspects of the results of Experiment run counter to the predictions of accessibility theory. Contrary to the predictions of accessibility, there was no effect of repetition on the realization of the target word when the antecedent was in a different structural position than the target word (No Antecedent vs. Different). This result replicated the complete lack of an effect on the realization of the target word for antecedents with different thematic roles found in Terken and Hirschberg (1994). Despite the different methodology—we used quantitative acoustic measures, Terken and Hirschberg (1994) used an annotation of accentedness—our results for the main effect of Position closely matched theirs. Our results show a trend toward an effect on the duration of the preceding determiner, such that determiners were shorter when the following word was repeated, in the same direction as the effect found in Arnold et al. (2012).

We did not find a difference in prosodic prominence in terms of one vs. two repetitions. This might be due to a counter-acting contrastive effect that highlights the fact that a shift in syntactic position happened between antecedent and target sentence, but it might also be an indication that number of repetitions does not, in fact, have an effect on prosodic prominence, or at least not a strong one.

6. Experiment 2

The design and methods of Experiment 2 were identical to those of Experiment 1, except that the materials were changed in such way that the predictions based on the
accessibility of grammatical role and those of focus theory were diametrically opposed.\textsuperscript{19} Again we manipulated whether the target word (e.g., \textit{bed}) was repeated once, twice, or not at all in the previous two instructions, and whether the previous instances of the word were in the same thematic position as the antecedent or whether it occurred in a different position. The difference to Experiment 1 was that this time, the target word was in goal position instead of theme position in all five conditions:

(23) \textbf{Example Items, Experiment 2}

a. \textbf{2 Repetitions, Antecedent in Same Position}
   Move the piano above the \textit{bed}.
   Now, move the house above the \textit{bed}.
   Now, move the pineapple above the \textit{bed}.

b. \textbf{1 Repetition, Antecedent in Same Position}
   Move the piano above the flag.
   Now, move the house above the \textit{bed}.
   Now, move the pineapple above the \textit{bed}.

c. \textbf{2 Repetitions, Antecedent in Different Position}
   Move the \textit{bed} above the flag.
   Now, move the \textit{bed} above the house.
   Now, move the pineapple above the \textit{bed}.

d. \textbf{1 Repetition, Antecedent in Different Position}
   Move the piano above the flag.
   Now, move the \textit{bed} above the house.
   Now, move the pineapple above the \textit{bed}.

e. \textbf{No Antecedent}
   Move the piano above the flag.
   Now, move the house above the bell.
   Now, move the pineapple above the \textit{bed}.

\textsuperscript{19} An unpublished experiment with a similar set up as our Experiment 2 was already reported in Watson et al. (2008).
The materials for this study consisted of 35 items similar to those in (23), and we ran 60 participants.\textsuperscript{20}

Thematic accessibility predicts that referents that were previously introduced as arguments with certain thematic roles should be more accessible in the following discourse than others, and the claim is that prosodic prominence should reflect the degree of accessibility. We might then expect more reduction when the antecedent is in theme position, following the rationale in Dahan et al. (2002) and Watson (2010). Focus theory makes very different predictions this time. The focus structures for the target sentence are as follows:

(24) a. **2 Repetitions, Same Position**
   Move the piano above the \textbf{bed}.
   Now, move the house above the \textbf{bed}.
   Now, $\sim$[move [the pineapple]$_F$ above the \textbf{bed}].

b. **1 Repetition, Same Position**
   Move the piano above the \textbf{flag}.
   Now, move the house above the \textbf{bed}.
   Now, $\sim$[move [the pineapple]$_F$ above the \textbf{bed}].

c. **2 Repetitions, Different Position**
   Move the \textbf{bed} above the \textbf{flag}.
   Now, move the \textbf{bed} above the house.
   Now, $\sim$[move [the pineapple]$_F$ above [the bed]$_F$].

d. **1 Repetition, Different Position**
   Move the piano above the \textbf{flag}.
   Now, move the \textbf{bed} above the house.
   Now, $\sim$[move [the pineapple]$_F$ above [the bed]$_F$].

e. **No Antecedent**

\textsuperscript{20}We ran an extra 20 participants in order to increase the power of the study and to give the repetition effect an additional chance to show up, but the results were actually qualitatively similar for the first 40 participants, which is the number of participants we had aimed for in Experiment 1.
Move the piano above the flag.

Now, move the house above the bell.

Now, [move [the pineapple]F above [the bed]F].

Focus theory therefore predicts that the target word will be accented and hence prominent in all conditions except (a) and (b), the conditions labeled same. If there is an effect of the intrinsic accessibility of thematic roles, we would expect (a) and (b) to be more prominent than (c) and (d). Table 7 summarizes the relevant factors for Experiment 2. A reviewer points out that it could be that prosody distinguishes cases in which a previously mentioned word appears contrastively accented in a new syntactic position with cases in which there was no prior mention of the word, as in our ‘new’ condition. We agree that this is possible and seems intuitively plausible, but we did not find quantitative evidence for such a distinction. A closer look at the precise pitch profile of the target words might reveal evidence for differences in accent types.

Accessibility theory predicts a reduction in prominence in the Different condition, since this is the condition in which the antecedent is in the theme position, which is more accessible. Focus theory, on the other hand, predicts a reduction in prominence in the Same position since this is the condition in which the target word is Given. Under the accessibility view one would also expect that the target word will be reduced more with more repetitions.

Table 7: Experiment 2: Relevant Factors for the prominence of the target word. Accessibility theory predicts more reduction of the target word for higher accessibility; focus theory predicts reduction for the Given condition and no reduction for the Contrastive conditions.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Repetition Accessibility</th>
<th>Thematic Accessibility</th>
<th>Focus Theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Same</td>
<td>High (2)</td>
<td>Medium (Goal)</td>
<td>Given</td>
</tr>
<tr>
<td>b. Same</td>
<td>Medium (1)</td>
<td>Medium (Goal)</td>
<td>Given</td>
</tr>
<tr>
<td>c. Different</td>
<td>High (2)</td>
<td>High (Theme)</td>
<td>Contrastive</td>
</tr>
<tr>
<td>d. Different</td>
<td>Medium (1)</td>
<td>High (Theme)</td>
<td>Contrastive</td>
</tr>
<tr>
<td>e. No Antecedent</td>
<td>Low (0)</td>
<td>Low (No Antecedent)</td>
<td>Contrastive</td>
</tr>
</tbody>
</table>

Table 7: Experiment 2: Relevant Factors for the prominence of the target word. Accessibility theory predicts more reduction of the target word for higher accessibility; focus theory predicts reduction for the Given condition and no reduction for the Contrastive conditions.
Figure 4 illustrates the mean values for duration, maximum pitch, and mean intensity for the target word in the five conditions.

The plotted means are as expected by focus theory. Mixed model regressions were conducted to test the significance of the positional effect, summarized in Table 8. The model involved Position as a fixed effect, and Item and Participant as random effects with intercepts and random slopes. As predicted by the focus theory, there was a significant effect of the position of the antecedent for all acoustic measures, such that the target word was significantly more reduced when there was an antecedent in the same syntactic position (the goal position) compared to the control condition without antecedent, but not when the antecedent was in a different position (the theme position). The results are opposite to the predictions of thematic accessibility.

We again tested for an effect of the number of repetitions by looking at the subset of data that excludes the No Antecedent condition. Table 9 summarizes the model. There was a significant difference for intensity and pitch distinguishing Same and Different, as expected by focus theory. The difference in duration between Same and Different did not reach significance. There was also a non-significant trend for an effect on intensity of
Table 8: Experiment 2: Linear mixed effects model of measures of the target word with fixed effect Position and random effects and random slopes for Item and Participant. Model: \( \text{lm}(\text{dv}\sim\text{Position}+(\text{Position}|\text{Item})+(\text{Position}|\text{Participant})) \)

<table>
<thead>
<tr>
<th></th>
<th>MaxIntensity</th>
<th>Duration</th>
<th>MaxPitch</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>SE</td>
<td>t</td>
</tr>
<tr>
<td>Intercept</td>
<td>69.26</td>
<td>0.71</td>
<td>97.70</td>
</tr>
<tr>
<td>Different</td>
<td>0.01</td>
<td>0.20</td>
<td>0.07</td>
</tr>
<tr>
<td>Same</td>
<td>-2.33</td>
<td>0.26</td>
<td>-8.92</td>
</tr>
<tr>
<td>Rep</td>
<td>0.43</td>
<td>0.25</td>
<td>-1.68</td>
</tr>
<tr>
<td>Rep*Pos</td>
<td>0.22</td>
<td>0.34</td>
<td>0.65</td>
</tr>
</tbody>
</table>

Table 9: Experiment 2: Linear mixed effects model Position, Repetition and their interactions as fixed effects, with random effects and random slopes for Item and Participant. Model: \( \text{lm}(\text{dv}\sim\text{Position}*\text{Repetition}+(\text{Position}*\text{Repetition}|\text{Item})+(\text{Position}*\text{Repetition}|\text{Participant})) \)

the number of repetitions. Finally, there was a significant interaction between Position and Repetition for pitch. It seems that a second repetition leads to a slightly higher pitch in the Same condition and a slightly lower pitch in the Difference condition. A reviewer points out that speakers might say this sentence with an overall increased pitch, due to the repetitiousness. We indeed found a similar trend for a higher pitch after two repetitions on the word ‘move’—so this effect might not be specific to the target word, but rather reflect something about the overall intonational tune when there are multiple repetitions of similar clause structures.

A look at the data plotted by Focus and Repetition further confirms that there is a clear effect of focus (Fig. 5). It also fails to show a clear pattern for the effect of repetition. A mixed model within the subset of data only comprising of Contrast trials once again failed to show any significant effect for any of the three acoustic dimensions, even for the somewhat promising-looking intensity measures.
Contrast
Intensity
Repetition
0
1
2
0.40
0.45
Contrast
Duration
Repetition
0
1
2
180
Contrast
Pitch
Repetition
0
1
2

Figure 5: Experiment 2: Mean duration, mean maximum pitch, and mean of the mean intensity of the target word plotted by Focus and Repetition. Error bars show standard errors of the mean.

<table>
<thead>
<tr>
<th>MaxIntensity</th>
<th>t</th>
<th>Duration</th>
<th>t</th>
<th>MaxPitch</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-6.56</td>
<td>0.68</td>
<td>-9.72</td>
<td>-0.21</td>
<td>0.00</td>
</tr>
<tr>
<td>Different</td>
<td>-0.19</td>
<td>0.23</td>
<td>-0.82</td>
<td>-0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Same</td>
<td>-1.94</td>
<td>0.25</td>
<td>-7.80</td>
<td>-0.01</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Table 10: Experiment 2: Linear mixed model of acoustic measures of the determiner preceding the target word, with Position as fixed effect and random effects and slopes for Item and Participant. Model: lmer(dv~Position+(Position|Item)+(Position|Participant)).

In sum, neither the presence/absence of repetition nor the number of repetitions had the expected effect on the realization of the target word. As in Experiment 1, we also tested for an effect on the determiner preceding the repeated target word.

Between Experiment 1 and 2, we varied the position of the target word. Perhaps the effect of focus is stronger with an antecedent in theme position or in goal position—which itself could reflect an accessibility difference. To test for this effect we ran a mixed
Figure 6: Experiment 2: Mean duration, mean maximum pitch, and mean of the mean intensity of the
determiner of the target word across conditions. Error bars show standard errors of the mean.

<table>
<thead>
<tr>
<th>MaxIntensity</th>
<th>Duration</th>
<th>MaxPitch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimate</td>
<td>SE</td>
<td>t</td>
</tr>
<tr>
<td>Intercept</td>
<td>−1.97</td>
<td>0.61</td>
</tr>
<tr>
<td>Focus</td>
<td>2.54</td>
<td>0.23</td>
</tr>
<tr>
<td>Experiment</td>
<td>6.66</td>
<td>0.58</td>
</tr>
<tr>
<td>Foc*Exp</td>
<td>−1.67</td>
<td>0.29</td>
</tr>
</tbody>
</table>

Table 11: Experiment 1 & 2: Linear mixed effects models on acoustic measures of the target
word with Focus, Experiment and their interaction as fixed effects, with random effects in-
cluding slopes for Item and Participant. Model: lmer(dv~Focus*Experiment+(Focus*Experiment
| Item)+(Focus*Experiment| Participant)

model comprising the target-word data from both experiments, and we checked whether
the focus effect interacted with word order in a mixed model with random slopes for
the main effects and interaction. The results are reported in Table 11. There was a
significant interaction between Experiment and Focus such that there was a greater
reduction of the target word if the antecedent was in the same position and in goal
position—this is the opposite of what one might have expected based on accessibility.
This interaction makes sense if post-focal reduction is greater than prefocal reduction,
as is commonly reported in the linguistic literature (cf. Wagner, 2005b, and references
therein).
6.2. Discussion

Experiment 2 pitted the accessibility manipulation by thematic role directly against the predictions of focus theory, and the results show a clear focus effect. Once again, there was no reduction of the target word due to repetition in the case where focus did not predict any reduction. The effects in Experiment 2 on intensity were comparatively greater than in Experiment 1—this is expected if post-focal reduction shows a bigger effect than pre-focal reduction, but is unexpected based on the greater accessibility of themes compared with goals.

The explanation for shifts in prominence offered by the alternatives theory of focus relies on the intuition that in examples like (25), what is prosodically marked is the location of the contrast between two statements which show linguistic overlap otherwise:

(25) Now, [move the house above the \textit{bed}$_{\text{antecedent}}$. Now, $\sim$[move \textit{[the pineapple]}$_F$ above the \textit{bed}].

The accessibility view, on the other hand, would seek the explanation for the lack of prominence on \textit{bed} in its greater cognitive activation or predictability. It is unclear, however, why exactly the greater accessibility through parallelism in (25) should trump the smaller thematic accessibility of the antecedent. While parallelism effects are a prediction of focus theory, they have to be stipulated in accessibility theory.

The combined results of Experiment 1 and Experiment 2 support the view that this notion of focus alternatives is central to the understanding of prominence effects, and against the view that they can be reduced to accessibility views.

7. General Discussion

The results of our two experiments are exactly as predicted by the alternatives theory of focus. Existing theories formulated in terms of accessibility cannot explain
these effects without additional stipulations. We argued that some previous experimental studies set within accessibility theory (e.g. Terken and Hirschberg, 1994) already showed related patterns, but the problematic nature of these results for accessibility theory and the confound between focus theory and accessibility has gone unnoticed in the previous literature.

Our experiments failed to show any evidence for those accessibility effects that do not align with the predictions of focus theory. There are several possible explanations why such effects may not have been picked up. One possibility we noted is that the effect of repetition in our experiment and that of Terken and Hirschberg (1994) may have been countered by an effect of an ‘anti-parallelism’ marking, where the contrasting thematic position of the target word in an otherwise parallel utterance is highlighted by additional prominence. Another possibility is that the methodology used here, a reading paradigm, is not be sensitive enough to get at the more subtle effects of accessibility, if these effects are in fact to production facilitation through priming or prior mention. One reason to doubt that the task played a major role in the present results is that the results of Experiment 1 were qualitatively similar to the results of the original experiment in Watson and Arnold (2005), which involved a dialogue task.

But it might also be the case that despite the important role that accessibility factors play in the choice of referential form (for example the choice between a pronoun and a full noun phrase), accessibility factors do not actually be an important factor in determining prosodic realization. That choices in referential realization require a different account from prosodic choices was already hypothesized in Brown (1983, 77). Baumann (2006, 88) similarly argues that morpho-syntactic choices such as that between pronouns and full noun phrases or definite and indefinite noun phrases depend on the identifiability of referents based on knowledge, while prosodic reduction relates to salience of linguistic antecedents in discourse. It may turn out to be misleading to think of accentual reduction and pronominalization as forming part of a single hierarchy.
of ever more reduced referring expressions.

When discussing the accessibility approach, we outlined a range of potentially contradictory factors that previous literature has argued to be relevant for accessibility, rather than presenting a single coherent theory. The lack of such an overarching predictive theory constitutes a challenge for the accessibility view. Such a theory should motivate the relevance of the individual factors, and also have to provide a principled way of deciding which factor should override others in cases where they make contradictory predictions. That an explanation in terms of accessibility remains incomplete without such a theory has has been repeatedly pointed out in papers set within this approach (e.g., Nooteboom and Terken, 1982; Terken and Hirschberg, 1994; Arnold, 2008). One way to think about availability or accessibility effects on prosody is to think of them as a consequence of the contextual ‘recoverability’ of a referent or referring expression Halliday (1967); Bolinger (1972); Prince (1981); Arnold (1998). Nooteboom and Terken (1982) and Terken (1984) explored precisely this hypothesis when looking at prosodic hypothesis. Predictability effects on prosody have become central in recent work on prosody (Aylett, 2000; Jurafsky et al., 2001; Bell et al., 2002; Aylett and Turk, 2004; Bell et al., 2009; Lam and Watson, 2010; Jaeger, 2010).

And yet, so far there has not been an attempt to show that predictability can account for the phenomena that focus theory was originally designed to explain. It seems likely to us that the notion of focus alternatives will remain necessary to account for prosodic prominence within such a theory, even if it is highly plausible that there are predictability effects affecting the contextual availability of particular focus antecedents (cf. Wagner, 2006). Predictability accounts have been successful at explaining choices between different grammatical options, for example the choice between pronouncing a complementizer or not pronouncing it (cf. Levy and Jaeger, 2007). The different prosodic options might similarly reflect different linguistic choices between different focus structures, and the alternatives theory of focus is one theory of what the various
options are that a speaker decides between when choosing one prominence pattern over another.

A question that should concern us, theoretical linguists and psychologists alike, is why it is that two very interesting lines of research on virtually the same phenomena have not been able inform each other to a greater extent, which would clearly have been beneficial to both sides, and avoided unnecessary confounds. Our goal in this article was to take a step toward overcoming this divide, and combine insights from the theoretical literature (e.g. Rooth, 1992b) with insights and methodological tools from the psycholinguistic literature (cf. Watson, 2010).
References


Topic continuity in discourse: A quantitative cross-language study, pp. 1–42. John Benjamins, Philadelphia, PA, USA.


Lam, T. and D. G. Watson: 2010, ‘Repetition is easy: Why repeated referents have reduced prominence’, *Memory & cognition* 38(8), 1137–1146.


Rooth, M.: 1985, Association with Focus, PhD dissertation, University of Massachusetts, Amherst.


Ross, J. R.: 1967, Constraints on variables in syntax, PhD dissertation, MIT.


Terken, J. and S. Nooteboom: 1987, ‘Opposite effects of accentuation and deaccentu-


and task-based constraints on acoustic prominence’. Presented at 18th Annual CUNY Conference on Human Sentence Processing, Tucson, AZ, USA.
