The Ohio State University

Working Papers in Linguistics No. 53

VARIA

Edited by
Amanda Miller-Ockhuizen
Robert Levine
Anthony J. Gonsalves

The Ohio State University
Department of Linguistics

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Edited by
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Table of Contents

Prosodic Cues "and" Syntactic Disambiguation[*]

Allison R. Blodgett
blodgett@ling.ohio-state.edu

In the literature regarding the relationship between prosody and parsing, three questions remain unanswered or only tangentially addressed. What is the nature of the prosodic information that might differentiate a temporary syntactic ambiguity? How consistently does this information occur in production? Are listeners sensitive to that information? I present the results of a set of production and perception experiments designed to investigate the nature of the prosodic cues that might disambiguate the temporary syntactic ambiguity inherent in coordinate structures. The results suggest that although most speakers fail to provide disambiguating prosody, when they do, they manipulate phrasing around, and accentuation of, the conjunction word *and*. The results further suggest that of the two cues, only the manipulation of phrasing is interpreted as a general cue across speakers. Specifically, the absence of a phrase break is interpreted as a prosodic cue to conjoined NPs.

Prosody is an essential part of any spoken utterance. As the examples in (1) show, prosody helps to define the context or set of contexts within which an utterance may be felicitously produced and understood. In each representation, the black line indicates the relative rise and fall in pitch, while capitalization indicates the "sentence stress," or the location of the most prominent pitch accent in the utterance.

(1a) The WINDOW'S open.　(1b) The window's OPEN.　(1c) The window's OPEN?

Even though these three utterances contain the same lexical information, they are not interchangeable. While (1a) can function as the response to the question, *What's*

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open? (1b) cannot. Conversely, (1b) can function as the response to the question, *What about the window?* while (1a) cannot. Furthermore, the question intonation of (1c) contrasts with the statement intonation of (1a) and (1b). Although it is clear from even this simple example that a relationship exists between the prosody of an utterance and the contexts within which it can be felicitously produced, other relationships involving prosody also exist, including a relationship between prosody and human sentence processing.

The idea that prosody and syntactic parsing are somehow related is not new. For example, work by Lehiste (1973) provided empirical evidence supporting a role for prosody in parsing. After hearing a structurally and semantically ambiguous utterance such as *The old men and women stayed at home*, participants were able to use differences in prosody to indicate reliably whether the speaker had intended the subject of the sentence to be interpreted as "old men and old women" or as "men who are old, and women who are possibly young."

More recently much of the research on prosody and parsing has been focused on determining the point at which prosody influences a syntactic parse. Establishing this point is important because the outcome will provide empirical support for one parsing model over another. If prosody is found to influence initial parsing decisions, then the class of Constraint-based Models (Boland, 1997; MacDonald et al., 1994; McRae et al., 1998) can be argued to provide a better account of human sentence processing behavior. This will be the case regardless of whether prosody is found to influence the generation of initial syntactic structure, or structures, or the selection of one structure from among multiple automatically generated structures. In either case, prosody will simply be adopted into the list of constraints that influence parsing decisions, a list that includes such factors as frequency, thematic information, verb subcategorization, and plausibility. On the other hand, if the influence of prosody is found to be limited to syntactic revisions, then the Garden Path Model (Frazier, 1978; Frazier & Clifton, 1996), which in all its forms excludes a role for prosody in initial structure building, can be argued to provide a better account.

In the work to date, however, no consensus has emerged regarding the relationship between prosody and syntactic parsing. Whereas work on the resolution of temporary syntactic ambiguities by Beach (1991), Marslen-Wilson et al. (1992), and Nagel et al. (1994) suggests that prosody exerts an early influence on parsing, work on

what are some of the exact same syntactic ambiguities by Stirling & Wales (1996) and Watt & Murray (1996) suggests otherwise.

One factor contributing to these mixed empirical results is likely to be the fact that several important questions remain unanswered or only tangentially addressed within this body of work. These questions include the following: What is the nature of the prosodic information that might differentiate a syntactically ambiguous construction? Or asked another way, what are the relevant components of the rhythm and tune that listeners might be using to resolve an ambiguity? Are speakers producing consistent prosodic cues, and if so, what are they? When presented with these cues, are listeners sensitive to them, and if so, is there evidence that those are the cues that are used to resolve the ambiguity? To address these questions, I conducted a set of production and perception experiments using the temporary syntactic ambiguity found at the conjunction *and* in the types of sentences shown in (2). The results of these experiments will suggest that when speakers do provide disambiguating prosody, they do so by manipulating phrasing and accentuation around the conjunction. The results will further suggest that listeners interpret those cues in different ways.

(2a) Mary both sold vegetables and bought seeds at the fair.

(2b) Mary both sold vegetables and seeds at the fair.

It might seem reasonable to expect, at least on the basis of what I intuitively consider to be the prescriptive rules of Standard American English, that the attachment site of *and* in (2a) is, in fact, disambiguated by preverbal *both*, and that (2b) is simply ungrammatical. In other words, when preverbal *both* occurs between a nondual subject and the verb, a prescriptive rule stipulates that it must take scope over conjoined verbs or verb phrases (VPs), as in (2a). The existence of such a rule is supported by the results of a corpus search conducted by Blodgett and Boland (1998). Their analysis of the first 150 tokens of *both* in the Wall Street Journal database of the PennTreebank corpus failed to find any examples of preverbal *both* taking scope within the VP.

Norming data, however, conflict with this apparent prescriptive rule. The results of sentence completion norms collected at The Ohio State University as part of an earlier series of experiments demonstrated that preverbal *both* could, in fact, take scope not only

over conjoined VPs, but over conjoined phrases within the VP as well; approximately 80% of completions were of the form *Warren both read French and Spanish* (Blodgett & Boland, 1998). Thus, when a parser that is incrementally building structure reaches the conjunction in the sentences in (2), as in *Mary both sold vegetables and...*, it is not clear whether *and* must be attached low in the phrase structure tree to conjoin two noun phrases (2b) or higher in the tree to conjoin two verb phrases (2a). In other words, while the combination of a nondual subject and preverbal *both* prevents sentence-level coordination, the occurrence of preverbal *both* does nothing to further disambiguate the attachment site of the conjunction.
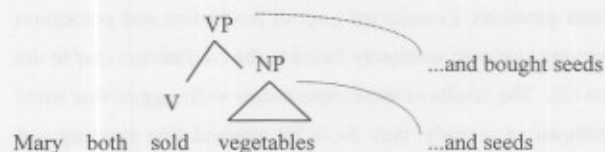
Figure 1. Example of Conjunction Attachment Ambiguity

Although the results of the sentence completions were quite robust, they represent the sole demonstration of the scope alternation of preverbal *both*. Therefore, in order to supplement these original findings and to confirm that the current experimental population also interprets preverbal *both* as taking scope over conjoined VPs and over conjoined NPs embedded within the VP, I collected a set of acceptability ratings on these two constructions. The results of these ratings not only provide additional evidence that the scope of preverbal *both* is not restricted to conjoined VPs, but they further suggest that this alternation is representative of multiple dialects of American English.

Methods

Participants. 21 students from an undergraduate linguistics course at The Ohio State University participated as an in-class experiment. An additional 21 students from an undergraduate, introductory psychology course at Rutgers participated for course credit. Responses from 2 nonnative speakers of English were subsequently excluded from the Ohio State pool and are not reported here. All of the remaining respondents were native English speakers.

Materials and procedure. After completing the perception experiment discussed later in this paper, participants turned to a page on which they were asked to rate *Mary both sold vegetables and bought seeds at the fair* and *Mary both sold vegetables and seeds at the fair*. The following three point scale was provided once for each sentence:

GOOD: I would say this and would find it ok if said by others.

ODD: I wouldn't say this but would find it ok if said by others.

BAD: I wouldn't say this and would find it strange if said by others.

Results

The proportion of GOOD, ODD, and BAD responses were tallied for each sentence by school, and the results are shown in Figures 2 and 3. As shown in Figure 2, only a very small percentage of respondents, approximately 10% at each university, rated the conjoined VP construction as BAD or completely unacceptable. This is not surprising, given that this construction is arguably the one that is consistent with the prescriptive rules of Standard American English.
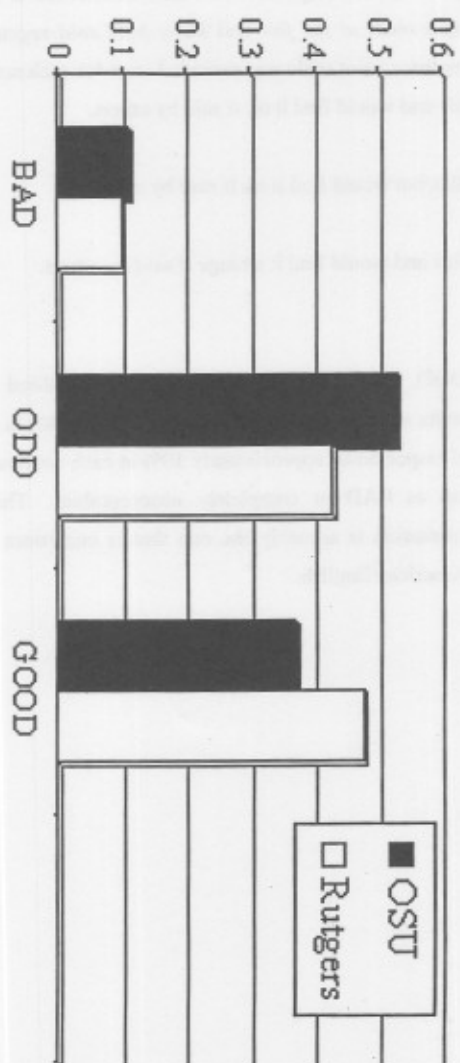
Figure 2. Acceptability Ratings for Conjoined VP

As shown in Figure 3, the conjoined NP construction also received a small percentage of BAD or completely unacceptable ratings, less than 20% at each university. Although this percentage is indeed higher than the comparable ratings for the conjoined VP construction, these responses are still in the minority. Furthermore, nearly half of the respondents at each university (52% at Rutgers and 42% at Ohio State) rated the construction as GOOD or completely acceptable.
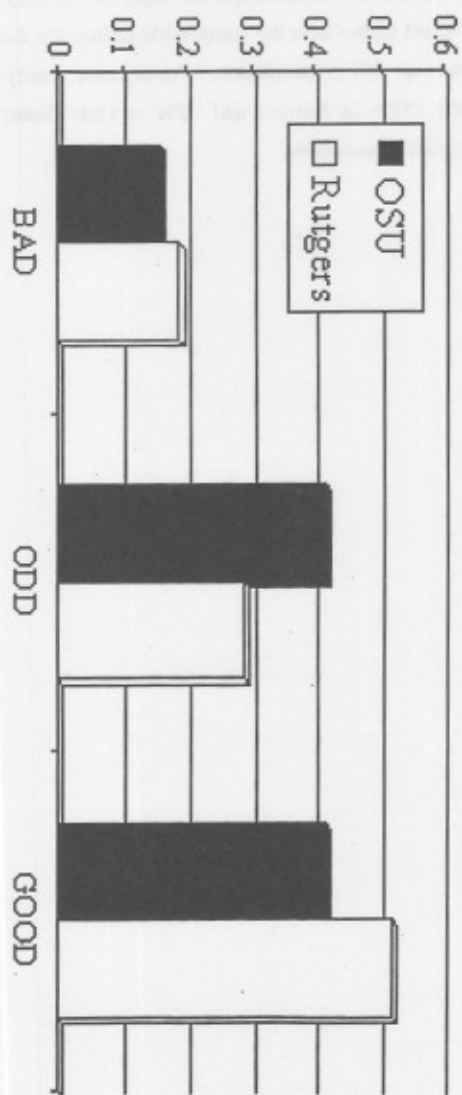
Figure 3. Acceptability Ratings for Conjoined NP

Discussion

The results of these acceptability ratings supplement the findings of the original sentence completions and provide additional evidence that contrary to the prescriptive rules of Standard American English, the scope of preverbal *both* can range over conjoined VPs or over conjoined NPs embedded within the VP.

These results further suggest that the alternation is represented in multiple geographical regions and in multiple dialects of American English. Students at two separate universities, Ohio State and Rutgers, accepted the alternations in scope for preverbal *both*. In terms of geographical location, Ohio State is located in Columbus, Ohio, a city in central Ohio, whereas Rutgers is located in New Brunswick, New Jersey, a city roughly equidistant between Philadelphia and New York City. Ohio State is in the Midwest; Rutgers is in the East. In terms of dialectal regions, Columbus sits at the border between the northern industrial cities dialect area and the Appalachian dialect area. New Brunswick, on the other hand, is situated between the intense linguistic, and social, variation of New York City and the northern border of the mid-Atlantic dialect area. Thus, this phenomenon has a wide geographical and dialectal distribution.

Although these ratings confirm that the current experimental population interprets preverbal *both* as taking scope over conjoined VPs and conjoined NPs, there is an apparent discrepancy between the overwhelmingly number of conjoined NPs obtained in the sentence completions (approximately 80%) and the relatively moderate proportion of GOOD or completely acceptable responses (approximately 50%) for that same sentence type. Why might participants produce conjoined NPs so frequently in sentence completions, but then not admit to using the construction in the acceptability ratings? One reason for the discrepancy might be the nature of the two tasks. Completing sentences is essentially a production task in which participants need only use their implicit knowledge of grammar. Acceptability rating, however, is a metalinguistic task that requires participants to make use of their explicit knowledge as well. Thus, the surprisingly small proportion of GOOD responses might reflect an awareness of the prescriptive rules of English. It might also reflect an inability of participants to think of an appropriate context for a sentence that was presented in isolation and that they themselves did not produce. In any event, the data demonstrate that these sentences are

not merely oddities that arise from the sentence completion task; rather they are acceptable constructions for many speakers of mainstream American English.

The Production Experiment

The production experiment was designed to investigate two questions. First, what is the nature of the prosodic information that might differentiate a particular temporary syntactic ambiguity? Second, how consistently do speakers produce those prosodic cues? I recorded speakers producing target utterances like those in (2), and then analyzed the prosodic structure of those utterances. On the basis of that analysis, I will argue that most speakers fail to produce consistent prosodic cues, at least in the region preceding any disambiguating lexical information, but when they do prosodically disambiguate conjunction attachment, they manipulate phrasing immediately before the conjunction word, and accentuation of the conjunction, as well.

Prosodic analysis. Although much of the work on the relationship between prosody and sentence processing has focused on the influence of such factors as pitch rise, pitch fall, and syllable duration (Beach, 1991; Marslen-Wilson et al., 1992; Nagel et al., 1994; Stirling & Wales, 1996; Watt & Murray, 1996), such analyses fail to take into account the prosodic structure that these factors help create. In the current study, by contrast, the utterances obtained in the production experiment were prosodically annotated using the ToBI (Tones and Break Indices) system (Silverman et al., 1992).

ToBI is a system for annotating the alignment of tune to text in some varieties of English, including mainstream American English. It is a system for expressing the relative prominences within an utterance, namely those syllables that native listeners perceive as being accented, and the relative groupings of words into intonational phrases. In other words, ToBI is a system for annotating the tune and prosodic structure of an utterance.

A ToBI transcription consists of a recording of the utterance that can be played in its entirety, or in smaller segments, as often as needed, a fundamental frequency contour showing the rises and falls in pitch, and symbolic codings on four tiers. The orthographic tier displays the words in the utterance; the miscellaneous tier provides a space for transcribers to annotate dysfluencies such as coughs; the break index tier displays subjective measures of the relative degree of disjuncture between adjacent words; and the tone tier displays the location and type of particular tones.

ToBI captures those stresses (or accentual prominences), and prosodic groupings (or phrasings), that are not predictable from the dictionary. For example, although native speakers of English know that the first syllable of *window* is stressed, they cannot predict whether *window* will be the most prominent word in a phrase such as *The window is open*. If the phrase is the answer to the question *What about the window?* the word *open* is likely to be most prominent (*The window is OPEN*). In contrast, if the phrase is a response to the command *Open the window*, when the window is already open, *is* is likely to be most prominent (*The window IS open*). It is also possible, although not necessary, to produce the syntactic phrase *The window is open* as two prosodic phrases, with a break between *the window* and *is open*, and with independent prominences on *window* and *open*. It is these sorts of unpredictable pieces of the tune and rhythm that ToBI is designed to express.

A closed set of pitch accents, including such tones as H*, L*, and L+H*, is used to represent the phrase-level stresses (or accentual prominences). Each accent is associated with a particular syllable. There are two levels of phrasing, the intermediate phrase and the larger intonational phrase. One or more pitch accents are nested within an intermediate phrase, and one or more intermediate phrases are nested within an intonational phrase. The right edge of an intermediate phrase is marked by a phrase accent, H- or L-. The phrase accent fills up the space between the last pitch accent and the right edge of the intermediate phrase. The right edge of an intonational phrase is marked by a boundary tone, H% or L%. In addition, the last pitch accent within an intermediate phrase is called the nuclear pitch accent, and it is typically perceived as being the most stressed within that phrase. Every utterance is spoken with at least one intermediate phrase and one intonational phrase. Speakers manipulate these components of pitch accents, phrase accents, and boundary tones, and intermediate and intonational phrases, to produce a tune or particular intonation for an utterance, and these are the components that were used to assess the prosodic structure of the utterances elicited in the production experiment.

Methods

Participants. 5 native speakers of mainstream American English were each paid $5 for their participation.

Materials and procedure. Speakers were recorded individually, as they produced twelve tokens of conjoined VP sentences (e.g., *Mary both sold vegetables and bought seeds at the fair*) and a matching set of twelve conjoined NP sentences (e.g., *Mary both sold vegetables and seeds at the fair*). A complete list of the target utterances is included in the appendix. Each recording session lasted 20 minutes and was conducted in a sound attenuated room. Speakers wore a Shure SM10A head-mounted microphone and were recorded on a TEAC V-427C stereo cassette deck using a TDK D90 cassette tape.

Prior to recording, each speaker was provided with written instructions that included a discussion of the structural contrast between the two types of sentences that speakers would be producing. In addition, the instructions stated that the experimenter was interested in the *way or ways that native speakers produce these two types of utterances*. Each speaker was prompted by the instructions and by the experimenter to ask for clarification about the uses of *both* or about the task itself; none requested any.

During a brief practice session, the experimenter set the recording level while speakers read contexts and sentences similar in kind to those used during the actual experiment. After the practice session, the utterances were obtained the following way: the experimenter read a two line context followed by the question, *Did you know that?* The speaker then produced the target utterance in response. Both the experimenter and the speaker read from a matching set of index cards on which they were able to see each context, question, and target utterance in its entirety. The index cards were divided into two blocks, with an equal number of conjoined NP and conjoined VP sentences in each block. If block one contained a particular conjoined NP sentence, the matching conjoined VP sentence was in block two. The order of block presentation was alternated between speakers, and for each speaker, the cards within each block were shuffled.

The same context was used for each member of an item pair, and the same question was used to prompt every utterance. This strategy is important because prosodic choices often reflect whether information in an utterance is new to the discourse or already shared by the parties involved (Chafe, 1976; Prince, 1981). By holding the questions and contexts constant, any prosodic differences could be attributed to the syntactic ambiguity in the target utterances, rather than to differences in information status induced by the context.

A total of 120 utterances were elicited (5 speakers x 24 sentences). ESPS/waves+ 5.0 was used to digitize each utterance and to calculate fundamental frequency contours.

Each utterance was digitized at 16 bits with a sampling rate of 16kHz, and each fundamental frequency contour was calculated using "get_f0," an autocorrelation-based F0-tracking utility program that is part of Entropic's ESPS/xwaves package. An experienced ToBI transcriber, who was naïve to the design and purpose of the experiment, annotated all of utterances.

The prosodic structure of each of the 120 ToBI transcriptions was analyzed for two types of prosodic cues. The first consisted of any consistent differences in the location of pitch accents, phrase accents, and boundary tones. The second consisted of any consistent differences in the particular tones used within each set of pitch accents, phrase accents, and boundary tones.

Results

Although there were no consistent differences in the particular types of accents (e.g., H* vs. L+H*, H % vs. L%) used by any of the five speakers, Speaker 4 (S4) did consistently manipulate the presence of a phrase accent and a pitch accent around the conjunction. Importantly, this manipulation occurred prior to the onset of the disambiguating region, the verb or noun of the second conjunct.

> disambiguating region
>
> Mary both sold vegetables and   bought seeds at the fair.
> Mary both sold vegetables and   seeds at the fair.

Figure 4. Example of Critical Items Marked for Onset of Disambiguating Region

To make a difference in phrasing, S4 produced a phrase accent after the stressed syllable in *vegetables* in all twelve conjoined VP sentences, but in only one conjoined NP sentence. Thus, there was a contrast between an intermediate phrase boundary following the first conjunct in the conjoined VP constructions (separating *vegetables* and *and*) and no boundary in the conjoined NP constructions.

In addition, S4 accented *and* in ten of the twelve conjoined VP sentences, but always left the conjunction unaccented in the conjoined NP sentences. Thus, there was a contrast between a stressed *and* in the conjoined VP constructions and an unaccented *and* in the conjoined NP constructions. Examples of ToBI transcriptions containing these contrasts of phrasing and accentuation are given in Figures 5 and 6.

Figure 5.   ToBI printout of conjoined VP

Figure 6.   ToBI printout of conjoined NP

As shown in Table 1, none of the other speakers manipulated phrasing and accentuation around the conjunction as consistently as S4. Looking only in the last row in Table 1, which summarizes the frequency of a phrase break occurring before *and* and the frequency of an accent occurring on *and* across speakers, there seems to be a strong tendency for conjoined VP constructions to be produced with an intermediate phrase break just before *and*. There does not seem to be any similarly strong constraint on phrasing in conjoined NP constructions. There also do not seem to be any constraints on the accentuation of *and* in either conjoined VPs or conjoined NPs.

Phrasing: intermediate phrase boundary before *and*			Accentuation: *and* is accented		
	Conj VP (n=12)	Conj NP (n=12)		Conj VP (n=12)	Conj NP (n=12)
S1	10	11	S1	6	10
S2	12	6	S2	1	1
S3	12	12	S3	10	8
S4	12	1	S4	10	0
S5	12	9	S5	12	12
total (prop.)	58 (0.97)	39 (0.65)	total (prop.)	39 (0.65)	31 (0.52)

Table 1. Number of Conjoined VPs and Conjoined NPs As Produced by Each Speaker That Show the Prosodic Cue of Phrasing Before *and* and the Prosodic Cue of Accentuation on *and*

Discussion

Of the five speakers who participated in the production experiment, only one of them (S4) consistently produced potentially disambiguating prosodic cues. This speaker manipulated phrasing around, and the accentuation of, the conjunction word *and*.

By inserting a phrase accent between the conjunction *and* and the preceding noun in the conjoined VP construction, S4 produced an intermediate phrase boundary between the first conjunct and the conjunction, thereby dividing the conjuncts into at least two

parts as schematized in Figure 7. In these constructions, the larger syntactic unit that contained the two conjuncts did not fall within a single intermediate phrase.

X-

Mary   both   sold   vegetables   and   bought   seeds
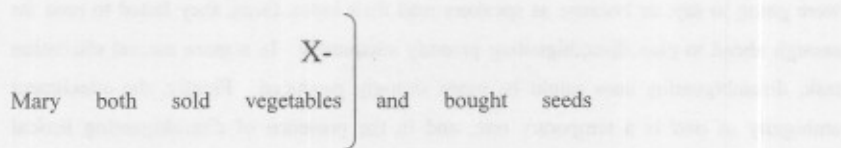
Figure 7. Example of a Phrase Accent Marking the Right Edge of an Intermediate Phrase and Dividing the Conjuncts

In contrast, by not placing an intermediate phrase break in the same location in the conjoined NP construction, it remained possible for the two conjuncts to be produced within the same intermediate phrase. In fact, S4 did just this in eleven of the twelve conjoined NP constructions. The larger syntactic unit containing the two conjuncts occurred within a single intermediate phrase.

By accenting *and* in almost all of the conjoined VP sentences, S4 made the conjunction perceptually more salient as compared to its unaccented match in the conjoined NP sentences. This is not to say, however, that *and* was perceived as the most stressed syllable in its intermediate phrase, for it is the last pitch accent in an intermediate phrase, the nuclear accent, that is typically perceived as the most stressed. Although the pitch accent associated with *and* was nuclear in only two of the ten cases, accenting *and* in the conjoined VP sentences may have been a way for S4 to clearly mark the onset of a new intermediate phrase after the first noun.

The results of the production experiment suggest that although manipulating phrasing and accentuation around *and* might disambiguate coordinate structures prosodically, most speakers fail to consistently provide those cues, even when they are aware that prosody is at issue. Why might it be that only one speaker out of five consistently produced disambiguating prosody? There are several possible explanations. First, at least for mainstream American English, there is no one-to-one relationship between syntax and prosody; it is possible to produce a given syntactic structure with multiple tunes. Thus, it could be that the variety of tunes obtained in the production experiment simply reflects the variety of naturally occurring tunes. Second, the instructions given to the speakers may have been too subtle. In other words, only S4 produced consistent prosodic cues because only S4 was able to understand the task

properly. Third, it is possible that the task was not conducive to eliciting strong prosodic cues, either because speakers knew that the experimenter was already aware of what they were going to say, or because as speakers read their index cards, they failed to read far enough ahead to plan disambiguating prosody adequately. In a more natural elicitation task, disambiguating cues might be more strongly produced. Finally, the attachment ambiguity of *and* is a temporary one, and in the presence of disambiguating lexical information, the need for prosodic disambiguation might be obviated.

Although only one speaker out of five consistently produced disambiguating prosodic cues, the results of the production experiment do provide some answers to the questions raised at the beginning. What is the nature of the prosodic information that might differentiate a syntactically ambiguous construction? Those components include phrasing and accentuation. Are speakers consistently producing prosodic cues? With the exception of S4, the answer is "no." Nonetheless, there are several interesting follow-up questions to be pursued in the perception experiment. Not only is it possible to ask if listeners are sensitive to the cues of phrasing and accentuation that S4 manipulated, but is it also possible to ask two new questions. One, to what extent are the phrasing around, and the accentuation of, the conjunction word *and* independent or related prosodic cues? Two, if the cues are independent, do they signal the same or different information?

The Perception Experiment

Even though there was a great deal of variety in the utterances that the speakers in the production experiment produced, one speaker (S4) did consistently provide potentially disambiguating prosodic cues. Furthermore, those cues occurred prior to the onset of lexical information that resolved the temporary syntactic ambiguity in question, namely the attachment site of *and* in conjoined VP and conjoined NP constructions. Thus, the consistency with which S4 produced disambiguating prosodic cues makes it possible to address the third and fourth questions raised at the beginning of this paper: Are listeners sensitive to prosodic information that might differentiate a temporary syntactic ambiguity, and if so, is there evidence that those are the cues that are used to resolve the ambiguity? In addition, it is possible to raise two new questions that evolved out of the production experiment. To what extent do the phrasing around, and the accentuation of, the conjunction word *and* represent independent or related prosodic cues? If the cues are independent, do they signal the same or different information?

With respect to these new questions, there are several reasons to expect that the absence of a phrase break before *and* is the primary prosodic cue, while the accentuation of *and* serves a secondary purpose. It is apparent from the totals in Table 1 that there is a strong tendency for conjoined VP constructions to elicit an intermediate phrase boundary after *vegetables*. However, because the presence of a phrase accent is "required" for conjoined VPs but "optional" for conjoined NPs, the only way in which that cue could be informative, is for its absence to signal a conjoined NP.[1] Thus, the absence of a phrase accent is likely to signal the presence of conjoined NPs, independently of the accentual status of *and*. Furthermore, the absence of a phrase break is likely to be a general cue to conjoined NPs, as opposed to a speaker specific one, for two reasons. First, the constraint on "obligatory" phrasing in conjoined VPs and "optional" phrasing in conjoined NPs extends across all five speakers. Second, work by Schafer & Speer (1998) and Kjelgaard & Speer (1999) also suggests that intermediate phrases play a privileged role in syntactic parsing.

The presence of an accent on *and*, on the other hand, is "optional" for both types of constructions. Therefore, its presence and/or absence is uninformative, and it is unlikely that the accentual status of *and* acts by itself as a cue to syntactic structure across speakers. It is possible, however, that listeners are sensitive to strategies employed by specific speakers, in which case the accentual status of *and* might act as a signal to syntactic structure when it is used consistently by a specific speaker, such as S4. A second, and more likely possibility, is that accenting the conjunction when it immediately follows a phrase accent (as S4 consistently did) represents a strategy for clearly marking the onset of a new intermediate phrase.

The perception experiment was designed to investigate whether or not listeners could perceive the prosodic cues that S4 produced and use those cues to identify sentence fragments as conjoined NPs and conjoined VPs. Listeners were not expected to be able to identify fragments from the other four speakers because their fragments contained neither the phrasing and accentuation cues that S4 had so consistently provided, nor additional prosodic cues. If listeners were actually able to identify the fragments from

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[1] I thank Rick Lewis for pointing this out to me. Unfortunately, this makes it impossible to use these constructions to test the influence of prosody in parsing, since conjoining NPs is already the default within both Constraint-based models and the Garden Path model.

speakers other than S4, then that would suggest that there were prosodic cues that had been overlooked. Finally, it was possible to investigate the extent to which the accentuation of, and the phrasing around, the conjunction word *and* represented independent or related prosodic cues. This was done by assessing identification rates to fragments that contained different combinations of these cues.

The results suggest that the manipulations of phrasing and accentuation around *and* are indeed perceptible prosodic cues. The results further suggest that the absence of a phrase break acts as a cue to conjoined NPs, and that this cue is not restricted in its interpretation to the one speaker who produced it the most consistently.

Methods

Participants. The 42 undergraduates who participated in the acceptability ratings participated first in the perception experiment. Responses from the same 2 nonnative speakers of English were again excluded from the Ohio State pool and are not reported here. All remaining respondents were native English speakers.

Materials and procedure. 118 sentence fragments of the form *Mary both sold vegetables and...* were created by splicing each of the 120 utterances that had been collected and digitized for the production experiment. Two conjoined VP utterances, one from Speaker 3 and one Speaker 5, were discarded due to dysfluencies within the fragment. The splice point for each fragment was chosen with two goals in mind, to keep as much of the offset of *and*, and as little of the onset of the following word, as possible. The fragments were randomized and recorded to a TDK D90 cassette tape. Fragments were separated from one another by 3 seconds of silence, a tone, and another 3 seconds of silence. A double tone separated every 10 fragments. The 20 minute tape was then presented to listeners, in groups and individually, on a portable cassette deck.

The fragments were presented in a forced-choice task; listeners had to decide whether each fragment belonged to a conjoined NP or a conjoined VP utterance. Listeners had one of two types of response sheets. Half of the listeners received "whole sentence" response sheets that presented the original sentences in their entirety. The other half received "partial sentence" response sheets that provided two versions of the fragment, one followed by NOUN and the other followed by VERB. This was done to address two concerns.

First, it is important to recognize that there are two types of information provided in each fragment, intonational and segmental. Since the last word in every fragment was *and*, it was likely to be coarticulated with the following word. Listeners who actually knew the word following *and* might be able to make their decisions based on segmental information rather than on intonational information. If listeners were indeed using coarticulatory cues to the following word's initial segments to make their decisions, as opposed to intonational cues to the prosodic parse of the sentence fragment, then they should be able to use that information in both conditions. Thus, there should be higher identification rates for conjoined VP constructions, as well as for conjoined NP constructions, from listeners with whole sentence response sheets.

The second reason for using two types of response sheets stemmed from the overwhelming preference for conjoined NP sentences that had been evident in the sentence completion data. This raised the possibility that there might be an overall bias to identify fragments as conjoined NPs. Because the whole sentence response sheets eliminate the need to think of a likely completion for a given fragment, bias effects should only be evident among those listeners with partial sentence response sheets.

The order of noun option first or verb option first was held constant for each individual response sheet but split among each set of response sheets.

Results

The proportion of each speaker's conjoined VP and conjoined NP fragments that were identified correctly are summarized in Table 2. As expected, listeners performed best at identifying the fragments produced by S4, the one speaker who consistently manipulated phrasing and accentuation around *and*, and performed poorly for the other 4 speakers who failed to produce consistent prosodic cues.

Proportion of Fragments Correctly Identified

Speaker	Conj VP	Conj NP
S1	0.56	0.47
S2	0.45	0.55
S3	0.47	0.55
S4	0.60	0.62
S5	0.42	0.56

Table 2. Proportion of Fragments Correctly Identified by Speaker and Fragment Type

The proportion of fragments identified as conjoined VP by subjects (F1) was submitted to a 2 (phrase type: conjoined NP or conjoined VP) x 5 (speaker) repeated measures ANOVA. Response sheet (whole sentence or partial) and order (noun option first or verb option first) were treated as between subjects variables.[2] The same proportion of responses was assessed by items (F2)[3] using a 2 (response sheet) x 2 (order) x 5 (speaker) repeated measures ANOVA. The results showed a main effect of phrase type [F1 $(1,36)$ = 11.598, p $\leq$ 0.002; F2 $(1,9)$ = 11.605, p $\leq$ 0.008], a main effect of speaker [F1 $(4,144)$ = 5.676, p $\leq$ 0.001; F2 $(4,36)$ = 4.766, p $\leq$ 0.003], and a speaker x phrase type interaction [F1 $(4,144)$ = 8.931, p $\leq$ 0.001; F2 $(4,36)$ = 11.435, p $\leq$ 0.001].

Looking at the data in Table 2, the positive responses to S4 seem likely to be contributing heavily to the speaker x phrase type interaction. To investigate this possibility, two additional ANOVAs were conducted. The first included only responses to S4 and the second excluded responses to S4.

The results of the S4-only ANOVA showed a strong main effect of phrase type [F1 $(1,36)$ = 25.884, p $\leq$ 0.001; F2 $(1,9)$ = 63.143, p $\leq$ 0.001]. Also in the items analysis, there was a reliable main effect of order [F2 $(1,9)$ = 5.661, p $\leq$ 0.04], and a marginal phrase type x list interaction [F2 $(1,9)$ = 4.457, p $\leq$ 0.06].

The results of the ANOVA that excluded S4 showed a main effect of speaker [F1 $(3,108)$ = 7.609, p $\leq$ 0.001; F2 $(3,27)$ = 7.181, p $\leq$ 0.001], and as expected, no speaker x

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[2] Because there were 19 Ohio State listeners, but 21 from Rutgers, school was not included as a variable.

[3] Two items were excluded from analysis because of an uneven number of cells. Because two speakers had produced dysfluent fragments, two items were missing a speaker/phrase type entry.

phrase type interaction. By subjects, there was a marginal speaker x order interaction [F1 $(3,108) = 2.404$, $p \leq 0.072$]. By items, there was a list x order interaction [F2 $(1,9) = 5.335$, $p \leq 0.046$] and a phrase type x list x speaker interaction [F2 $(3,27) = 4.031$, $p \leq 0.017$].

The results suggest that listeners are in fact able to use the prosodic cues provided by S4 to identify her conjoined VP and conjoined NP fragments. This analysis is further supported by a set of post-hoc t-tests that were based on the total proportion of conjoined NP and conjoined VP fragments identified correctly, by 40 listeners, for each speaker. The only statistically significant response belonged to S4 [t (79) = -4.169, $p \leq 0.001$]; the responses to the other four speakers were nonsignificant.[4]

The absence of any reliable effects of response sheet in the primary ANOVA suggests that listeners were indeed relying on intonational information, and not segmental information, to make their decisions. In further support of this interpretation, listeners with whole sentence response sheets did not perform better at identifying both types of fragments.

There is some suggestion, however, that listeners are biased to identify fragments as conjoined NPs. As shown in Table 2, listeners are more likely to identify fragments as conjoined NPs when those fragments are produced by S2, S3, and S5. These are three of the four speakers who failed to produce consistent prosodic cues. Additionally, listeners with partial sentence response sheets were more likely to identify both types of fragments as conjoined NPs.

In order to assess the relationship between the phrasing and accentuation around *and*, responses to groups of fragments that contained various combinations of those two prosodic cues were analyzed. Table 3 presents a summary of different subsets of fragments and the proportion of conjoined VP identifications for each of those different subsets. For example, across all five speakers, ninety five fragments contained a phrase accent between *and* and the preceding object noun; twenty three fragments did not. Sixty four fragments contained both a phrase accent between *and* and the preceding object noun, and a pitch on *and*; nineteen fragments contained neither.

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[4] It is surprising that the results from a signal detection theory analysis suggest that the conjoined NP prosody and conjoined VP prosody of S4 are not discriminable (D-prime = 0.534, beta = 1.013, criterion = 0.291). I am not sure at this point how to reconcile these findings with the ANOVAs and t-tests.

Excluding S4, fifty eight fragments contain a pitch accent on *and*; thirty six fragments did not.

Proportion of Subsets of Fragments Identified as Conjoined VPs (n = number of tokens)					
	all speakers			all speakers except S4	
	with tonal cue	without tonal cue		with tonal cue	without tonal cue
phrase break before *and*	0.50 (n = 95)	0.38 (n = 23)	phrase break before *and*	0.48 (n = 82)	0.39 (n = 12)
accent on *and*	0.50 (n = 68)	0.44 (n = 50)	accent on *and*	0.47 (n = 58)	0.46 (n = 36)
phrase break and accent	0.50 (n = 64)	0.38 (n = 19)	phrase break and accent	0.48 (n = 54)	0.37 (n = 8)

Table 3. Proportion of Subsets of Fragments Identified as Conjoined VPs

The data presented in Table 3 provide evidence that listeners interpret the absence of a phrase break before *and* as a general prosodic cue; interpretation of this cue is not restricted to its most robust source, S4, but rather extends across speakers. The proportion of conjoined VP identifications decreases whenever a phrase accent is omitted. This occurs even when responses to S4 are excluded from analysis, as shown on the right hand side of the table.

Although there also seems to be a slight effect of the absence of accentuation, the effect is not particularly robust, and it disappears when S4's fragments are excluded. Furthermore, there is no evidence that the absence of an accent on *and* combines with the absence of a phrase break to further decrease the number of conjoined VP identifications. Thus, these data provide evidence that across speakers, listeners do not interpret either the presence or absence of an accent on *and* as a cue to syntactic structure.

Discussion

The results of the perception experiment provide evidence that listeners are able to perceive the prosodic cues produced by S4 and use those cues to identify her conjoined

VP and conjoined NP fragments. The data also suggest that listeners show a slight bias to identify fragments as conjoined NPs, particularly in the absence of prosodic cues.

Although S4 manipulated phrasing and accentuation around the conjunction word *and*, these two potentially disambiguating prosodic cues were interpreted by listeners in different ways. In terms of phrasing, its absence was interpreted as a cue to conjoined NPs, across speakers. This finding accords well with the differences in distribution of phrasing obtained in the production experiment, and with evidence from other experimental work regarding the privileged role that intermediate phrases play in parsing (Schafer & Speer, 1998; Kjelgaard & Speer, 1999).

In contrast, the presence or absence of an accent on *and* did not act as a general cue to syntactic structure, and based on its distribution in conjoined NPs and conjoined VPs, it could not have. With respect to the speaker who consistently manipulated the accentual status of *and*, S4, accenting the conjunction in the conjoined VP sentences may have been a way of clearly marking the onset of a new intermediate phrase. However likely this may be, I cannot rule out the possibility that the accentual status of *and* was interpreted by listeners as a speaker specific cue to syntactic structure. Not only were listeners able to identify S4's conjoined NPs, most likely on the consistent absence of a phrase break in those constructions, but they were also able to identify her conjoined VPs. Since the presence of a phrase break cannot act as a cue to conjoined VPs, some other prosodic cue must have been providing that information. One possibility then, is that listeners were sensitive to the way in which S4 manipulated the accentuation of *and*, and they reserved the interpretation of accented *and* for only her utterances.

Of course, it is not possible from these data to know whether listeners were using only accented *and* to detect S4's conjoined VPs, or whether the relevant prosodic cue was some other event or combination of events. For example, whenever S4 used accented *and*, she also produced a phrase break before it. Thus, speakers might have been sensitive to the combined effect of a phrase break preceding the accented conjunction. Another possibility, and one that I am actively investigating, is that listeners were sensitive to a particular tonal contour that S4 produced over the first VP conjunct. This contour, a prenuclear L+H* immediately followed by a downstepped nuclear H* (!H*), can be seen in the ToBI transcription in Figure 5. This pattern holds promise for explaining the apparent VP bias shown in listener responses to S1, as well.

In sum, even though S4 consistently manipulated both phrasing and accentuation around the conjunction, only the absence of a phrase break is interpreted as a reliable prosodic cue to the syntax of coordinate structures, independent of the speaker who produced it. The absence of a phrase break signals conjoined NPs, across speakers. In the case of the accentual status of *and*, it is clear that no such general interpretation exists. Furthermore, the extent to which it acts as a cue to other prosodic structures, such as the onset of a new intermediate phrase, or acts as a speaker specific cue to syntactic structure remains an area for future research.

General Discussion

The combined results of the production and perception experiments provide evidence that speakers can in fact consistently produce prosodic cues as a means of disambiguating the temporary syntactic ambiguity inherent in coordinate structures, although most of them fail to do so, at least in the region preceding disambiguating lexical information. The results also suggest that speakers are likely to make use of phrasing and accentuation around the conjunction when asked to provide disambiguating prosody, although there seems to be some variation in the ways that listeners interpret those two cues. In the case of phrasing, listeners are sensitive to the general constraint that the presence of a phrase break is optional only in the case of conjoined NPs. In the case of accentuation, no such constraint exists, and thus, the accentual status of *and* cannot and does not act as a general cue to syntactic structure.

The role of accentuation highlights one of the more interesting, and ongoing, research questions raised by this data. Given the general bias to identify fragments as conjoined NPs, and given that the informativeness of phrasing is limited to the absence of a phrase break signaling conjoined NPs, what accounts for the large proportion of correct VP identifications for S4 and for what seems to be a VP bias in the case of S1? As mentioned above, one possibility is that listeners were sensitive to S4's manipulation of the accentual status of *and*. Another possibility, and one that I am actively investigating is that listeners were sensitive to a particular tonal contour, or section of tune. This tonal contour has possible ramifications for work on *association with focus* (Jackendoff, 1972; Rooth, 1992) and the scope ambiguity of preverbal *both*.

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Appendix

Listed below are the materials from the production and perception experiments. Conjoined NP and conjoined VP sentences have been collapsed; the second verb is marked in parentheses. A "/" marks the end of the fragment used in the perception experiment. An "*" marks the two dysfluent conjoined VPs that were excluded from the perception experiment.

1. Ohio's vegetable farmers always do a lot of business at the state fair, but last year it was more than farmers. Columbus city gardeners participated, too. Did you know that?

    Yes, Mary both sold vegetables and / (bought) seeds at the fair.

2. Last summer there was a power outage during one of the worst heat waves ever. People went crazy. Did you know that?

    *Yes, looters both destroyed stores and / (stole) cars during the blackout.

3. David and his friends like getting together at Barley's on Friday nights. Last week they ended up staying for several hours. Did you know that?

    Yes, the gang both had sandwiches and / (drank) beer at the brewpub.

4. The ranger really enjoyed his post at Yellowstone National Park. He was in pretty close contact with the wildlife. Did you know that?

    Yes, the ranger both tracked elk and / (saw) bear throughout the park.

5. The choir met in the church basement to begin learning their first number. They were there for hours. Did you know that?

    Yes, the choir both whistled choruses and / (sang) verses during the song.

6. The gardener woke up early each day ready to work in her greenhouse. She easily spent several hours there every day. Did you know that?

    Yes, the gardener both selected herbs and / (chose) flowers during the morning.

7. The student enjoyed last quarter's English class. It was the first one he had taken at OSU. Did you know that?

   Yes, the student both learned stories and / (memorized) poems from the book.

8. The coach of the little league team was always at his busiest at the beginning of the season. He had several responsibilities. Did you know that?

   Yes, the coach both picked players and / (held) equipment for the team.

9. Christopher worked for a landscaping company last Friday. He said it was hard work. Did you know that?

   Yes, Christopher both carried rocks and / (brought) tools to the site.

10. The maid complained about her job to anyone who would listen. She worked her fingers to the bone. Did you know that?

    Yes, the maid both scrubbed dishes and / (did) floors all by hand.

11. The officer did a pretty thorough job looking into the robbery at the high school. He took notes on everyone. Did you know that?

    *Yes, the officer both investigated parents and / (met) teachers before the assembly.

12. William always had a good time playing construction site at the vacant lot. He would play there for hours. Did you know that?

    Yes, William both shoveled dirt and / (threw) stones just for fun.

Tonal Associative Morphemes in Optimality Theory[*]

Michael Cahill
cahill@ling.ohio-state.edu

Associative (= possessive or genitive) morphemes in many African languages consist solely of a tone. In a sample of 29 languages, this tonal morpheme is manifested on either the head noun or the noun to the right. It is never manifested on a dependent noun to the left. These patterns are analyzed as the result of two constraints. The first constraint, TONE-RT, states that surface tones associate to the right of their underlying positions. The other constraint, HEAD-PROM, states that heads rather than non-heads attract phonetic prominence. These constraints are supported by a variety of cross-linguistic evidence, and their interaction is illustrated from a variety of languages. In the complex case of the Makaa language of Cameroon, the associative morpheme docks left in some instances and right in others. I show that in Makaa, HEAD-PROM outranks TONE-RT, but is itself outranked by other constraints, giving the alternate directions of docking.

1. Introduction

In Optimality Theory, constraints have been proposed to be universal (Prince & Smolensky 1993). If this is true, then these constraints would be expected to be active cross-linguistically. Thus for any such proposed universal constraint to be well-supported, it is worthwhile for the investigator to examine data from a wide variety of languages. Examining cross-linguistic data relating to a particular phenomenon may in turn yield previously unsuspected generalizations, which then can be translated into constraints. These constraints may in turn lead to new and more insightful analyses of previously-analyzed data. Casali's (1997) work on vowel elision in hiatus is a case in point. As a result of examining several dozen languages in which vowel elision occurs in hiatus contexts, he proposed a small set of general constraints which in various

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combinations of rankings account for all the attested patterns of elision, rather than the

purely stipulative rule-based accounts previously available for individual languages.

Another area in which the same approach has proved fruitful is examined in this paper. This is the area of floating tonal morphemes marking the associative construction in noun phrases. By examining constructions from a variety of languages, we can derive some generalizations which account for the patterns found, but have not been previously noted for any of the individual languages.

This paper is organized as follows. In Section 2, after a brief look at associative morphemes which are purely segmental, I present data from 29 languages in which the associative morpheme is purely tonal, showing that the realization of the associative morpheme is always either on the head noun or to the right (or both). In Section 3, I motivate two basic constraints which will be central to the analysis of these morphemes, TONE-RT (tones "move" rightward) and HEAD-PROM (heads are phonetically prominent), and use these to analyze the possible patterns of associative tonal behavior in the languages listed. The more complex situation of the Makaa language, in which the associative tone docks in different directions depending on the context, is examined more closely.

2. The data

2.1 Segmental associative morphemes

In an associative construction (also called genitive or possessive), the head noun is the possessed one; the dependent noun is the possessor. Nichols (1986) shows that cross-linguistically, the associative relation can be morphologically marked on either the head noun or its dependent.[1] For example, she cites the two Caucasian languages Chechen and Abkhaz as marking the dependent noun and the head in associative constructions, respectively (superscripts H and A mark the Head noun and the Associative Marking):

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[1] My thanks to Arnold Zwicky for pointing out this reference.

(1)   Chechen: de:-ˤn   ˠa:xča   'father's money'
                     father-GEN   money

        Abkhaz: à-č'k°'ən   ˤyə-ᵏy°nə 'the boy's house'
                     the-boy   his-house

Which noun a segmental associative morpheme attaches to, then, can be purely a language-specific matter of the morphology. Other cases can be easily adduced.

For English, the *'s* marker attaches left to the dependent noun, e.g. *chair's leg*, as in the Chechen case above, while in Hausa, the *-n* or *-r* associative marker attaches left to the head noun (Cowan & Schuh 1976):

(2) a.   agogo-n̲ malam   b.   tunkiya-r̲ Maryama
          watch-of teacher   sheep-of Maryama
          'teacher's watch'   'Maryama's sheep'

Other languages can mark the genitive relationship to the dependent noun to the right:

(3) Modern Greek[2]
     kɛfaʎ-a   kot-on   'chicken's head'
     head-SG.NOM   chicken-GEN.PL

(4) Gaelic
     taigh   bhalaich   'boy's house' (cf. balach 'boy (nom)')
     house (nom)   boy (**gen**)

Examples may be multiplied from the reader's experience. With segmental morphemes, an associative or possessive marker may attach to the head or the dependent noun, to the left or to the right. All combinations are found, and it does not seem that any are rare. In contrast, a more restricted pattern applies to purely tonal associative morphemes.

2.2 Tonal associative morphemes

In the African context, the associative morpheme consisting entirely of tone arose historically from a morpheme which had segmental as well as tonal content. This morpheme occurred between the possessed and possessor nouns, in conformity with Greenburg's word-order universals (Greenburg 1966). When the segmental content, often

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[2] My thanks to Panos Pappas and Tom Stewart for supplying the Greek and Gaelic examples.

a vowel, was lost, the tonal effect remained behind (see discussion in Welmers 1963). In this section I present data from languages which synchronically have an associative morpheme consisting solely of tone. The much-analyzed Bamileke-Dschang (Hyman 1985), which has associative markers consisting of segmental as well as tonal material, is a borderline case, since the segmental part of the associative marker frequently elides, leaving only tonal effects. All the examples in this paper are from African languages, though from several language families. Whether tonal languages from other areas of the world, such as Asia or Meso-America, have associative morphemes consisting solely of tone remains to be seen.

For the first language I examine, I explicitly lay out the reasoning that causes the analyst to posit a separate morpheme consisting solely of tone. In languages following, I merely present the data for the reader's examination, and assume the same type of analysis. The language data is grouped by families below. The diacritics (ˋ, ˊ, ^, ˇ, ˉ, !) will respectively symbolize Low, High, Falling, Rising, Mid, and Downstep below unless otherwise indicated.

2.2.1 Gur

In Kɔnni, a Gur language of northern Ghana, a segmentless High tone is the morpheme which marks the associative construction in third person, as in 'his stone' or 'child's stick'. The evidence for this is that the head noun of every such construction for third person as possessor has a High tone on its initial syllable. It is only the third person, singular or plural, that has the High tone as associative marker:

(5)		1st	2nd	3rd	3rd non-human	
	singular	ǹ dàáŋ	fĭ dàáŋ	ʊ̀ dá!áŋ	kà dá!áŋ	'my, *etc*. stick'
	plural	t̀ dàáŋ	ǹì dàáŋ	bà dá!áŋ	à dá!áŋ	

If the head noun already has a High tone on its first syllable in citation form, then there is no change when it is placed in an associative construction. Examples are given below with both pronouns and nouns as possessors.

(6) a.   tǎŋ   ù tá[!]ŋ[3]   'stone, his stone'

         zàsíŋ   ù <u>zá[!]síŋ</u>   'fish, his fish'

         dàmpàlá   ù <u>dám</u>[!]pálá   'bench, his bench'

    b.   bùàwá <u>dá[!]áŋ</u>   'child's stick'   (cf. bùàwá 'the child', dàáŋ 'stick')

         bùá <u>kárénîà</u>   'child's cutlass'   (cf. bùá 'child', kàrénîà 'cutlass')

         chùrú <u>dám</u>[!]pálá 'husband's bench'   (cf. chùrú 'husband', dàmpàlá
                                                  'bench')

The alternation between the initial Low for head nouns in citation form and the initial High in the associative construction is explained by the existence of a High tone between the two nouns. The High will dock to the head noun, giving the observed pattern of a High tone on the first syllable (sometimes as part of a H[!]H contour on that syllable, as in 'stone' and 'stick' above).

(7)   L   H   L H   L   H L H
         | | | → | \ /
         u   zasıŋ   u   zasıŋ   ù zá[!]síŋ 'his fish'

In Moore, it appears that the same pattern occurs (adapted from Peterson 1971).

(8) sáánà + dòògó   →   [sáánà dóó[!]gó]   'stranger's house'
     stranger   house

A similar pattern also appears to occur in the related language Dagbani (Goad 1988):

(9) nàá + nàá   →   [nàá ná[!]á]   'chief's chief'
     chief   chief

In Senoufo, the same pattern of a High associating right to the head noun occurs, but its realization seems to be optional (Mills 1984).

(10) lòmúrúẃ + lɔʔɔ   →   lòmúrúẃ <u>lɔʔɔ</u> ~ lòmúrúẃ lɔʔɔ   'the lemon's juice'
      lemon   water

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[3] The form tá[!]ŋ has a contour tone of High-downstepped High on a single syllable. Rather than attempting to write H[!]H on the [a], I have written the downstepped High tone on the nasal for convenience' sake

2.2.2 Adamawa-Ubangi

In the Adamawa-Ubangi family, the Suma language of the Central African Republic as analyzed by Bradshaw (1995a, b) has a floating [+upper] or "high register" feature that marks the associative construction. Suma has three pitch levels, and in Bradshaw's analysis, [+upper] characterizes both Mid and High tones. Thus a floating [+upper] will have no effect on Mid and High (11a-b), since they are already [+upper], but will only affect nouns ending in a Low tone (11c-d), as follows:

(11) a.   zàká   +   sàɗè   →   zàká sàɗè   'animal horn'
          horn   animal

    b.   kōy   +   kàm   →   kōy kàm   'leftover food'
          remains   food

    c.   kpárè   +   fǒn   →   kpáré fón⁴   'millet seeds'
          seeds   millet

    d.   rì   +   bèrè   →   rī bèrè   'breast milk'
          water   breast

Thus the [+upper] associative morpheme docks left, to the head noun. The difference in Low changing to High in (c) and Low changing to Mid in (d) is due to additional tone rules (note the following word begins with High in (c) and Low in (d)).

The Ali language is spoken in Central African Republic and has the same type of pattern (Monino 1987, English glosses supplied by M. Bradshaw):

(12) a.   zù   +   sàɗì   →   zū sàɗì   'animal head'
          head   animal

    b.   sālā   +   tè   →   sálá tè   'body hair'
          hair   body

The Mumuye language, Zing dialect, is spoken in Nigeria, and has two types of genitive construction (Shimizu 1983). In one of these, the head noun is to the right with no associative marker between it and the dependent possessor noun. This type is generally limited to cases in which the possessor is animate. In the more general case, used for both animate and inanimate possessors, which we will consider here, the head noun is on the left and the associative tone docks to it.

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⁴ Note typo in Bradshaw 1995a, in which the form is listed incorrectly as kpárè fón (Bradshaw, pc).

(13) a. yūū   +   nàpõ →   yúú nàpõ   'head of cow'
         head   cow

     b. tnárĩ   +   zãã   →   tnárí zãã   'teeth of dog'
         teeth   dog

     c. kiǹ   +   kpàǹfĩ →   kiń kpàǹfĩ   'chicken of chief'
         chicken   chief

2.2.3 Kwa

In Dolphyne (1988), we see that a High associative tone in the Kwa language Akan between nouns normally docks to the head noun, to the right (see also Dolphyne 1986, Nyaggah 1976):

(14) Kòfì nyá[1]mé   'Kofi's god'   Kòfì Nyàmé   'Kofi Nyame' (proper name)
     (cf. nyàmé 'god')

Welmers (1963:439,441) mentions Akan as having an associative Low tone, but his data deals with compounds rather than the Noun + Noun associative constructions cited above. Forming a compound *word* involves different processes than forming an associative *construction*.[5]

2.2.4 Kru

In Bété de Gbadi (Charette 1983), the head noun is to the right. There are four tones: High, Mid-High, Mid, and Low. The Mid-High is unmarked in the transcriptions below (my translation from the French glosses).

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[5] For example, in Kɔnni, a compound noun's first noun stem lacks a suffix, and there is no tonal perturbation traceable to any separate morpheme, while in the associative construction, both nouns have their respective suffixes and there is a tonal perturbation traceable to a morpheme distinct from either noun, as in (5-6).

(15) a.   glimɔ   yu   →   glimɔ yù   'agouti's child'

agouti child

b.   sìpu yu   →   sìpú yū   'cat's child'
cat   child

c.   yu du   →   yú dù   'child's village'
child village

d.   nēmē̄ gʷi   →   nēmē̄ gʷì   'animal's horns'
animal horns

e.   sū dádè   →   sū dădè   'wooden pipe'
tree pipe

f.   gʷì lɔ→   gʷì lɔ   'elephant totem'
totem elephant

g.   yu ɓùdù   →   yú ɓùdù   'child's house'
child house

h.   sū gbè   →   sū gbè   'wooden totem'
tree totem

Though there are several complexities which we will not examine here,[6] a general pattern is evident. The head noun, to the right, is lower in tone in associative construction than in isolation form (cf. especially 'child' in a, b, c, and g). Charette analyzes this as due to a floating associative Low tone which docks right.

2.2.5 Chadic

In the Chadic language Ga'anda, the dependent noun, to the right in an associative construction, is marked by an initial High tone (Kenstowicz 1994):

(16) a.   āl   +   cùnèwà   →   āl cúnèwà   'bone of elephant'
bone   elephant

b.   ɓár   +   pūnó   →   ɓár púˈnó   'husk of maize'
bark   maize

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[6] For example, many of the Mid-High tones word-finally in citation forms are analyzed by Charette as underlyingly High, with a rule of final Lowering giving the surface Mid-High. Thus the apparent change of yu to yù in noun 1 position is not due to any tonal rule applying, but rather that Lowering does not apply when yu is not utterance-final. It should be noted also that Charette analyzes citation Mid tones as underlyingly toneless.

2.2.6 Benue-Congo: Cross River

For Efik, Ward (1933) reports a "genitive tone" in possessive constructions. This appears to be a High tone which associates to the right, to the dependent noun, as seen from the data adapted from Ward (1933:42)

(17) a. èkpàt   èdèm   ékpàt   'bag's outside (outside of the bag)'
         bag   outside bag
     b. ùbóm   ísó   úbóm   'canoe's front (front of the canoe)'
         canoe   front   canoe
     c. àŋwâ[7]   isìm   áŋwâ   'cat's tail'
         cat   tail   cat

Kana (or Khana) is also classified in the Cross River division of Benue-Congo and spoken in Nigeria. The head noun is to the left, and it is the tone on that noun which can change. Kana has four surface tones: High, Raised, Mid, and Low. The Raised is regarded as derived from a lowered High (Ikoro 1995). A High tone on the head noun never changes, a Low changes only before a Mid (as the result of a separate raising rule, not the associative construction), the Raised changes before any tone except Mid, and Mid changes before any other tone. Changes due to the associative construction are shown below. Raised tone is unmarked.

(18) a. gbɔ   +   té   →   gbɔɔ̀ té   'wooden fishing net'
         net   tree
         gbɔ   +   fa   →   gbɔɔ̀ fa   'net of a boat'
         net   boat
         ko   +   bɔ̀ɔ̀   →   koǫ̀ bɔ̀ɔ̀   'dangerous friend'
         friend   danger
     b. yēb   +   zim   →   yēèb zím   'ancestral dance'
         dance   anc.spirit
         bē   +   fa   →   bēè fa   'home of vehicles'
         compound   vehicle
         yēb   +   dū   →   yeb dū   'market dance'
         dance   market
         bū   +   dèrè   →   būù dèrè   'vulture's stomach'
         stomach   vulture

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[7] Ward's symbols indicate that the falling tone in àŋwâ 'cat' is from Mid to Low, but the text states it is "high--high-fall". The exact phonetics of the second syllable is not crucial to the main point here.

With the exception of 'market dance,' which shows the effect of a Mid raising

rule, it can be seen that the first noun shows a Low tone as a result of the associative construction. Thus Kana is an example of a relatively rare Low associative tone which docks.

2.2.7 Benue-Congo: Defoid

Welmers (1973:43-44) reports that the associative construction in some phonological environments in Yoruba is marked with a mid tone that combines with a High ending the first word to give a High-Mid glide on the first word (which is the head noun), or, as in the data below, replaces a low tone ending the first word. See also Welmers (1963, 1970):

(19) a.   ɔ̀nà   ɔ̀nā   Èkó   'road to Lagos'
          road   road Lagos
     b.   àkpò   àkpō èkpà   'bag of peanuts'
          bag   bag   peanuts

2.2.8 Benue-Congo: Igboid

When nouns are put into associative constructions in Igbo, as sketched in Welmers (1963, 1970), one must filter out the effects of other tonal processes to see the effect of the associative marker. But it is clear that, as Welmers concludes, there is an associative High tone in Igbo, as seen in the following data from Welmers (1963), translated from his representation[8]:

(20) a.   ótù   +   ikó   →   ó'tú ⎱íkó   'unit of cup (i.e. one cup)
          unit   cup
          ọ́gụ́   +   ìkó   →   ọ́gụ́ ⎱ìkó   'score of cups (i.e. 20 cups)
          score   cup
     b.   ázù̀   +   ànyị̀   →   á'zụ́ ⎱ányị́   'our fish'[9]
          fish   us
          ìtè   +   ànyị̀   →   ìté ⎱ányị́   'our pot'
          pot   us
     c.   é⎱gó   +   ànyị̀   →   égó ⎱ányị́   'our money'
          money   us

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[8] In his representation, an unmarked syllable has the same tone as the preceding one, and with two acute accents on succeeding syllables, the second represents a downstepped High, for example.
[9] Welmers notes that the tonal associative morpheme is absent with singular pronouns as possessives.

I will not attempt a complete analysis of the above data[10], but will limit myself to noting that in all the above examples, the noun on the left, the head noun, ends in a High tone (or downstepped High) when in the associative construction. Thus we conclude that the High associative morpheme docks left to the head noun in Igbo. This is also the analysis proposed in Williamson (1986).

Interestingly, Hyman (1974) (see also Pulleyblank 1997) shows a difference in Igbo dialects in the direction of associative High tone docking. In Central Igbo, presumably the dialect exemplified by Welmers above, the High associative tone docks left, but in the Aboh Igbo dialect, it docks right, to the dependent noun:

(21) Central Igbo: àgbà + èŋwè   →   àgbá̱ èŋwè   'monkey's jaw'
                    jaw   monkey
     Aboh Igbo: àgbà + èŋwè   →   àgbà éŋwè   'monkey's jaw'

Hyman (1974), in a thorough discussion of associative constructions in an appendix, analyzes some associative constructions as having the associative High docking right in Central Igbo (though this is not as clear as the cases in which it docks leftward), but also notes the apparently exceptionless rightward shift of the High in the Aboh dialect.

2.2.9 Benue-Congo:Nupoid

Gwari was classified as Kwa in the Greenberg system, but has been reclassified as in the Nupoid group of New Benue-Congo (Rosendall 1992). As reported in Hyman & Magaji (1970), Gwari has the head noun to the right, to which the associative tone also docks. Gwari has 4 tone levels, the lower mid being unmarked below:

(22) a. ēɓí + yàɓà   →   ēɓí yáɓà   'child's banana'
         ēɓí + tnūbwà →   ēɓí tnúbwà   'child's ear'
     b. ōsū + yàɓà   →   ōsū yāɓà   'chief's banana'
         ōsū + tnūbwà →   ōsū tnúbwà   'chief's ear'
     c. òvyì + yàɓà   →   òvyì yaɓà   'thief's banana'
         òvyì + tnūbwà →   òvyì tnúbwà   'thief's ear'

The exact phonetic effect of the associative construction varies with the possessor noun on the left. The first syllable of *yaɓa* 'banana,' low in citation form, surfaces as either

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[10] The downstep in each example here, for example, is analyzed to be a result of an underlying Low tone at the beginning of each second noun, not a result of its being in an associative construction.

High, Mid, or Lower Mid, depending on the preceding noun. The important generalization is that the tone on *yaɓa* always does raise in this construction. The tone on *tnūbwà* always raises as well. Whatever the tonal features required to account fully for Gwari, it is clear that the tonal effect is on the head noun, to the right.

2.2.10 Benue-Congo: Edoid

In the Edoid languages of Etsako and Bini, a floating High associative morpheme docks left, to the head noun. In Etsako, this can be seen more clearly in the stage before the phonetic representation, which Elimelech describes as "before vowel elision takes place." In both Etsako and Bini, the surface representation, involving as it does elision and/or assimilation of contiguous vowels, makes determination of the direction of floating High docking difficult, but the various workers who have written on these languages all agree that the direction is leftward, perhaps (and this is speculative on my part) based on more careful pronunciation when no vowel elision occurs.

(23) Etsako (Elimelech 1976)

a.	àmè	+	èθà	→	ámέ èθà	[ámêθà]	'father's water'
	water		father				
b.	únò	+	èθà	→	únó èθà	[únêθà]	'father's mouth'
	mouth		father				
c.	únò	+	ódzí	→	únóódzí	[únódzí]	'crab's mouth'
	mouth		crab				

In Bini (also called Ɛdo in the literature), we find a similar pattern. Besides the following, also see Amayo (1983), who notes that "in all the instances of tone shifting in Ɛdo, the floating tone moves leftwards" (p. 183).

(24) Bini (Akinlabi 1995, citing Amayo 1976)

òwè	+	òsà	→	òwέ òsà	'chimpanzee's leg'
leg		chimpanzee			

In Engenni, also in the Edoid subgroup, Thomas (1978) reports that the dependent noun ("genitive construct", in her terms) is marked by an upstepped high tone (′). The dependent noun is the second one in Engenni. High tone is unmarked below.

(25) a. ɔmù   ɔ̀gà ɔ́mù   'house, side of the house'
         house   side house
     b. ùkwô   ɔ̀gà ûkwô   'farm, edge of the farm'
         farm   side farm

2.2.11 Benue-Congo: Bantoid

Nkem is an Ekoid Bantu language spoken in Cross River State, Nigeria (Sibomana 1986, 1989). It has two types of tonal variations in associative constructions, depending on the noun class of the first noun. If Noun 1 is of the *yó* or *yí* class (in Sibomana's terminology), the associative marker is Low and Noun 2 will either begin with Low or downstepped High, as in (b) below. Nouns in other classes have a High-toned associative marker, and Noun 2 will invariably begin with a High, as in (a) below. (If noun 2 has a nasal prefix, a vocalic associative marker *a* is manifested, which we do not illustrate here.) Constructions which exhibit a tonal change are shown below. Hyphens indicate noun class prefixes.[11] There are more complexities in Nkem than are illustrated here, e.g. kinship nouns do not follow the usual pattern. However, tonal changes due to the associative construction are always on the second noun, which is the head noun.

(26) a. ì-bór   +   ì-tàb   →   ì-bór í-tàb   'house top'
         top   house
         à-ɫ̃ĩŋ   +   ì-tég   →   à-ɫ̃ĩŋ í-tég   'native medicine'
         medicine   house
     b. ḿ-bébél +   í-kób   →   ḿ-bébél !í-kób   'a red cup'
         red   cup
         ń-kókól +   í-ríŋ   →   ń-kókól !í-ríŋ   'an old cricket'
         old   cricket

Makaa (Heath 1991), a Narrow Bantu language of Cameroon, illustrates a rather complex case of associative tonal behavior. There exist three types of associative markers, depending on noun class. Some noun classes have a zero associative marker, some have a segmental morpheme with accompanying High tone, and some are marked

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[11] Sibomana 1989 has some different analysis than Sibomana 1986, among which is that Nkem does not have a Mid tone, but rather downstepped Highs. Though some data here is from the 1986 article, the matter of what tones are present is based on the later paper. Thus I have translated the 1986 Mid tones into downstepped Highs, as Sibomana himself does with some data.

by High tone alone. Whether the High tone is floating or associated to a segment, the High docks (or in the case of the segmentally-associated High, spreads) to the prefix of the noun on the right, the dependent noun, as in (a) below. However, if there is no prefix on the second noun, and the first noun ends with a Low-toned open syllable, then the associative High docks left, to the head noun, as in (b). Finally, when there is no prefix on the second noun, and the first noun ends in a closed syllable, an epenthetic vowel appears on it, to which the associative High docks.

(27) a. bùdè   + mà-kwìindyè → bùdè mákwìindyè 'potato of the posts'
         potato   posts
     b. bùdè   + jùgà   → bùdè jùgǎ   'potato of the plug'
         potato   plug
     c. cwòlòòmb + kààfè   → cwòlòòmbú kààfè 'unfurled macabo
         unfurled.leaf macabo   leaf'

Thus Makaa displays different directionality of docking the associative High tone in different contexts. These different patterns will be examined more closely in Section 3.3.4.

In another Narrow Bantu language, Kakɔ, the associative High tone docks right, to the dependent noun (Ernst 1991):

(28) màl + kɔ̀   → màl kɔ́   'bachelor's goiter'
      goiter   bachelor

Bangwa, an Eastern Grassfields language of the Mbam-Nkam subgroup, offers either a floating Low or a floating High tone as associative marker, depending on the noun class (Chumbow & Nguendjio 1991). Though the effect is not visible in (c-d) below, (a-b) show that either associative tone docks left to the head noun. A similar pattern holds with pronominal possessives, e.g. té (L) pé → tê pé 'my father.'

(29) a. sú   (L)   ŋwɔ́ →   sû ŋwɔ́   'friend of child'
     friend ASSOC child
   b. mfɔ̀   (H)   lá'   →   mfɔ lá'[12] 'chiefs of village'
     chiefs ASSOC village
   c. fɔ̀   (L)   lá'   →   fɔ lá'   'chiefs of village'
     chiefs ASSOC village
   d. pwó   (H)   sɔ́k →   pwó sɔ́k   'children of bird'
     children ASSOC bird

Bafut, another language of the Mbam-Nkam subgroup in Cameroon, has segmental material as associative morphemes in noun classes 2, 5, 6, and 11, but has only floating tones marking associative constructions for other noun classes. This associative tone is Low for classes 1 and 9 and High for other classes (Ambe 1989, Mfonyam 1989). The head noun in Bafut is on the left, and Ambe has two tone rules specific to the associative construction which interact with other tone rules as well. His first rule docks the Low associative tone left (to the head noun). His second rule docks the associative High to the right (to the dependent noun). Unfortunately, he gives no data to illustrate this. Tamanji (1997) gives some data which partly confirms Ambe's generalizations and partly contradicts it. In Tamanji's data, both High and Low associative tones dock left, to the head noun:

(30) a. ìwùm (H) mfɔ̀   →   ìwǔm mfɔ̀   'chief's figtree'
     figtree   chief
     nkàà (H) bìsɔ̀rɔ̀ →   nkǎǎ bìsɔ̀rɔ̀ 'mermaids' monkey'
     monkey   mermaids
   b. lú?ú (L) mfɔ̀   →   lú?û mfɔ̀   'chief's spoon'
     spoon   chief
     ndá (L) mísì   →   ndâ mísì   'younger one's houses
     houses younger

Both writers agree that Low associative tones dock left to the head noun. Compared to other languages in this survey, it is unusual that a floating Low would dock rather than merely creating a downstep. The disagreement between the two writers is in the behavior of the associative High tone. It is possible they are dealing with different dialects, or that each has only considered part of the language. I presently do not have the information

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[12] I assume the loss of the original High tone in *mfɔ̀* 'chief' is due to a constraint against rising tones.

needed to resolve this question. Mfonyam (1989) also notes a subset of forms, in class 9

that can dock in either direction, but I have not yet seen the data he bases this on.

Ejagham (Watters 1981) has an associative morpheme i̱ which is Low-toned if the first noun of the construction, the head, is from noun class 1 or 9, and High-toned with other noun classes. If the second noun begins with a vowel, the i̱ deletes, leaving its tone. With a Low associative marker, this remains floating, resulting in downstep, but a High from the associative marker docks right, to the dependent noun:

(31)   èkpin i̱   àtèm   →   èkpìn átèm   'friend's life'
       life ASSOC friend

Bamileke-Dschang (Hyman 1985) is a Bantu language of Cameroon whose tonal complexity is such that it has proved a fertile testing ground for competing theories of tone, particularly in dealing with downstep and related phenomena (see articles in van der Hulst & Snider 1992 for several analyses). It actually has three associative markers --/è/, /é/, /á/, depending on the noun class. The /é, è/ markers are normally deleted in conversation, though often /á/ remains, assimilated to the preceding vowel. The Low tone left behind with deletion of /e/ remains floating, and unfortunately Hyman does not give data with the /é/ class of nouns, which would give a High when the /e/ is deleted. So we cannot test this language at present.

However, for Bamileke-Fe?-fe?, Hyman (1972) gives an explicit account of floating tones in associative constructions. Again, noun classes 1 and 9 take a floating Low associative tone, but other classes take a floating High tone (à, á, a å being High, Low, Mid, and raised Low tones). Underlined tones in the output are meant to indicate joining as tone glides with the preceding word.

(32)   a. `thú` + ´   + `múu′   →   thǔ̱′ muu   'child's tree'
           tree   ASSOC   child
       b. ŋkéé + ˎ   + `múu′   →   ŋkee̱ muu

In each case, the associative tone docks left, to the head noun.

Haya (Hyman & Byarushengo 1984) has a High tone inserted only when the possessor is a singular pronoun. This High tone manifests itself on the head noun to the left. They analyze the lack of a High in the cases in (b) below as tone reduction when followed by plural pronouns.

(33) a. eki tabǫ́ kyange   'my book'   but   b. eki tabo kyáitu   'our book'
        eki tabǫ́ kyaawe   'your book'   eki tabo kyáanu   'your.pl. book'
        eki tabǫ́ kye   'his book'   eki tabo kyáabo   'their book'

2.2.12 Benue-Congo: Platoid

Eggon is classified by Gerhardt (1989) in the Platoid subfamily of Benue-Congo. Sibomana (1985) gives three examples of associative constructions involving nouns. They are, with Mid tones unmarked and hyphens marking noun class prefixes:

(34) a.   o-dne →   a-ʒē òdne   'house door' (cf. a-ʒē 'door')
          house
     b.   à-bú   →   i-ʃí èbu   'a dog's head' (cf. i-ʃí 'head)
          dog
     c.   à-ʃé   →   e-ɓí âʃe   'a woman's farm'
          woman

This data is intriguing in that in (a) the prefix of the second noun is lowered from Mid to Low, but the stem tone is unaffected, while in (b,c), the prefix, already Low, is unaffected, but the stem tone is lowered from High to Mid. The data in the article is insufficient to offer an analysis of this (though it is tempting to speculate about the possibility of a [-upper] floating morpheme similar to the [+upper] morpheme for Suma in (11)). The point to note for this paper is that the tonal change occurs on the rightmost, nonhead noun.2.2.12 Summary

The following table sums up the preceding presentation of language data.

(35) Typology of directionality and which noun is affected (BC = Benue-Congo)

	Tone docks Left	Tone docks Right
Head noun	Suma: Adamawa-Ubangi Ali: Adamawa-Ubangi Mumuye: Adamawa-Ubangi Kana: BC, Cross River Yoruba: BC, Defoid Central Igbo: BC, Igboid Etsako: BC, Edoid Bini: BC, Edoid Bangwa: BC, Bantu Fe'fe'-Bamileke: BC, Bantu Haya: BC, Bantu Bafut: BC, Bantu Makaa: BC, Bantu[13]	Kɔnni: Gur Moore: Gur Dagbani: Gur Senoufo: Gur Akan: Kwa Gwari: BC, Nupoid Bété: Kru
Dependent noun		Ga'anda: Chadic Efik: BC, Cross River Engenni: BC, Edoid Aboh Igbo: BC, Igboid Bafut: BC, Bantu[14] Makaa: BC, Bantu[11] Kakɔ: BC, Bantu Ejagham: BC, Bantu Nkem: BC, Bantoid Eggon: BC, Platoid

The pattern evident in the table is that an associative tone may dock to the left only if it docks to a head noun. It docks to a dependent noun only if that noun is on the right. Thus the tone can dock to the head noun, or to the right, or both, but never to a dependent noun on the left.

In two languages I know of, the associative tone docks left to a non-head element, but this non-head element is a pronoun. These include Dagbani and the Fante dialect of Akan. Fante contrasts with other dialects of Akan, e.g. Asante.

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[11] Note that Makaa has the associative tone on either the head noun or the dependent; this case is discussed in Section 3.3.4.

[14] As discussed above, there is some question of whether Bafut docks an associative High to the right or not.

(36) mɛ́ hɔ̀hòé 'my guest (Fante)' cf. mɛ̀ hɔ́hòɔ́   'my guest (Asante)'
                                                    (data from Dolphyne 1988:70)

For the Gur language Dagbani, Issah (1993:11) notes that the third person singular pronoun is High-toned only when in a possessive construction, as in ó bíhí 'his children.' While further investigation is needed, it seems quite likely that for Dagbani at least, the possessive pronoun is underlyingly toneless, and a floating associative High docks to the empty position in preference to a position which already has a tone present, similar to the Makaa case examined in Section 3.3.4. It is likely the same type of situation also applies in Fante.

3. Analysis

In this section, I discuss two key constraints needed to account for the behavior of the associative tone cross-linguistically, and apply them to the patterns shown above. We have seen in the table in (35) that an associative tone often docks to the head noun. However, when it does dock to a dependent noun, that dependent noun is always to the right. Or, to put it another way, most docking of associative tones is to the right, and when it is to the left, the leftmost noun is always the head noun. It appears, then, that there are two principles involved in determining which noun an associative tone will dock to. The first is that the tone should dock right, and the second is that the tone should dock to the head noun.

3.1 Tone-docking right

In non-associative constructions with floating tones, it is common to find that floating High tones generally associate to the right. Goldsmith (1990) provides an example of this in a non-African language, the Mexican language Mixtec de San Miguel El Grande, using data from Pike (1948). In this Mixtec dialect, some nouns have a suffixal High tone which is underlyingly unassociated. This tone shows its effects on a following word, if one is present. Goldsmith proposes a rule that docks a floating tone to the right.

Floating Low tones, in contrast, often remain floating. In African languages with downstep, this floating Low tone can create such a downstep, as in Ga'anda (Kenstowicz 1994), Frafra (Schaefer 1974,1975), Chumburung (Snider 1986), Dɛg (Crouch 1994) and

a host of other more widely-known languages the reader may consult. Most of the

discussion in this section will therefore refer to non-Low floating tones.[15]

Lango (Clifton 1975) provides a language which displays both. A floating High tone shows up on the following word, while a floating Low is manifested as downstep.

Interestingly, when there is an empty TBU between two associated tones, and either tone could potentially spread to it, the more usual case is that a tone will associate in a rightward direction. This is illustrated in Clements and Ford's (1979) second tonal association convention, according to which T_1 rather than T_2 will spread to the free vowel V_2 in the configuration below.

(37) V_1 V_2 V_3
             | / |
            T_1 T_2

This is concretely illustrated by the tone manifested by Nupe borrowings of Hausa words. Nupe inserts a vowel between the consonant clusters which occur in Hausa. With few exceptions, the tone on the inserted vowel is identical to the tone to its left, not its right (Hyman & Schuh 1974):

(38) | Hausa | Nupe | |
        |-------|------|---|
        | àlbárkà | /àlùbáríkā/ | 'blessing' |
        | fûskà | /fúsíkā/ | 'face' |
        | hár | /hárí/ | 'until' |

It may be that the tendency toward rightward spreading is also connected to the almost universal left-to-right application of linking tones to TBU's (Odden 1995), with Hausa and Kanakuru being two exceptional languages which display the more marked right-to-left linking. In the case where there are more TBU's than tones (and in a language that spreads rather than fills in vacant TBU's with a default tone), the common result is (39a) rather than (39b):

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[15] Of course, in some languages, in some contexts, if there are more tones than TBU's in a word, the excess tones can dock to the word that sponsored them, especially when these words are in citation form or isolation, as in Supyire (Carlson 1985), Kɔnni (Cahill 1992, 1997a), and Chumburung (Snider 1986).

(39) a. T_1 T_2 b. T_1 T_2

           | | \   / | |

         V_1 V_2 V_3 V_1 V_2 V_3

This would relate to directionality of spreading. In (39a), T_2 has spread to the right. In (39b), T_1 has spread to the left. Thus it is possible that the predominance of left-to-right *association* is a specific consequence of left-to-right *spreading*.

The preponderance of word-final rather than word-initial tonal contours can also be seen as a consequence of rightward spreading. As Hyman & Schuh (1974) note, word-final contours resulting from rightward spreading as in (a) below are relatively common, but word-initial contours as in (b) are rare if they occur at all.

(40) a. T_1 T_2 b. T_1 T_2

           | \ | | / |

         V_1 V_2 V_1 V_2
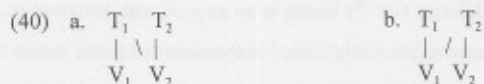
It is also relevant that in the common processes of tone movement in Bantu languages, the direction of tone movement is generally to the right. This would include tone "doubling," tone shift, and tone spread (see discussion in Odden 1995 and references therein).

Hyman & Schuh (1974) make the claim, based on their examination of 24 African languages, that tones always spread to the right. Examination of other languages shows that this claim in its absolute form is too strong (cf. Kɔnni *tígè, ti'géhé* 'houses, the houses,' in which the High tone from *hé* spreads leftward -- Cahill 1992, 1998, 1999). However, there does seem to be a strong tendency for languages to spread tones to the right.[16] Besides the African context, it is suggestive, though hardly conclusive, that the only non-controversial cases of spreading in Chinese mentioned in Yip (1995) are rightward, though she does not include a specific discussion of directionality. Silverman (1997) notes in Comaltepec Chinantec of Mexico that all spreading is rightward. Maddieson (1978), drawing from Asian and Meso-American languages as well as African, notes that although there is not "an overwhelming predominance of

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[16] Goldsmith (1990:40-41) analyzes Soyaltepec Mazatec (data from E. Pike 1956) as having a leftward High-spread rule. However, his rule also deletes the tone which is to the left of the High, and it is quite possible that the High links to an empty TBU rather than an actively displacing the previous tone by spreading.

perseverative rules," there nonetheless is "a certain excess of perseveration over anticipation." [17] This perseverative spreading of tones contrasts with the tendency for many *segmental* assimilations to be anticipatory, i.e. to spread to the left.

In the preceding discussion, we have seen a clear pattern of directionality of tone movement: spreading right, associating to the right, shifting right. Some attempts at phonetic explanations have been proposed. As an articulatory basis for this perseverative rather than anticipatory effect, Hyman & Schuh (1974) write that the laryngeal adjustments required to regulate pitch changes seem to require more time than articulatory adjustments required to produce successive segments (fn. 3). Silverman (1997) goes into more detail on research on the applicable physiological constraints and reaches the same conclusion. Maddieson (1977) found in an experiment designed to test for a perceptual explanation for perseverative (rightward movement) of tones rather than leftward, that subjects surprisingly tended to perceive ambiguous cases as anticipating the following pitch level rather than perseverative, and noted that if this experiment was confirmed, then "a problem remains in reconciling these experimental data with the linguistic facts." Finally, an experiment by Javkin (1976) found that F_0 change and formant change were judged to occur simultaneously most often when the tone change occurred 10 ms before the formant change, seeming to cause listeners to perceive and thus produce tones as spreading into following segments. Whether an articulatory or perceptual explanation or both turns out to be more explanatory, we can surmise that there is some phonetic basis for the predominant rightward movement of tone.

As a consequence of this pattern, I propose the general constraint ALIGN TONE-RIGHT:

(41) ALIGN TONE-RIGHT: ALIGN (TONE-R, PROSDOM-R) - align a tone to the right edge of its prosodic domain (TONE-RT)

The effect of this constraint aligns any tone to the right edge of its particular domain. This would include the cases of docking a floating tone, spreading a linked tone,

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[17] Chumbow & Nguendjio (1991) give data from several constructions in Bangwa which all have floating tones docking to the left. Some of these constructions have heads to the left, as the associative construction and some verbal aspect markers, but some do not. It seems that in Bangwa, and perhaps the entire Mbam-Nkam subgroup, (Hyman & Tadadjeu 1977) TONE-RT is ranked quite low. Maddieson (1978) also reports Villa Alta Zapotec of Mexico to have only leftward assimilations, and several languages with both.

or shifting the position of a tone. In the cases considered in this paper, the domain of the constraint would include the second noun in the associative construction. Of course, other conflicting constraints would prevent a tone from being realized on the last TBU in most cases. For example, LINEARITY, which preserves the serial ordering of elements and penalizes metathesis, would prevent a tone in question from skipping over intervening tones to dock on the last TBU.

TONE-RT will always operate in conjunction with other relevant constraints which motivate a tone change to give direction to the change, producing effects such as the above. For example, the empty TBU's in (37) and the precursors to surface forms in (38) and (39) are filled by spreading. This spreading is the consequence of two constraints: one that disallows toneless TBU's, and one that penalizes insertion of tones. The empty TBU must then get its tone from a neighboring TBU. At this point, TONE-RT comes into play and forces the spreading of tone rightward rather than leftward. In the Mixtec case, a constraint that penalizes floating tones forces the floating tone to dock, and TONE-RT forces the choice of rightward rather than leftward docking. In the Bantu case of tone doubling, there would be constraints against a singly-linked High, and TONE-RT would force the tone to double to its right rather than left. Similarly, with tone shift or spread, various constraints would penalize the underlying position of the tone, and TONE-RT would force the direction of the change.

In the associative cases we will examine here, there will be a constraint penalizing floating tones (or more specifically, floating High tones, since we have seen that floating Lows causing downstep are perfectly acceptable in many African languages), and TONE-RT motivates the choice of the associative tone docking right rather than left.[18]

3.2 Docking to Head Noun

While the motivation for TONE-RT may plausibly be traced to a phonetic basis, the motivation for a constraint causing a tone to dock to the head noun cannot be phonetic. There is no inherent or underlying phonetic difference between head and dependent nouns, but rather a syntactic and semantic difference. It is syntactic in that the

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[18] Since TONE-RT is motivated across a wide variety of languages and tonal phenomena, it is quite possible that this could replace the more specific constraints for rightward spreading proposed in other papers. In this schema, TONE-RT would be active, but its scope would be modified by other constraints.

head noun controls agreement and governs the dependent noun. It is semantic in that the

head noun is instinctively felt to be the "main" part of what the noun phrase is about. What occurs here in docking of the associative tone to the head, then, is a mapping of phonetic prominence to syntactic/semantic prominence.

This, of course, is regularly done with intonation and stress in English and other languages. When one wants to emphasize or stress a particular component of a sentence, one can change either the pitch or the volume of one's voice for the emphasized element, often, but not always, raising these qualities.

In Balinese, one type of phonetic prominence can be shown to be strictly connected to the syntax, specifically, appearing as a function of the phrase. There is an F0 peak on both the last syllable of the head of the phrase and also on the last syllable of the phrase itself, whether noun phrase or verb phrase (Herman 1997).

Both of these can be viewed as exhibiting *functional* constraints. Investigation of functional constraints with a semantic or syntactic basis is still in the beginning stages. One area where functional constraints have been applied is in the area of vowel elision in hiatus contexts. Casali (1997), in a survey of 87 languages, shows that a vowel in a function word is more likely to elide than one in a lexical word, that an affixal vowel is more likely to elide than one in a root. There is again, a semantic/syntactic function for a constraint.

In the most general way of putting it, we can propose a broad constraint HEAD-PROM as follows:

(42) **HEAD-PROMINENCE (HEAD-PROM)** - if a portion of a phrase is not identical
with its underlying representation, it is the head of the phrase which will be
phonetically prominent.[19, 20]

Like **TONE-RT**, **HEAD-PROM** is a "steering" constraint: given that other constraints force a change from the underlying representation, these constraints give direction to that change. What constitutes "phonetic prominence" will of course depend on the available features of the language in question. In the context of tonal phenomena

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[19] Since in current syntactic theory prepositions are heads of prepositional phrases, but prepositions are rarely phonetically prominent, the constraint should be qualified to exclude prepositional phrases.

[20] Alternatively, the constraint could be cast in more morphological terms, such as "**HEAD-MARKING**: if a morpheme cannot stand alone prosodically, it is associated with its morpho-syntactic head"

and associative morphemes, **HEAD-PROM** will generally interpret a High tone as phonetically prominent, and thus the head noun will attract the High tone of an associative marker.[21] This implies that if a High associative morpheme is sandwiched between two Low-tone nouns, where the direction of docking is easily detectable, **HEAD-PROM** will force the High to dock to the head noun.[22]

3.3 Analysis of Tonal Associative Morphemes

With the two crucial constraints of **TONE-RT** and **HEAD-PROM** in place, we now proceed to an analysis of associative tone docking. In a constraints-based approach, any constraint is violable in principle. Given the two constraints **TONE-RT** and **HEAD-PROM**, we can analyze the patterns of data of associative constructions given in Section 2 by ranking one of these constraints above the other, or by having indeterminate ranking. We will see cases of all of these.

In passing, one may note that the position tonal associative marker on either Noun 1 or Noun 2 is always on the TBU nearest the original position of the floating tone, either the last TBU of Noun 1 or the first TBU of Noun 2. We assume this is due to a LINEARITY constraint, which ensures that there is no metathesis of tones or line crossing. Since this is the situation in all languages mentioned here, I will not discuss it further.

Two additional constraints will be pervasively active in the analysis of tonal associative morphemes. These will be *(H) and **MAX-H**:

(43) *(H) - floating High tones are not licensed

(44) **MAX-High (MAX-H)** - every High tone in the input must have a correspondent in the output

As we have seen, while floating Low tones giving rise to downstep are allowed and even common in African languages, floating High tones have no comparable widespread phonetic effect. It is commonly assumed they must be associated to make

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[21] This is the general case, but in some language in which a High may be a default tone, the Low may be the one adding phonetic prominence. In the cases above in which Low is the associative tone, it would be interesting to investigate whether Low or High (or neither) could be considered a default tone.

[22] Tamanji (1997) proposes a constraint that aligns a floating associative tone with the right edge of a head noun (thanks to Martin Jansche for bringing this to my attention). This accounted for the two languages Tamanji examined, but is inadequate for the larger sample examined here.

their presence felt. If not associated, then they delete. (However, I briefly consider the possibility of upstep caused by floating Highs below). In either case, we see that a floating High is not a configuration that is tolerated in these languages. **MAX-H** is one of a family of faithfulness constraints that penalizes deletion of material in the input. For some languages, **MAX-Low** can be combined together with **MAX-H** to give a general **MAX-T**, but in others they must be ranked separately, as we will see in the case of Makaa below. Since we are focusing in this paper on the behavior of a tone which is generally High, I will refer to only **MAX-H** in most of the languages here.

Below I present analyses of one language which has **HEAD-PROM** ranked above **TONE-RT**, one language in which the ranking is reversed, one language in which the ranking is indeterminate, and one language in which another constraint outranks them both and forces variable direction of associative tone docking.

3.3.1 Bini: HEAD-PROM >> TONE-RT

As reported in Akinlabi (1995), Bini has a High tone as associative marker, which docks leftward to the head noun, as in:

(45) Bini (Akinlabi 1995, citing Amayo 1976)

òwè + òsà → òwɛ́ òsà 'chimpanzee's leg', from (24)
leg   chimpanzee

We illustrate the constraints responsible for *òwɛ́ òsà*. In this and all following tableaux, the head noun is underlined for reference. The convention of having dotted lines separate constraints with indeterminate ranking is followed here and in all following tableaux.

(46)   HEAD-PROM, *(H), MAX-H >> TONE-RT

UR: òwè (ʹ) òsà	HEAD-PROM	*(H)	MAX-H	TONE-RT
☞ a. òwɛ́ òsà				*
b. òwè (ʹ) òsà		*!		
c. òwè òsà			*!	
d. òwè ɔ́sà	*!			

In this tableau and the following, I view a floating tone as actually present; how it may be phonetically implemented is an open question and may vary from language to language. One reasonable phonetic interpretation for a High that remains floating is an upstep, similar to downstep caused by a floating Low tone. This would be compatible

with the enriched "register tier" representation of tone proposed by Snider (1990), which has been applied to a number of West African languages successfully (Snider, pc). In this model, besides the High and Low tones, the "register tier" has dynamic autosegments which shift the register up or down. A floating <u>h</u> register, part of a floating High tone, could conceivably raise the entire register of the following tones. The rarity of upsteps in general might indicate that floating Highs are also correspondingly rare, and that *(H) is undominated in almost all languages. In the absence of further evidence, this must remain speculative at this point.[23]

Above, the undominated constraint *(H) prohibits floating High tones, forcing the floating associative High to dock. With candidate (b), the High has not docked, and thus incurs a fatal violation of *(H). Candidate (c) has deleted the High altogether and would violate **MAX-H**, which prohibits deletion of High tones, and possibly **HEAD-PROM** as well. In candidate (d), the associative High has docked to the right, to the dependent noun. In some languages this would be allowed, but since **HEAD-PROM** is ranked above **TONE-RT** in Etsako, then the violation of **HEAD-PROM** is fatal. The relative rankings of *(H) and **MAX-H** with respect to **HEAD-PROM** cannot be determined from the data considered here, but it is clear that they both outrank **TONE-RT** in Etsako, since violations of *(H) and **MAX-H** are fatal, but a violation of **TONE-RT** is not.[24]

3.3.2 Efik: TONE-RT >> HEAD-PROM

In Efik (Ward 1933), there is a High associative tone which docks right, to the dependent noun, as in:

(47)   isim +   àŋwâ →   isìm áŋwâ   'cat's tail', from (17)
         tail   cat

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[23] If a floating High had no phonetic effect at all, it could be universally disallowed, and both the column with the constraint *(H) and the rows with candidates containing floating Highs could be deleted from the tableaux.

[24] Another possible candidate is ɔ̀wɛ̠ ɔ̀sà, with the High associative merging with the Low to give a Mid. Ruling out this candidate would involve detailed examination of the nature of universal tonal features and how they are played out in Bini. For the present, we will merely note that Bini has no Mid tone, so a constraint *Mid, shorthand for penalizing the combination of tonal features that comprises a Mid tone, could be written to rule out such a candidate

In the tableau below, the same types of candidates are considered as were in the previous section.

(48)   TONE-RT, *(H), MAX-H >> HEAD-PROM

UR: isìm (´) àŋwâ	TONE-RT	*(H)	MAX-H	HEAD-PROM
☞ a. isìm áŋwâ				*
b. isìm (´) àŋwâ		*!		
c. isìm àŋwâ			*!	
d. isím àŋwâ	*!			

Similar to the previous tableau, in candidate (b), the floating High remains floating and fatally violates *(H). In candidate (c), the floating High is deleted altogether, fatally violating Max-H. Candidate (d) keeps the High tone and does dock it to the head noun, but this head is to the left, and in Efik, the highly-ranked **TONE-RT** rules it out. Again, the precise ranking of ***(H)** and **MAX-H** is indeterminate from this data, except that both must be ranked above **HEAD-PROM**.

3.3.3 Kɔnni: indeterminate ranking

In Kɔnni, as analyzed in Cahill (1992, 1999), the associative High docks right to the head noun, as below:

(49)   ʊ̀ + zàsíŋ →   ʊ̀ zá'síŋ   'fish, his fish', from (6)
        3sg   fish

The same types of candidates and strategy used above are considered below.

(50)   Indeterminate ranking

UR: ʊ̀ (´) zàsíŋ	*(H)	MAX-H	HEAD-PROM	TONE-RT
☞ a. ʊ̀ zá'síŋ				
b. ʊ̀ (´) zàsíŋ	*!			
c. ʊ̀ zàsíŋ		*!		
d. ʊ́ zàsíŋ			*!	*!

In this tableau, unlike the others, none of the relevant constraints can be ranked with respect to each other, at least on the basis of this data.[25]   Each of the losing

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[25] However, from other work (Cahill 1998, 1999) we know that *(H) is undominated, and that at least some spreading in Kɔnni is leftward, so TONE-RT is dominated by other constraints. It is possible that most

candidates violates at least one of the constraints, and candidate (d) violates both of the constraints central to this paper. On the other hand, the winning candidate violates none of these.

3.3.4 Makaa: docking in both directions

In the Optimality Theory framework, constraints are expected to interact with each other, and general patterns may be overridden in specific cases. Thus it is not surprising that we find at least one language in which the associative tone docks left in one set of circumstances and right in others.

Makaa, as analyzed in Heath (1991), illustrates a more complex case of associative tonal behavior than those we have examined. The type of associative marker varies with noun class in Makaa: one associative marker is zero, one is purely tonal, and some consist of segmental material with tone. In this paper, I will concentrate on the associative constructions which are marked by tone alone. In his appendix, Heath gives examples of all pertinent combinations of noun classes and tonal patterns of the associative construction, from which the patterns given below are taken. I am presuming his parentheses around a gloss indicate a particular species or kind of that entity.

(51) Makaa associative construction (syllables with tonal changes are underlined):

a.	bùdè	+	mə̀-kwiìndyè	→	bùdè mə́kwiìndyè	'potato of the posts'
	potato		posts			
b.	wáágá	+	mə̀-bágɔ́	→	wáágá mə́-bágɔ́	'(vegetable) of the
	(vegetable)		ashes			ashes'
c.	bùdè	+	jùgà	→	bùdě jùgà	'potato of the plug'
	potato		plug			
d.	búgə̀	+	jùgà	→	búgɔ̌ jùgà	'corner of the plug'
	corner		plug			
e.	wáágá	+	jùgà	→	wáágá jùgà	'(vegetable) of the
	(vegetable)		plug			plug'
f.	bùdè	+	cáánzɔ́	→	bùdè cáánzɔ́	'potato of the broth'
	potato		broth			
g.	búgə̀	+	cáánzɔ́	→	búgə̀ cáánzɔ́	'corner of the broth'
	corner		broth			
h.	cwòlòòmb	+	kàáfè	→	cwòlòòmbú kàáfè	'unfurled leaf of
	unfurled.leaf		macabo			macabo'

cases of indeterminate ranking may be resolved with a more in-depth investigation of the total tonal system.

Several patterns are evident in the above data. First, (a-b) shows that when there is a prefix available on Noun 2, the associative High tone docks to that prefix (class prefixes are Low when the noun is in citation form, and High in the associative constructions as above). In (c-d), there is no prefix on Noun 2, and we see that if Noun 2 is Low-toned, and Noun 1 ends in a Low tone, the associative tone docks to Noun 1. In (e, f, g) there is also no prefix on Noun 2, and if either Noun 1 or Noun 2 is High-toned, then there is no overt effect of the associative High. Example (h) is similar to (c), except that there is no underlying vowel word-finally in Noun 1 for the associative tone to dock to, so a vowel is inserted.

There are obviously more constraints coming into play in Makaa than the four that we have been using above. The analysis proposed here is somewhat tentative and depends solely on the associative data presented in Heath (1991); hopefully it will be consistent with other tonal patterns in Makaa besides the associative construction.

The first fact we must deal with is that if there is a prefix available on Noun 2, which is the dependent noun, the High docks there. On first examination, it appears that this would not be purely a consequence of the **TONE-RT** constraint, since the High does not dock rightward to a noun stem with no prefix. There is seemingly a distinction made on the basis of the grammatical category of the syllable to the right: right-docking to prefixes is permitted; right-docking to stems is not.

However, we must ask if there is any phonological characteristic of the prefix, aside from its morphological category, which might make it amenable to High-docking. There is a definite possibility available. In many Bantu languages, a Low tone is the default tone, added only in places where Highs are not associated. Added to this general tendency is the propensity of affixes to be unspecified for tone. Considering these factors, we can see there is quite a high likelihood that the prefix is unspecified for tone in underlying representation. If so, then in citation form, the prefix receives a Low tone by default, but in the associative construction, the floating High tone associates to the empty TBU of the prefix.[26]

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[26] Another possibility, suggested by David Odden, is that MAX-T for affixes is ranked more lowly than MAX-T for stems, and thus affixes would be more vulnerable to permutation of tones than stems would. This suggestion is promising but will not be pursued here.

The other patterns, illustrated by (51c-h) above, are that the floating High either docks left or seemingly has no effect.

Phonetically, we cannot discriminate between the floating High docking to a noun with a High already present and its deleting, since the same phonetic result is obtained if the floating High either docks, merging with the already-present High, or deletes altogether. Since there is no phonetic difference, the issue must be decided on theory-internal grounds. In any autosegmentally-based model, two High tones on a single TBU is an unlikely configuration, ruled out by an OCP effect or, more basically, by a literal application of Occam's Razor: "do not multiply entities needlessly". Having two (or more) identical tones residing on a single TBU is certainly multiplying entities needlessly. So let us consider that configurations in which the High docks to a TBU with an existing High are ruled out by an undominated constraint prohibiting two identical tones associated to the same TBU; let us call this constraint *2TONE. Such configurations will not be further considered in the analysis to follow. So in the absence of a prefix on Noun 2, the associative patterns for Makaa may be generalized as the following.

Delete the associative High if Noun 1 or Noun 2 is High; otherwise dock left.

This formulation gives a credible motivation for the output; delete a High when it is adjacent to another High. We will briefly consider two plausible approaches based on this statement, but reject them in favor of an alternative. One approach is to propose a constraint *STRAY which deletes a floating High when adjacent to another High. This is a shorthand of a type sometimes used (e.g. the SPREAD constraint in Padgett 1995), but it is actually stated in the form of a rule ("do X in environment Y") rather than as a true constraint or constraints that would be needed. We will avoid such a pseudo-constraint and use more general constraints to account for this pattern.

It is also possible that a form of the OCP could be relevant here, but Heath (1991:6) specifically distinguishes between noun stems which have only one High in underlying representation and those which have two, so presumably the OCP cannot be an absolute prohibition against adjacent Highs in Makaa. The OCP here would thus have to specifically refer to a floating High, so this OCP constraint would not do more than the *(H) which is already in place. Finally, as we will see below, the cases in which an OCP-like constraint might be called upon have alternatives that will account for the data.
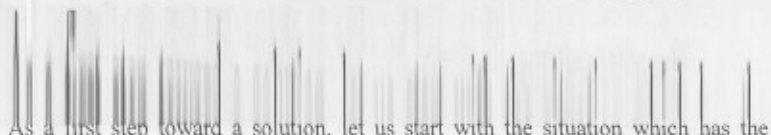
As a first step toward a solution, let us start with the situation which has the fewest complexities, the case in which the High tone is bordered by two nouns each having all Low tones in citation form. We see that given this simple choice, the High tone docks leftward to the head noun, showing that of the two main constraints proposed in this paper, **HEAD-PROM** is ranked above **TONE-RT**.

(52)   bùdĕ jùgà 'potato of the plug': *(H), HEAD-PROM >> TONE-RT

UR: bùdè (´) jùgà	*(H)	HEAD-PROM	MAX-H	TONE-RT
☞ a. bùdĕ jùgà				*
b. bùdè (´) jùgà	*!			
c. bùdè júgà		*!		
d. bùdè jùgà			*!	

In this tableau, similar to preceding ones, candidate (a) wins, even though it does violate **TONE-RT**. The losing candidates (b, c, d) violate either **HEAD-PROM**, ***(H)**, or **MAX-H**, showing that these constraints must be ranked above **TONE-RT**. In fact, **TONE-RT** is ranked low enough in Makaa so that it rules out no candidates in the data examined here and so will be omitted in the following tableaux.

In a phrase with a High tone on the last syllable of Noun 1 (the head noun), **HEAD-PROM** will not be violated, and two constraints which are independently needed in Makaa are active in this context. In common with many languages, Makaa has no word-initial contours. This quite probably has a relation with the TONE-RT principle which deserves further investigation, but as a surface constraint let us formulate it for now as follows:

(53) ***#CONTOUR (*#CONT)** : word-initial tone contours are disallowed

The constraint **MAX-LOW**, penalizing deletion of Low tones, is also active in the next two tableaux:

(54) **MAX-LOW (MAX-L):** every Low tone in the input has a correspondent in the output

The tableau for '(vegetable) of the plug' will then be:

(55) wáágá jùgà '(vegetable) of the plug': *#CONT, *(H), MAX-L >> MAX-H

(55) wáágá jùgà '(vegetable) of the plug': *#Cᴏɴᴛ, *(H), Mᴀх-L >> Mᴀх-H

UR: wáágá (ʹ) jùgà	*#Cᴏɴᴛ	*(H)	Mᴀх-L	Hᴇᴀᴅ-Pʀᴏᴍ	Mᴀх-H
☞ a. wáágá jùgà					*
b. wáágá (ʹ) jùgà		*!			
c. wáágá jûgà	*!				
d. wáágá júgà			*!		

Candidate (a) is optimal in spite of its violation of **Mᴀх-H**. Other candidates are ruled out by violations of ***#Cᴏɴᴛ**, ***(H)**, or **Mᴀх-L**. **Hᴇᴀᴅ-Pʀᴏᴍ** is not violated by any of these candidates.

In the discussion of a phrase which has a noun with High tone on Noun 2, a specific constraint ***Rɪsᴇ-Hɪɢʜ** must be included. In Heath's data, we notice that all instances of a rising tone have a Low tone following. There is no instance of Rise-High. With the suspicion that there is possibly some deeper generalization present (again, with a possible link to **Tᴏɴᴇ-Rᴛ**), for our purposes here I propose for Makaa the constraint ***R-H**:

(56) ***Rɪsᴇ-Hɪɢʜ (*R-H):** a Rise-High sequence of tones is prohibited.

With this constraint in place, we present the tableau for 'potato of the broth.'

(57) bùdè cáánzɔ́ 'potato of the broth': *R-H, *(H), Mᴀх-L >> Hᴇᴀᴅ-Pʀᴏᴍ

UR: bùdè (ʹ) cáánzɔ́	*R-H	*(H)	Mᴀх-L	Hᴇᴀᴅ-Pʀᴏᴍ	Mᴀх-H
☞ a. bùdè cáánzɔ́				*	*
b. bùdè (ʹ) cáánzɔ́		*!			
c. bùdě cáánzɔ́	*!				
d. bùdɛ́ cáánzɔ́			*!		

Above, in the winning candidate, the floating High does not show up on Noun 1 and so this candidate violates **Hᴇᴀᴅ-Pʀᴏᴍ**. However, other candidates violate other constraints, which must therefore be more highly ranked than **Hᴇᴀᴅ-Pʀᴏᴍ**. Candidate (b) violates ***(H)** by the High remaining floating. Candidates (c,d) violate ***R-H** or **Mᴀх-L**, and shows that in this case in Makaa, ***(H)** would rather be satisfied by deletion of the High than by docking to the head noun.

With the above constraints in place, we can turn to the last two cases, in which the associative High docks to the prefix of Noun 2. In the first case, we see that it is better in Makaa to link the High present in underlying representation to the toneless TBU than to

insert a default Low, which is what happens when there is no extra floating tone available. We propose a constraint *TONELESS:

(58) *TONELESS TBU (*TONELESS) - every TBU must have a tone linked to it.

The constraint DEP-L also comes into play here, penalizing insertion of a Low.

(59) DEP-L - every Low tone in the output has a correspondent in the input

*(H) is undominated in Makaa, but in the citation form *mə̀–kwìindyè* we see that Low tone may be inserted on the prefix, violating DEP-L. So *(H) outranks DEP-L. Below we see also that DEP-L must outrank HEAD-PROM.

(60)   bùdè mə́kwiìndyè 'potato of the posts': DEP-L >> HEAD-PROM

UR: bùdè (´) mə-kwiìndyè	*TONELESS	*(H)	DEP-L	HEAD-PROM	MAX-H
☞ a. bùdè mə́kwiìndyè				*	
b. bùdè̆ mə̀kwiìndyè			*!		
c. bùdè (´) mə̀-kwiìndyè		*!	*		
d. bùdè̆ məkwiìndyè	*!				
e. bùdè (´) mə̀-kwiìndyè		*!	*	*	
f. bùdè məkwiìndyè	*!			*	*

Finally, the same constraints also account for the case of Noun 2 having a prefix and Noun 1 being High-toned.

(61)   wáágá mɔ́-bágɔ́ '(vegetable) of the ashes':

UR: wáágá (´) mə-bágɔ́	*TONELESS	*(H)	DEP-L	HEAD-PROM	MAX-H
☞ a. wáágá mɔ́-bágɔ́					
b. wáágá (´) mə-bágɔ́	*!	*!			
c. wáágá mə-bágɔ́	*!				*
d. wáágá (´) mə̀-bágɔ́		*!	*		
e. wáágá mə̀-bágɔ́			*!		*

Candidate (a) violates no constraints. Candidates (b,c) violate the undominated *TONELESS. The interesting losing candidates are (d, e), in which we see that it is better to dock the present High to the toneless prefix than to insert a default Low. The undominated constraint *(H) rules out (d), while DEP-L rules out (e).

Constraints needed for Makaa, then, are the following. The bolded constraints are the ones needed for the previously analyzed languages; unbolded ones are new for the Makaa analysis.

(62) ***(H)**
    *TONELESS >> DEP-L >> **HEADPROM** >> **MAX-H** >> **TONE-RT**
    *R-H
    *#CONT   MAX-L >>

In the crucial ranking **HEADPROM** >> **TONE-RT**, Makaa most closely resembles the Etsako pattern above, although with the limited data we examined for Etsako, no determination was made of other constraints' rankings.

In this project, I have shown that patterns in docking of tonal associative morphemes are not random, but are the result of interaction of two key constraints, **TONE-RT** and **HEADPROM**, both of which are well-supported by cross-linguistic evidence.

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Positional Contrast and Labial-Velars

Michael Cahill
cahill@ling.ohio-state.edu

The labial-velar stops [kp] and [gb] display several distributional patterns cross-linguistically: they almost never occur syllable-, morpheme- or word-finally, and have a strong tendency to occur only morpheme-initially and in roots rather than affixes. They are always released into a sonorant or vowel. In Amele and perhaps other languages, a phonemic labial-velar is manifested as a labial word-finally. Three constraints are proposed, permitting labial-velars to be licensed only before sonorants, morpheme-initially, and in roots. While the first is phonetically-based, the latter two are morphologically-based. Various rankings of these account for the different phenomena of labial-velars in different languages. It is speculated that these constraints may be connected to broader patterns with multiply-articulated consonants.

1. Introduction

Labial-velar consonants, as the term is used in this paper, are those made with approximately simultaneous velar and labial closures. Labial-velar is a more accurate term than the more traditional "labiovelar" (since the term "labio-velar" implies the lip extending to the velum, not an optimal physiological configuration for the normal human vocal tract!), and I will use the term "labial-velar" in this paper. This designation commonly includes the stops /kp/, /gb/, and the nasal /ŋm/. In this paper I also will not discuss [w] or labialized velars [kʷ, gʷ] under the umbrella of "labial-velar."

Labial-velars are relatively rare in the languages of the world as independent phonemes, occurring in approximately 6% of the 317 languages surveyed in the UCLA Phonetic Segment Inventory Database (UPSID) (Maddieson 1984). Phonemic labial-velars occur exclusively in West/Central Africa and a small region of Papua New Guinea and nearby islands. Labial-velar consonants occur in at least some languages of all of the 10 main subfamilies of Niger-Congo (Bendor-Samuel 1989), and many of the languages of Nilo-Saharan as well. African languages with labial-velars far outnumber the handful of Papuan languages that have them (10 of the Huon Peninsula languages surveyed in

McElhanon 1967 have /kp/ and /gb/, and the total number of Papuan languages with labial-velars is probably less than 20, while the number of African languages with labial-velars is in the range of several hundreds.). Since the Papuan languages are relatively rarer, I will note them with (PNG) by the language name.[1]

In this paper, I will examine the distribution of labial-velar stops cross-linguistically. We shall see that phonemic labial-velars never occur as phonetic labial-velars word-finally. They also never seem to occur in affixes. Furthermore, in some languages they are severely restricted to morpheme-initial position. Appropriate positional constraints are proposed to account for these patterns of occurrence, leading to the conclusion that both phonetically-based and morphosyntactically-based constraints are needed to account for this distribution.

2. Cross-linguistic distributional patterns of labial-velars

2.1 Position in word, syllable, and morpheme

In the more than 80 languages for which I have data (see Cahill 1999), phonemic labial-velars always occur word-initially, but never occur word-finally. However, there are two unusual "fringe" cases of *phonetic* labial-velars word-finally that I am aware of. In Vietnamese, [kp] and [ŋm] are allophones of word-final /k/ and /ŋ/ when preceded by back round vowels. (Dick Watson - pc, Liêm 1970:138,141, Smalley 1964:306). Second, Ndyuka, a Creole language of Suriname, has word-final [gb] in ideophones only (Huttar & Huttar 1994). Since the Vietnamese and Ndyuka labial-velars do not contrast with other segments, I will not consider them further in this paper. All languages I am aware of allow labial-velars word-medially, though they are often restricted to morpheme-initial position, as discussed in specific languages below.

Labial-velars are almost never found syllable-finally. Amele (PNG) is the only exception I have found, e.g. ['tugb.dɔʔ] 'to butcher' (cf. ['tub.dɔʔ] 'to join') (Roberts 1987:346). Even in this language, /gb/ surfaces as [p] word-finally (see Sec. 2.4).

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[1] A few Caribbean Creole languages also have labial-velars, presumably as a result of an African substratum. In both Saramaccan (Rountree 1972) and Ndyuka (Huttar & Huttar 1994) the labial-velars can be considered allophones of labialized velars (see Cahill 1999 for details).

Amele is also the only language I have found which has a labial-velar in morpheme-final position, with the single segment /gb/ as the first person plural agreement marker on verbs (Roberts 1987).

While there is a clear generalization that languages almost never have labial-velars word- or syllable-, or morpheme-finally, the question of morpheme-internal vs. morpheme-initial position is more involved, and in the next sections we examine specifics of the position of labial-velars within morphemes in several languages.

2.1.1 Adele, Ono, Ibibio, Eggon

In Adele, a Kwa language of Ghana, /kp/ and /gb/ are never found morpheme-medially (Kleiner 1989). In fact, there are only two situations in which labial-velars are found word-internally. The first is in reduplicated forms, such as *gbà-gbà* 'really.' The other situation is in nouns. Nouns generally have a noun class prefix, and following this prefix the noun stem can begin with any consonant of the language, including /kp/ and /gb/: *è-kpèná* 'ghost', *gè-gbá* 'shirt'. There are also cases where nouns themselves include reduplication, e.g., *è-kpá-kpá* 'cockroach'.

With Ono, from Papua New Guinea, we find a similar pattern. The sole labial-velar in this language is /gb/, and it occurs only word-initially with the exception of reduplicated forms (Phinnemore 1985). That is, all cases of labial-velars in Ono are morpheme-initial.

In Ibibio also, Bruce Connell (pc) notes that labial-velars occur only in morpheme-initial position, and that the few cases in which labial-velars occur morpheme-medially are clearly exceptional.

In Eggon, though not mentioned explicitly in the dictionary of Blench & Hepburn (1995)[2], almost all nouns begin with vowels, particularly the non-high vowels *a, e, o,* which evidently are prefixes marking noun classes. Of the approximately 180 words listed which contain labial-velars (this is somewhat inflated since multi-word expressions have separate entries), Eggon has approximately a dozen reduplicated forms, e.g. *gbagbagba* 'swaying,' *gbyingbyin* 'of necessity' but only eight that appear to be

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[2] The Eggon dictionary from which information here was taken is in-progress and accessible on the Internet at http://lucy.ukc.ac.uk/dz/alda.data.html.

morpheme-medial, e.g. nsakpa or erbekpa 'entrance hut.' The overwhelming majority of

labial-velar stops are found either word-initially in verbs and adverbs, or following the vocalic noun class prefix. In the case of Eggon, labial-velars are almost exclusively morpheme-initial.

While the pattern of restricting labial-velars to morpheme-initial position is clear and definite in these languages, in others the situation has changed historically, as we see below.

2.1.2 Kɔnni and Buli

Kɔnni and Buli form a subgroup of their own in the Oti-Volta branch of Gur (Naden 1988, 1989). These languages are considered together because they shed light on the historical developments relevant to positions of labial-velars. Also very relevant is the practical consideration that I have more data at my disposal for these two languages than for most languages. The Buli data is taken from the dictionary of Kröger (1992), and the Kɔnni data from my own field notes, parts of which appear in Cahill (1992).

Kɔnni freely allows only nasals and /l/ syllable-finally, and only the nasal ŋ word-finally. Buli allows a slightly wider range of consonants word-finally, including /k, b/ and /m, n, ŋ/. Labial-velars pattern the same as other consonants in not appearing in these positions. Word-internally, labial-velars appear in many words, including some seemingly monomorphemic ones. As we shall see, it is quite probable that these words were at least historically polymorphemic. We shall examine cases of labial-velars in several situations, beginning with cases of compounds, in which the words in question are clearly bimorphemic:

(1)		Kɔnni compounds		Buli compounds	
	a.	haŋ-gbaaŋ (bush-dog)	'leopard'	bí-kpíŋ (child-die)	'orphan'
	b.	bitie-gbarɪŋ (jaw-lower?)	'beard'	víá-kpīāk (valley-fowl)	'partridge (sp)'
	c.	nu-kpaŋ (arm-?)	'thumb'	nán-kpīēŋ (?-big)	'cattle-yard'
	d.	na-kpaŋ (leg-?)	'big toe'	sūēŋ-kpārūk (rabbit?-farm)	'mongoose (sp)'

Some elements of the compounds cannot be assigned specific glosses at this point, and perhaps never will (cf. English *cran-* in *cranberry*). However, identification of at least one component can be made for the examples above. Some labial-velars occur not in compound words, but in other words which can be identified as polymorphemic, either with the adjective *-kpɪɪŋ/-kpieŋ* 'big' or in reduplicated forms, as below:

(2)	Kɔnni		Buli	
productive morpheme break				
a.	lɔlɪŋ-kpɪɪŋ	'high (big) voice'	mogi-kpieŋ	'big lake'
reduplications				
b.	gbaga-gbaga	'be feverish'	gbáŋ-gbáŋ	'very red'
c.	gbuŋ-gbuŋa	'chicken w/out feathers'	gbīŋ-gbíŋ	'chicken w/out feathers'
d.			gbìtì-gbìtì	'loudly'

There are a number of words in both languages which seem to be monomorphemic, but investigation shows to be at least historically polymorphemic. Some samples of these which we will examine include:

(3)	Kɔnni		Buli	
a.	sìŋkpááŋ		sùŋkpàām	'groundnut'
	(sììmé 'bean', kpááŋ 'oil')		(sumi 'bean', kpáám 'oil')	
b.	kpibíŋ		chikpèbì	'louse'
c.	gɪgbɪŋ	'rib'	gbèin	'meatless'

The word for 'groundnut' (or 'peanut' in American terminology) is *sìŋkpááŋ* in Kɔnni, *sùŋkpàām* in Buli. Kröger (1992) gives the etymology of *sùŋkpàām* as derived from *sumi* 'bean' and *kpáám* 'oil'. Since peanuts do indeed resemble beans and contain oil, this is a reasonable etymology. (Kröger does not tell us whether his etymologies are based on historical reconstruction, interviews with native Buli speakers, or inspection of likely candidates.) All in all, we can take the case of 'peanut' as being polymorphemic in Kɔnni and Buli as well established, and thus the *kp* is actually morpheme-initial in this word.

'Louse' is *kpìbíŋ* in Kɔnni and *chikpèbì* in Buli; the difference relevant to our discussion is *chì-* in the Buli form. If the Buli form is taken in isolation, it appears to be a case of *kp* occurring morpheme-internally. However, in the Kɔnni form, the first syllable

chì- has been stripped off, leaving *kp* word-initial, and by hierarchical implication, also morpheme-initial. Most consistent with the thesis being developed for these languages is that *chì-* is a prefix of some sort in Buli, with unknown meaning. Supporting this is the fact that *chì-* occurs with many other words, some of which also have second elements with identifiable meanings, such as *chíchámá* 'doubts', *cham* 'to doubt'. Thus in the historical development, Kɔnni speakers eventually dropped the initial morpheme. An alternative explanation is that Kɔnni deleted the *chi-*, but not by dropping a morpheme *per se*. Rather when *chìkpèbì* was historically re-interpreted as a single morpheme, Kɔnni, not tolerating a morpheme-internal labial-velar, dropped the initial syllable.

With this approach, we can examine other cases of putative intramorphemic labial-velars and see if they, too, might have a reasonable polymorphemic compositional explanation. Such a case is *gɪgbɪŋ* 'rib' in Kɔnni above. The Buli form for 'rib' is *nyípìk kōbī*, literally 'chest bone,' bearing no resemblance to the Kɔnni term.

When closely related languages have totally unrelated forms for a term, one distinct possibility (besides borrowing or the less common practice of coining of a totally new word) is that one language has used a compound word or phrase for the item in question. This could be done for metaphoric or euphemistic purposes (Hock & Joseph 1996, Ch. 7), as was evidently done in the general Kɔnni word for 'snake,' *javukiŋ*, literally 'wriggling thing' which bears no resemblance to the Buli *wáób* (Tony Naden, pc). The original proto-Buli-Kɔnni word lives on in Kɔnni in the form *wáákpɪ́íŋ* 'python,' literally 'big snake.'

We see a very good possibility of the same type of process producing Kɔnni *gɪgbɪŋ* 'rib.' The Buli adjective for 'meatless' is *gbèìn*, and of course, ribs do not bear an abundance of meat compared to some bones in an animal. Combining this with a prefix or noun *gɪ-*, then we have *gɪgbèìn* becoming Kɔnni *gɪgbɪŋ* by regular sound changes. Admittedly, we have no idea at present what meaning or even word category *gɪ-* has. However, this was also the case with the *chì-* of *chìkpèbì* examined above. Thus it is possible to present a reasonable hypothesis for the origin of a seemingly synchronically monomorphemic word as polymorphemic.

Of course, just because a clever linguist can invent a good story about a word does not mean it is true, or even if true, then active on a conscious level for modern speakers of a language. It seems likely that there is a continuum in processes like these. At one end of the continuum, a word can be polymorphemic and the morphology perfectly transparent to native speakers. Moving along the continuum, the word is still recognizable as two morphemes, but the native speaker has to exert some effort to separate the two; it is not the first analysis of the word that comes to mind. At the other extreme, all traces of separate morpheme composition have been obliterated in the speaker's mind; polymorphemicity has now become a historical relic, and synchronically the word is monomorphemic.

At this point, there are words in both Buli and Kɔnni which have labial-velars word-internally but defy decomposition into separate morphemes. At least synchronically, these may be monomorphemic:

(4)   *synchronically monomorphemic?*
       Kɔnni   Buli
   a. jɪŋmɪŋ   'evening'   sākpāk   'witch'
   b. kàgbá   'straw hat'   tákpárúk   'window'

It is possible that these may eventually be discovered to be composed of two distinct morphemes, or that were at one time polymorphemic, but historical change has obscured their origins. Of the 65 words in the Kɔnni database containing word-medial labial-velars, about a dozen appear synchronically monomorphemic. The ratio is 10 out of 60 in Buli.

2.1.3 Basa, Gbari[3]

We conclude our examination of individual languages with a brief look at two languages of Nigeria. Unfortunately, the sources for these languages are not complete enough to allow us to reach definite conclusions on the distribution of labial-velars, but I include them to broaden the database of this study and in the hope that more information will eventually elucidate the patterns of these languages.

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[3] The dictionaries from which information in this section was taken are in-progress and accessible on the Internet at http://lucy.ukc.ac.uk/dz/alda.data.html.

The Basa dictionary of Blench, Imoh, & Hyslop (1991) contains approximately 90
forms with labial-velars. Of these, 31 have word-medial labial-velars. Of these, 13 appear
to be reduplications, e.g. *i-kpekpe* 'chili pepper', leaving 18 cases of apparent morpheme-
medial labial-velar stops, e.g. *u-sekpe* 'guinea-yam.' In the present state of the
manuscript, the authors do not mark any nouns as compounds. More knowledge of the
language is needed to decide the question of possible internal composition of such words.

Similarly, the Gbari dictionary of Blench & Doma (1993) has about 270 entries
for words containing labial-velar stops. Of these, exactly half, 135, have a word-initial
labial-velar, so the number of words with word-internal labial-velars is large. Some of
these, as above, can be identified as reduplicants, as *gbwegbwe* 'groundnuts,' and others
can be identified as morphologically complex, especially since a large number have the
"suffix" *-gba* 'expertise, specialty.' However, there is still a considerable number of
apparently monomorphemic words with an internal labial-velar, such as *tsukpa* 'a sore.'

These may be languages in which labial-velars do freely occur morpheme-
internally, but in light of the discussion above for Kɔnni and Buli, it is also quite possible
that the labial-velars occur only morpheme-initially and this outside linguist has not been
able to analyze the morphemic composition

To sum up this section, while in some languages a minority of labial-velars may
occur word- and morpheme-internally, in many other languages there is a definite and
overwhelming tendency to occur only in morpheme-initial position.

2.2 Position in roots vs. affixes

I know of no languages in which labial-velars occur in either prefixes or suffixes.
They always occur in roots. In Adele, Kɔnni, Buli, Eggon, Gbari, Kaanse, and Basa, for
which dictionaries or wordlists of several hundred words are available, all entries
containing labial-velars are listed as noun, verb, adjective, or more rarely, adverb. The
only seeming exception is Gbari, in which *-gba* 'expertise' is listed as a suffix. However,
egba 'expertise' is also listed as a noun, with the note that it often appears as a "suffix"
-gba. It seems likely that *-gba* is not a true suffix, but a noun which commonly forms
compounds.

The lack of labial-velars in affixes is not surprising, since affixes in languages commonly use considerably less than the full segmental inventory available in the language, and the expectation is that the least marked segments (unlike labial-velars) would be the ones most commonly used. For example, in Kɔnni only 11 of the 24 available consonants are used in suffixes.

From another point of view, there are no labial-velars found in function words, such as prepositions, pronouns, conjunctions, time-depth or other particles; all are in lexical items.

2.3 Labial-velars in consonant clusters

In all the languages mentioned, a nasal consonant may precede a labial-velar stop, either as a syllabic nasal or as a coda of the preceding syllable. Labial-velar stops rarely enter into consonant clusters other than with nasals. This is quite possibly due to the fact that the predominant syllable structure in many of the languages in which they occur allows either only open syllables or else syllables with only nasal codas. (Though Buli above does allow /b, k/ word-finally, these are noun suffixes and do not occur syllable-finally within a word.) Below I examine the few cases I am aware of in which labial-velars occur in consonant clusters besides those with preceding nasals.

Eggon, a Niger-Kordofanian language of Nigeria, has several stop clusters unusual for African languages, e.g. [kp, bg]. Labial-velars also can participate in at least some stop clusters; [k͡pk] and [g͡bg] exist, as in *ak͡pki* 'stomach' and *g͡bga* 'grind' (Ladefoged & Maddieson 1996:334-5, Maddieson 1982). Interestingly, as Ladefoged & Maddieson note, the first member of a stop cluster is clearly released. In the spectrogram of *og͡bga* they provide, the vocalic transition between *g͡b* and *g* is approximately half the duration of the full vowel o̱ preceding it, and shows clear transitional formants out of the labial-velar stop. Presumably a similar release would be present in the sequences *g͡br* and *k͡pr* as found in a few words in Blench & Hepburn (1995). Maddieson (1982) asserts that these clusters are within the same syllable, basing this on morpheme boundaries. Better evidence is that these clusters may occur word-initially. Also, it seems likely that nasals are the only syllable codas allowed; by far the majority of entries in Blench & Hepburn (1995) end with vowels, and the few that end in consonants all end with nasals.

In Ewe, there is a sequence of labial-velar plus lateral, as with other stops, as in

kplo 'to lead', *gbla* 'to exert oneself' (Ansre 1963).

In Adele, spoken in an area where Ewe is a trade language, Kleiner (1989) notes that in a CICV sequence, where I represents a high vowel, the I may be optionally reduced to the point of deletion; no vowel quality can be discerned by the ear. Also, the second consonant must be either /r/, /l/, or /n/, each of which is pronounced as a flap with "lax articulation" in these circumstances. With labial-velars in the first consonantal position, all the cited cases from her wordlist of 725 items have /l or r/ as the second consonant.

Crouch (1994) reports Dɛg, a Gur language of Ghana, has the ideophone *kpírkpírkpir* 'very black,' but mentions no other labial-velars in clusters except for a preceding nasal. This seems to be on the fringe of the normal phonology, being a reduplicated ideophone.

Gwari and Mada, Nupoid and Platoid languages, respectively, from Nigeria, are interesting in that both have labial-velar stops releasing into nasals. In her survey of the various Gwari lects, Rosendall (1992) posits CNV as a syllable type, on the basis of forms like *tmûtmu* 'send,' *dnásò* 'river,' and *knúβʷa* 'ear.' Labial-velars also follow this pattern, with forms like *gbmínà* 'feather,' *kpmà* 'take off.' A nasal can both precede and follow the labial-velar, as in *wʲédʒíŋgbmà* 'dark.'

Mada, as reported in Price (1989), takes the pattern a step further with a nasal following a labial-velar functioning as the nucleus of the syllable, though infrequently, in words like *kpm̀* 'to plow,' *kãgbm̄* 'to go home.' Mada also, like Adele and Ewe, may have a liquid following labial, velar, or labial-velar (but not coronal) consonant. Price refers to this as a "liquid feature" and transcribes the release as a superscript rather than a full segment, as in *kpˡa* 'unmarried,' *gbʳe* 'ripe.'

All of the cases discussed here have the second consonant following the labial-velar. However, the nature of the following phonetic material in each case is such that release characteristics of the labial-velar stop are preserved, either in a vocalic transition in Eggon, the lateral resonant in Ewe, or the sonorants in Adele, Gwari, and Mada.

2.4 Positional neutralization of labial-velars in Amele, Ndyuka, Efik

We have discussed the licensed positions of labial-velars across a variety of languages. Also relevant is the active neutralization of labial-velars when they occur underlyingly in positions in which they are not licensed.

In Amele (PNG), /b/ is realized as [p] at the end of polysyllabic words, e.g. [bɔ'lɔp] 'trap,' and [b] elsewhere: [be] 'his neck', [du'bɪn] 'stalk', [sib] 'rubbish' (Roberts 1987). Crucially for our discussion, /gb/ is neutralized with /b/ word-finally. The first person plural agreement marker on verbs is [gb] word-medially: ['ho-gb-ə] 'we came (today)', but [p] word-finally -- [hɔ-'lɔ-p] 'we used to come.'

In Ndyuka, the ideophone [ffagbgb] 'ideophone for swift action' varies with [vvabb] (Huttar & Huttar 1994). (The transcription [gbgb] denotes a longer duration for [gb], not two separate articulations.) Again we see the neutralization of a labial-velar, in this case optional.

In Efik, [kp] appears in syllable-initial position, but [p] does not, and [p] appears in syllable-final position, but [kp] does not (Ward 1933, Welmers 1973). It appears, then, that [p] and [kp] can be treated as allophones of phonemic /kp/ (Welmers 1973:48). In syllable-final position, the velar component of /kp/ is lost. The same distribution is found in the closely related Ibibio (Boys 1979).

3. Constraints on labial-velar positions

Recently there has been considerable attention in the literature to constraints linked to certain positions in words. Some work has focused on a strictly positional perspective, such as word-initial or final position, as in Beckman's (1997) work showing that Shona vowels exhibit more contrasts in the first syllable of a word than elsewhere. Steriade (1994, 1995, 1997) has focused more on specific phonetic environments to explain why contrasts are found more robustly in certain positions than others. Finally, Casali (1997) has also considered semantic and informational functional explanations, such as preserving monosegmental morphemes from deletion. In this section, we will examine how phonetic and morphosyntactic factors play a role in the distribution of labial-velar phonemes.

3.1 Positional constraints on labial-velars

3.1.1 Phonetic constraint

Recall that labial-velar phonemes are never found word-finally as phonetic labial-velars. Very few languages even have underlying labial-velar phonemes in this position, and the languages which do have them (Amele, Ndyuka, Efik, Ibibio in Sec. 2.4) neutralize them as plain labials word-finally. Again, only Amele to my knowledge has a labial-velar syllable-finally.

Thus there is a near-absolute prohibition against labial-velars in syllable- or word-final position. The question arises whether it is the prosodic position which is the cause, or the distribution can be plausibly traced to a combination of phonetic factors, as Steriade (1995, 1997) has demonstrated with retroflex and voicing neutralization. Let us examine what phonetic factors may be relevant in the environment preceding and following labial-velars.

To review the results of the preceding sections, a labial-velar consonant is commonly preceded by silence (if utterance-initial, which entails word-initial), a vowel, or a nasal. The fact that only nasal consonants precede labial-velars is quite likely a result of the fact that in all these languages, nasals are commonly the only codas allowed. In most of these languages, a NC cluster is the only consonant cluster type allowed. The preceding environment varies widely and thus may or may not have transitions into the labial-velar or any cues to the following labial-velar.

As for the environment following a labial-velar, cross-linguistically, a labial-velar consonant is almost always followed by a vowel (whether full vowel or a transition) or a sonorant (liquid or nasal). A phonetic characteristic of all these is that the following environment allows the release characteristics of a labial-velar to be manifested.

It appears, then, that labial-velars are only licensed in phonetic environments which allow their release bursts and transitions into another sonorant to be manifested. However, a natural question is whether the distribution of labial-velars is at all different than other stops in the relevant languages. As previously mentioned, most of these languages license only nasals in codas, and in these languages labial-velars merely follow the same pattern as other non-nasal consonants. However, Buli licenses both a labial *b* and a velar *k* word-finally, but not a labial-velar. Most pertinently, the cases of Efik,

Ibibio, Amele, and Ndyuka, in which a labial-velar is neutralized, show that labial-velar licensing must have a ranking separate from other stops.

(5) **KP-son**: Labial-velars are licensed only before sonorants.

The above constraint will cover all cases except Amele in which *gb* can occur syllable-finally. A relevant question is if there is in fact a transitional vowel as in the case of Eggon. Roberts (pc) states definitely that there is no transitional vowel between [gb] and [d] in ['tugb.dɔ?] 'to butcher,' and for the present I have no account for this.

What are the cues that identify labial-velars, especially word-initially? In spectrographs from several languages, the transition from a vowel into a labial-velar has velar characteristics, and the release has labial burst characteristics (Connell 1994, Ladefoged & Maddieson 1996). The reason for this is shown in the diagram below showing electromagnetic articulographic measurements of an Ewe labial-velar stop: the velar gesture slightly precedes the labial one. This direct measurement of articulator movements explains the spectrographic evidence.

(6)
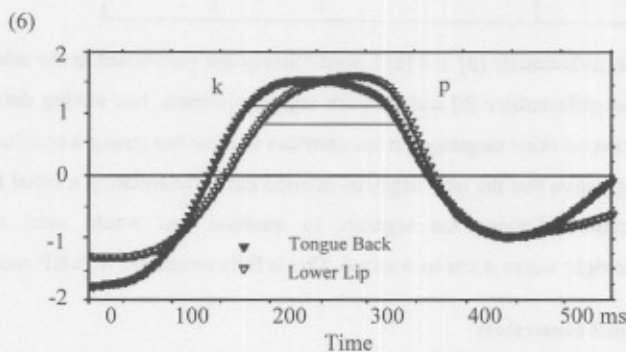
Coordination of lower lip and tongue back movements in the Ewe word **akpa**. Y-axis is vertical displacement; horizontal lines indicate the likely duration of actual contact of the articulator. (Ladefoged & Maddieson 1996)

Intervocalically, both the transition into the labial-velar and the following burst are salient. If a labial-velar occurs between a nasal and a vowel, the place cues of the nasal and the burst suffice to distinguish labial-velars from both labials and velars. The phonetic cues needed to distinguish the labial-velar stops /kp, gb/ from the labial stops /p,

b/ in word-initial position need more detailed examination. All have labial releases; what distinguishes them word-initially?

While more investigation is certainly in order, I have enough recordings of Buli and Kɔnni to suggest some tentative answers. In both languages, while voiceless stops in general are aspirated, the [kp] is not.[4] Word-initial voiced stops are pre-voiced (negative VOT), though not pre-nasalized, and voicing continues throughout the entire stop. Furthermore, the acoustic characteristics of this pre-voicing are different for [gb] than for [b]. For [gb], the resonating cavity is blocked off at the soft palate, while for [b], the resonating cavity extends to the lips. Thus we may speak of a velar characteristic of pre-voicing for [gb], but a labial characteristic of prevoicing for [b]. The word-initial phonetic differences may be summarized as below.

(7) Phonetic differences between word-initial labials and labial-velars (Buli & Kɔnni)

	aspirated	"velar" pre-voicing	"labial" pre-voicing
kp			
p	x		
gb		x	
b			x

The cues to differentiate [p] and [kp] word-initially are manifested in the release, while the cues that differentiate [b] and [gb] are segment-internal. Not having detailed phonetic information on other languages, it is hazardous to draw too strong a conclusion. However, it is suggestive that the only segment-external cue differentiating a labial from a labial-velar occurs following the segment in question and would need some environment to the right where it can be realized. This is fully consistent with KP-son.

3.1.2 Morphological constraints

The phonetically-based constraint of (5) is necessary to account for the near-universal tendency for labial-velars to not occur word- or syllable-finally, but does not

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[4] This is characteristic of voiceless labial-velar stops in general. In many languages, they have an implosive air mechanism, but even when they do not, labial-velars are generally not aspirated, though other voiceless stops in a language typically are. An extreme case of this is Phwin, a Gur language of Bukina Faso, in which all voiceless stops are *contrastively* aspirated, with the sole exception of /kp/ (Kevin Warfel, pc).

explain the strong tendency for labial-velars, when word-internal, to occur morpheme-initially rather than morpheme-medially. We now turn to an examination of this pattern.

As noted in Section 2.1, it is quite common, though not quite universal, for languages to restrict labial-velars to morpheme-initial positions in a word. This may be either word-initial, in a noun stem following a noun class prefix, as a member of a compound, or in a reduplicated form. There is no obvious phonetic basis for such a restriction in distribution (but see discussion below); in Adele, for instance, a word-medial labial-velar may occur intervocalically, but *only* if it also begins a morpheme. In such languages, we need a morphosyntactically-based constraint to account for this surface generalization:

(8) **KP-mi**: Labial-velars are licensed only morpheme-initially

This is unlike most constraints in OT literature in that it is based on a syntactic entity. This constraint has a distinct communicative function, which is to more clearly demarcate the edge of a morpheme.

A question that naturally arises is whether this morpheme-initial position might in fact be phonetically different, perhaps stronger in some way (force of articulation, amplitude, etc.), than a morpheme-medial position would be. If so, then there could be a greater number of phonetic cues available, and the licensing of the labial-velar would be tied directly to phonetic rather than morphological factors.[5] At this time, I have no data to bear on this point. The detailed phonetic records or tape recordings necessary to decide this issue are not available to me for the languages (Adele, Ono, Ibibio, Eggon) for which labial-velars occur strictly morpheme-initially. Interestingly, even if there are shown to be phonetic cues which are more common or present in positions in which labial-velars occur, these cues would be a consequence of being in the morpheme-initial position, and thus while **KP-mi** could be looked on as a kind of shorthand for the relevant phonetic dues, these cues themselves are due to the morpheme boundary.

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[5] Ward (1933) makes a similar point for Efik when he notes that the consonants t and k weaken intervocalically to r and x respectively if not *root*-initial. Root-initial t and k remain unchanged phonetically, as Ward says, "evidently because there is stress on the verb root" (p.3), though stress is not contrastive in Efik

Presumably increased robustness of morpheme-initial phonetic cues would lead to more robust psycholinguistic identification of segments in this position, as it does for word-initial position. However, though much research has been done on *word*-initial segment recognition in psycholinguistics studies (Cutler 1995, Marslen-Wilson 1987 etc.), there has not been the same concentration on recognition of segments or other processing in *morpheme*-initial positions (M. Pitt, pc), so there is little if any relevant psycholinguistic literature in this area.

Besides this constraint, which as we have seen is sometimes violated, we need another constraint to express the generalization, exceptionless to my knowledge, that labial-velars never occur in affixes or function words, but only in roots: nouns, verbs, adjectives, adverbs. This will be:

(9) **KP-rt**: Labial-velars are licensed only in roots

From a communicative point of view, roots are more salient than affixes or function words; they carry the major semantic load, as shown by phenomena ranging from baby talk to telegraphic communications. As we have seen for Kɔnni, more contrastive segments appear in roots than in affixes or function words, and examples could be multiplied from other languages.

It may be possible to subsume **KP-rt** and **KP-mi** under one constraint, **KP-ri**, allowing labial-velars only in root-initial position. However, as presently viewed, the constraint **KP-rt** applies differently from **KP-mi** in two ways. First, while **KP-mi** would allow labial-velars in morpheme-initial position in affixes and function words, **KP-rt** would rule them out. Second, while **KP-rt** allows morpheme-medial labial-velars, **KP-mi** rules them out. Both constraints are necessary, since they apply in different situations. Also, cross-linguistically, **KP-rt** seems never to be violated, while **KP-mi** sometimes is.

3.1.3 Interaction of constraints and typology

As far as is known, **KP-rt** is never violated in any language, so it is universally undominated and will not be considered in the candidates in tableaux below. **KP-son**, too, seems to be never violated (except in the singular case of Amele). However, we have seen **KP-mi** violated in some languages. Therefore, the pertinent typologies, considering

only **KP-son** and KP-mi, are either an indeterminate ranking or **KP-son** outranking **KP-mi**. We will see these below.

If Efik is analyzed as having [kp] and [p] as allophones of one phoneme (recall [p] occurs word-finally and [kp] occurs word-initially), then Efik displays an example of indeterminate ranking of both the relevant constraints on labial-velar position. (A similar tableau could be constructed for Amele.)

(10) Efik: indeterminate ranking; [ísip] 'kernel'

UR: /ísikp/		KP-son	KP-mi	MAX(lab)	MAX(dors)
☞ a.	isip				*
b.	isikp	*!	*!		
c.	isik			*!	

Candidate (b), which preserves the underlying word-final /kp/, fatally violates both KP-son and KP-mi. The difference between candidates (a) and (c) is which of the place features gets deleted. Since [dorsal] is deleted in preference to [labial] we see that MAX(lab) must outrank MAX(dors). Interestingly, it would only be in the case of neutralization of underlying labial-velars that these rankings could be determined. In other cases, if there is an underlying labial or velar, it simply surfaces as such.[6]

In Basa, there is the apparently morpheme-medial labial-velar in *u-sekpe* 'guinea-yam.' If, as I have asserted, KP-son is cross-linguistically undominated, then it must dominate KP-mi in Basa.

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[6] Another way of looking at the pattern involves a closer look at the nature of labial-velars. Rather than considering the labial and velar components as equal as was done above, we can consider an alternate geometry. Cross-linguistically, where evidence is available, it seems that labial-velars pattern primarily as labial consonants. (Besides the word-final neutralization in Amele, Efik, Ibibio, and Ndyuka mentioned here, labial-velars also pattern with labials in consonant co-occurrence constraints in Ngbaka and Kukú, vowel restrictions in Nupe and Yoruba, and blocking of [round] harmony in Nawuri. Also, it is quite common for labial-velars to change to plain labials historically. For details of these, see Cahill 1999.) The dorsal component is then secondary. In this view, an alternative would be to posit a constraint **C** that would simply disallow secondary articulations word-finally. Seeing that [dorsal] is the secondary articulation, this [dorsal] would delete, retaining [labial] as the primary articulation.

(11) Basa: KP-son >> KP-mi

UR: u-sekpe	KP-son	MAX (lab)	MAX (dors)	MAX (seg)	DEP (seg)	KP-mi
☞ a. u-sekpe						*
b. u-sekp	*!			*!		*
c. u-sekpte	*!					
d. u-sepe		*!				
e. u-seke			*!			
f. u-kpe				*!*		

It is only by noting the surface generalization that **KP-mi** is sometimes violated in Basa, but **KP-son** never is, that we can be confident in ranking **KP-son** above **KP-mi**. Generating a candidate which violates **KP-son** but not **KP-mi**, with no other complications, is impossible with the given input. Violating **KP-son** would involve removing the vowel following the *kp*, or else inserting a consonant. Removing a vowel, as in (b), violates **MAX** constraints, which I have generalized as **MAX(seg)** above. Inserting a consonant as in (c) violates **DEP** constraints which I have generalized as **DEP(seg)** above. It is impossible to separate out the relative contributions of the **MAX** and **DEP** violations and the **KP-son** violations with this type of data. Changing the value of the underlying labial-velar to either a plain labial or a plain velar will be ruled out presumably by the relevant **MAX** constraints, as in candidates (d) and (e) above, or possibly by a **MAX** constraint specifically applying to labial-velars. Candidate (f) violates neither **KP-mi** nor **KP-son**, but involves two violations of **MAX(seg)**.

3.2 Multiply-articulated consonants

In this section we examine the possibility of subsuming the proposed positional constraints on labial-velars under more general constraints on multiply-articulated consonants. Besides labial-velar stops, multiply-articulated consonants include clicks, which have multiple closures, and possibly other stops with secondary articulation, i.e. labialized, velarized, or palatalized stops. In inventories of the world's languages, these are the more marked sounds, being articulatorily more complex.

It is possible, even likely, that the phonetically-based **KP-son** can be subsumed under a more general constraint against having any stops with multiple articulations in

syllable-final or word-final position. Let us briefly examine distributions of other consonants with multiple articulations.

Clicks occur as phonemes in far fewer languages than labial-velars, these being the Khoisan languages and a few neighboring Bantu languages such as SiSwati. The total number of languages with clicks is probably limited to a few dozen. Of these, none have clicks in any position but syllable-initial. There are no attested cases of clicks word-finally or even syllable-finally (Miller-Ockhuizen 1997).

Cross-linguistically, then, it seems reasonable to propose a general constraint **MULT-son**, analogous to the previous **KP-son**.

(12) **MULT-son** - multiply articulated consonants are licensed only before sonorants

In view of the common Slavic (and possibly other) language patterns of allowing palatalized stops word-finally, we must ask whether **MULT-son** is merely often violated in Slavic or if the patterns noted in this paper could best be captured by another generalization. One possibility is that multiply articulated consonants must be *released*. This release could be into a vowel or other sonorant, but also could be merely a released stop rather than unreleased, as with the Slavic cases. If released in some way, then the crucial cue of the burst of the consonant would be present.

Then the question arises of whether **KP-son** should be re-formulated in terms of release rather than followed by a sonorant. This question needs more attention at a more opportune time.

3.3 Summary

In this paper, I have shown definite distributional restrictions on the occurrence of labial-velars. They never occur outside of roots. They almost never appear syllable- or word-finally. There is an extremely strong tendency for labial-velars to appear only morpheme-initially. These generalizations can be formulated as the constraints **KP-rt**, **KP-son**, and **KP-mi**. While the interactions of these constraints with others in the relevant languages needs more study, in particular demanding that they be studied in relation to other general constraints in these languages, a positive result of this study is that both phonetically-based constraints, such as **KP-son**, and morphosyntactically-based constraints, such as **KP-mi**, are necessary in phonological theory.

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Deviations from the Greek in the Gothic New Testament

Hope Dawson
hdawson@ling.ohio-state.edu

The dependence on the use of New Testament texts in the study of the Gothic language requires that the potential influences on the Gothic language be acknowledged and taken into account. The influences of the original Greek language itself, as well as of parallel passages and variant texts, for example, can hinder the study of the nature of Gothic syntax and stylistics. Several examples of passages in the Gothic and Greek will be examined in this paper, with a discussion of the possible explanations for any deviations found in them.

The study of the Gothic language requires that many factors be taken into consideration in making any claim about the nature of the language. The problems stem from the fact that most of the available corpus of Gothic is made up of portions of the New Testament. Since the Gothic New Testament is a translation from the Greek original, the influence of the Greek original must always be considered, as well as the possibility of later influences from variant texts during scribal transmission, and influences at work within the text itself. For this reason a fundamental question within this area is what can really be known about Gothic syntax apart from the basics. In this paper some of these issues are discussed, and some examples of texts will be looked at in regard to the role of the various influences.

The nature of the translation technique employed by the Gothic translator Wulfila has been disputed. The common belief, however, is that the Gothic New Testament is a word-for-word or basically inter-linear translation of the Greek, as seen in Friedrichsen's statement that "the fundamental principle underlying the translation is the systematic correspondence of the Gothic text with the Greek, word for word, and in precisely the same order." [1926:15] While some might not agree on the degree to which the Gothic translator based the Gothic on the Greek, the word-for-word translation technique, rather than a thought-for-thought or looser translation, is undeniable.

The nature of the translation technique limits the ability to discern aspects of the language which could be called true "Gothic" and be considered to be a natural language, as actually spoken by the Goths. Therefore, anywhere the Gothic text is not a word-for-

word rendering of the Greek is important as a possible reflection of true Gothic. Studies

often focus on the examples of deviations because "deviations from a strictly word-for-word translation may be traced to the requirements of Gothic grammar, style, or idiom on the one hand, and to external influences on the other." [Friedrichsen 1926:16] The goal of studying these cases is to determine what these requirements might be. Other than determining grammatical aspects of Gothic, one might also use deviations to study areas such as style, as recognized by Yoshioka's statement that "the Gothic translation of the Bible as a whole is a slavishly literal translation, but when we take up individual passages and examine them closely, some instances can be found where scrupulous care is paid in the selection of words and subtle renderings are attempted out of stylistic consideration." [Yoshioka 1996:219] The problem is determining whether such deviations can be attributed to constraints within the language or whether they simply reflect other influences on the text.

One such potential influence is that of variant texts. The exact version of the Biblical text which was used by the Gothic translator is unknown, and there were certainly variant texts either in the Latin or in the Greek to which the translator or scribes were exposed. This problem has been recognized by Burton, as he asserted "...[while] not claiming that a lost variant [for a particular text] definitely existed, ... it *may* have existed, and ... for this reason it is impossible to have complete confidence in the explanation of the apparent discrepancy between the Greek and the Gothic as the result of any 'independence' on the part of the translator." [Burton 1996:90] This will be a possible explanation for any example of a discrepancy between the Gothic and the Greek, and it is especially difficult to deal with in that it can never be proven or disproven. While this must always be considered in a study, it is the goal of this paper to concentrate on other possible explanations.

Another influence which could have led to deviations in the Gothic from the Greek are parallel texts. The extant Gothic texts of the New Testament are mainly Gospel texts. Multiple accounts of the same story are often given in the different Gospels. Since the translator and scribes would have been familiar with the different accounts, it would be natural for one account to influence another. The deviations in which this type of influence can be seen most clearly and which can be attributed most convincingly to this type of influence are lexical deviations, particularly cases in which the Gothic text

contains words which do not have a correspondent in the Greek text. This can be seen in the following examples.

The first example is one of true parallel texts, in which the Sermon on the Mount is recounted by both Luke and Matthew.[1]

1.   Luke 6:20

audagai   *jus* **unledans ahmin**,   *unte   izwara ist*
'blessed (are) you **poor   (in) spirit**, because yours is
          thiundangardi   himine
          (the) **kingdom of heavens'**

makários   **hoi pto:khoí**, *hóti   humetéra estìn* **he: basileía   toû theoû**
'blessed (are) **the poor**,   because yours   is   **the kingdom of God'**

Matthew 5:3

adaugai   *thai* **unledans ahmin**,   *unte   ize ist*
'blessed (are) the **poor   (in) spirit**, because theirs is
          thiudangardi   himine
          (the) **kingdom of heavens'**

makários   **hoi pto:khoì pneúmati**, *hóti   autón estin*
'blessed (are) **the poor   in spirit**, because theirs is
          he: basileía   tô:n   ouranô:n
          the kingdom of the heavens'

The Gothic differs from the Greek in Luke in adding *ahmin* 'in spirit' and in translating 'the kingdom *of God*', *toû theoû*, as 'the kingdom *of heavens'*, *himine*, both of which deviations parallel the text in the Matthew account. Influence of the parallel text would seem to be a natural inference to draw in this case.

The second example is not from parallel Gospel accounts, but rather is an example of a prophecy from the Old Testament being repeated in the New Testament. The Gothic translation of the Old Testament passage is missing, but again the translator or scribes would undoubtedly have been familiar with the passage, whether in the Greek or in the Gothic, and it is given here in the Greek. In this example, the Greek third person singular pronoun *autoû* 'of him' is represented in the Gothic by *gudis unsaris* 'of our God', which is the phrase found in the original prophecy.

2.   Mark 1:3

raíhtos waúrkeith staígos gudis unsaris

'straight   make   (the) path **of God   our'**

*euthéias poieîte tàs tríbous **autoû***

'straight   make   the paths   **of him'**

Isaiah 40:3

*euthéias poieîte tàs tríbous **toû theoû he:mô:n***

'straight   make   the paths   **of God   our'**

The third example is another case of parallel Gospel narratives, in which the same event is recounted in the two different texts. The passage in Mark contains the phrase *thata taihswo* 'the right', which represents the Greek *tò deksión* seen in the text of John, but not in that of Mark.

3.   Mark 14:47

    *jah   afsloh   **imma ausu thata taihswo***

    'and he struck **to him ear   the   right'**

    kaì apheîlen   autoû tò o:tíon

    'and he cut off **his   ear'**

    John 18:10

    *jah   afmaimait   **imma ausu taihswo***

    'and he cut off   **to him ear   right'**

    *kaì apékophen **autoû tò otíon tò deksión***

    'and he cut off **his   ear   the right'**

In each of the examples given above, the textual deviation is one in which words are added in the Gothic which do not represent words found in the Greek. In these cases, looking to the parallel texts can provide an explanation of the Gothic digression.

Another type of deviation, and one which is more interesting and potentially profitable from the linguistic standpoint, is that involving grammar. There are certain grammatical areas in which the Gothic differs from the Greek everywhere, areas in which it is clear that constraints within the Gothic dictate how the Greek is rendered, such as the translation of the Greek historical present as past, the rendering of Greek futures with the Gothic present subjunctive or indicative, etc. [Klein 1992:334] These systematic deviations reveal aspects of the Gothic grammatical structure because of the consistency with which the Greek structure is translated into the Gothic. Other examples can be seen,

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[1] The standard transliteration of Gothic is used here, except that *–th-* is used rather than *þ*.

however, in which the Gothic grammatically deviates from the Greek in a non-systematic
way, and those instances can perhaps also reveal something of Gothic grammatical or
stylistic constraints.

One example of this can be seen in the following text, in which a Greek aorist
(perfective past) *ebáptisa* 'baptized' is rendered by a Gothic present tense verb, *daupja*.

4.   Mark 1:8

        *ik **daupja** izwis in watin*

        'I **baptize** you in water'

        *egò: mèn **ebáptisa** humâs en húdati*

        'I   indeed **baptized** you   in water'

Similar deviations were noted by Klein 1992 [368], where the Gothic present tense verbs
swegneid 'exults' and *gasaihwam* 'see' are used to translate the Greek aorists *e:gallíasen*
and *eídomen*.

5.   Luke 1:46-7

        *mikileid saiwala meina fraujan,   jah **swegneid** ahma meins du guda*

        '**exalts**   soul   my (the) Lord, and **exults**   spirit my in God'

        *megalúnei he: psukhé: mou tòn kurion, kaì **e:gallíasen***

        '**exalts**   the soul   my the Lord,   and **exulted***

                    tò pneûma mou epì tô:i theô:i

                    the spirit my in the God'

6.   Luke 5:26

        gasaihwam wulthaga   himma daga

        'we **see**   wonderful (things) this   day'

        eídomen parádoksa   sé:meron

        'we **saw**   wonderful things today'

In the section of the article where these examples are given, Klein is discussing cases in
which deviations would seem to give evidence of Gothic independence from the Greek.
"Other irregularities or discrepancies [other than the renderings of Greek historical
present and future, e.g.] in the area of tense in particular between Gothic and Greek seem
to be nonsystematic, although they do challenge the contention that the Gothic translation
is a slavish imitation of the Greek." [Klein 1992:368] His explanation for these deviations

in particular is as follows. "The contexts of both passages [Luke 1:46-7, 5:26] make it

appear as though the aorist denotes a past so recent as to be directly contiguous with the

present. In 1:47 Mary had been moved to ecstasy by the equally ecstatic words of

Elizabeth ... and in 5:26 the multitudes are awestruck upon just having witnessed Jesus'

healing of a leper. It is therefore most likely the case that the translator found the Gothic

preterite both too remote and impersonal and colorless to render both the temporal

nuance and the wonder and ecstasy of the speakers." [Klein 1992:368] This explanation

calls on the nuances of meaning which the translator might wish to convey.

Having seen the explanation given by Klein for these two instances of an aorist

rendered by a present, we must now look back to the similar example (4) seen in Mark

1:8. Can the strategy given by Klein of appealing to nuances of meaning apply to this

case, or must we look for another? To address this question, we will look at the context of

the passage of Mark to see if the same sort of temporal and emotional nuances are

present. The verses preceding Mark 1:8 give the following context (Mark 1:4-7) "John

did baptize... and preach.. and there went out unto him... and were all baptized... and John

was clothed... and did eat.... and preached..." This context clearly lacks the "wonder and

ecstasy" and temporal nuances seen in (5) and (6).

Another potential explanation for deviations, discussed earlier, is the influence of

parallel texts. In this case, the account is given in all four of the Gospels. The Gothic text

of the parallels in Matthew and John did not survive, but the Greek is given.

7.   Luke 3:16

ik allis izwis watin   daupja

'I indeed you (with) water **baptize**'

egò mèn húdati   baptízo: humâs

'I indeed with water **baptize** you'

Matthew 3:11

egò mèn húmas baptízo: en húdati

'I indeed you   **baptize** in water'

John 1:26

egò baptízo: en húdati

'I   **baptize** in water'

It can be seen that in each of the parallel texts, the verb "baptize" is given in the present tense in the Greek, *baptízo*, as well as in the Gothic of the surviving passage in Luke, *daupja*, which makes an explanation based on this influence rather compelling.

Having determined that the explanation for the grammatical deviation in Mark does not seem to be due to syntactic or stylistic constraints, but rather parallel passages, let us now look again at the deviations seen in (5) and (6) to determine if there might be alternate explanations. Since neither of the Luke passages has a parallel, we shall look to other factors.

Luke 1:46-7

mikileid saiwala meina fraujan, jah **swegneid** ahma meins du guda
'**exalts** soul   my   the Lord, and **exults**   spirit my   in God'
megalúnei he: psukhé: mou tòn kúrion, kaì **e:gallíasen**:
'**exalts**   the soul   of me the Lord,   and **exulted**
            tò pneûma mou epì tô:i theô:i
            the spirit   of me in God'

While Luke 1 does not have a parallel Gospel account, a similar explanation might be seen in the influence of the context. Possible contextual deviations, in which the verses immediately surrounding a text could have influenced the text, can be seen in examples such as the following.

8.   John 11:11

akei **gaggam**,   ei   uswakjau   ina
'but **we go/let us go,** that I may awaken him'
allà **poreúomai**, hína eksupníso   autón
'but **I am going**, that I may awaken him'

In this text, the first person singular form of the verb in Greek, *poreúomai* 'I am going' is rendered by a first person plural form *gaggam* 'we are going/let us go' in the Gothic. Looking at a few verses before and after the relevant text, in which the same speaker is addressing the same people, we can see a very similar structure.

9.   11:7

gaggam   in Iudaian aftra
'**let us go** to Judea   again'
ágo:men eis tè:n Ioudaían pálin
'**let us go** into Judea   again'

akei **gaggam** *du imma*

'but **let us go** to him'

all' àgo:men pròs autón

'but **let us go** to   him'

The force of these surrounding verses in which the command *gaggam* 'let us go' appears could have influenced the translation of the grammatical number of the verb in verse 11. Similarly, the parallel clauses seen in Luke 1, "my soul exalts the Lord" and "my spirit exults in God", could have resulted in the tense of the second verb influencing that of the first. The force of this explanation can be increased by looking to the nature of the text itself. This text is the song of Mary, and as such is poetic, and the clausal parallelism noted above is a common poetic device, which could increase the desire for continuity in the tenses of the verbs.

Looking again to the second example given by Klein,

Luke 5:26

gasaihwam *wulthaga*   *himma daga*

'**we see**   wonderful (things) this   day'

eídomen *parádoksa*   *sé:meron*

'**we saw** wonderful things today'

we note again that there is no parallel text for this passage, and the context is not such that would be likely to lead to a contextual deviation. Another potential explanation for the deviation lies in variant texts. Specifically, an alternate form of verb, *ídomen*, is given in a variant text [Streitberg 106], and this form could potentially be interpreted as a non-past form.

It is certainly possible that the deviations seen in the Luke texts were due to the explanation given by Klein, but we have seen that other explanations are also possible. The passage in Mark 1:8, on the other hand, would seem most likely to be due to the influence of parallel texts.

Having demonstrated the usefulness of the explanation of parallel texts, we shall now look at some instances in which this explanation has been taken too far and used to explain deviations where other explanations would seem to be preferable. The examples of deviations given below are ones which are cited in Streitberg as being due to parallel passages.

In the first example, the Greek phrase *tô:n khoíro:n* 'of the pigs' appears twice, but the second instance was not translated into the Gothic text, which reads simply *alla so hairda* 'all the herd'.

11. Matthew 8:32

    galithun   in   hairda   sweine, ... jah rann ... **alla so hairda**

    'they went into (the) herd of pigs, .. and ran … **all the herd** '

    apê:lthon eis tè:n agéle:n tô:n khoíro:n ... kai... hó:rme:sen

    'they went into the   herd   of pigs   … and… ran...

        pâsa he: agéle: tô:n khoíro:n

        all   the herd   of pigs'

While parallel passages could potentially be involved in this instance, the context could quite well also explain the deviation, since the repetition of the phrase "of pigs" within the verse is redundant. Variant texts could also very well be responsible for the discrepancy, as shown in the following text from the Reformed Standard Version for the relevant part of the verse, in which the Greek also lacks the second occurrence of the phrase.

12. *...kai ... hó:rme:sen **pâsa he: agéle:*** [RSV]

    'and … ran   **all   the herd** ...'

Another example of an overuse of the parallel passages explanation can be seen in the next example, in which the deviation in the Luke passage is explained by Streitberg as being due to the influence of the passage in Mark. In the passage in Luke, the Greek verb *eîpen* 'said' lacks an explicit pronominal subject, but the Gothic does show an explicit subject in *is qath* 'he said'. The passage in Mark, however, does have an explicit pronominal subject *ho* 'he' with the same verb in the Greek.

13. Luke 7:50

    *ith **is qath*** *than do thizai qinon*

    'but **he said** then to the   woman'

    eîpen   *dè   pròs tè:n gunaîka*

    '**(he) said** but to   the   woman'

    Mark 5:34

    *ith   **is qath*** *du izai*

    'but **he said** to her'

    ho dè eîpen autê:

but he said to her

The problem with the explanation given by Streitberg is that the passage in Mark is not parallel to the one in Luke, as it is the account of a completely different event, and the woman in question is not even the same. Since the third person singular nominative pronoun is not necessary in either the Greek or the Gothic, it is much more likely that this is due to a variant text or something within the Gothic itself.

The last example of a deviation for which the parallel passage is not the most likely explanation is found in Mark, with a parallel passage in Matthew.

14.   <u>Mark 15:45-6</u>

fragaf **thata leik** *Iosefa* ... **ita** *biwand* *thamma leina*

'he gave **the body** to Joseph ... **it** he wrapped with the linen

jah galagida ita hlaiwa

and laid **it** in the tomb'

edoré:sato **tò ptô:ma** *tô:i Io:sé:pha* ... **autòn** *eneíle:sen* *tê:i sindóni*

'he gave **the body** to Joseph ... **him** he wrapped with the linen

kaì katéthe:ken **autòn** *en mne:meío:i*

and deposited **him** in the tomb'

<u>Matthew 27:59-60</u>

jah nimands **thata leik** *Iosef* *biwand* **ita** *sabana* *hrainjamma*

'and taking **the body** Joseph wrapped **it** with clean fine linen

jah galagida ita...

and laid **it**...'

kaì *labò:n* **tò sô:ma** *ho Io:sè:ph enetúliksen* **autò** *sindóni* *katharã*

'and taking **the body** Joseph wrapped **it** in a sheet clean

kaì éthe:ken **autò**..

and placed **it**...'

In this example, the deviation is the use of the third singular neuter accusative pronoun *ita* 'it' in the Gothic to represent the masculine pronoun *autòn* 'him' seen in the Greek. While it is true that in the parallel Matthew passage the neuter pronoun in the Gothic reflects the neuter pronoun in the Greek, that explanation overlooks a much simpler grammatical explanation. In both of the Gothic passages the antecedent of the pronoun is *thata leik*, 'the body', which is a neuter noun, as are the corresponding nouns found in the Greek, *tò ptô:ma* and *tò sô:ma*. The deviation in the Gothic is actually just the usage of

the grammatically correct form of the pronoun to refer back to the neuter noun. The Greek's use of the masculine pronoun in Mark to refer to the neuter noun is apparently a stylistic choice, by which the writer can speak of the body as still being a person. The Gothic translator apparently chose not to reflect this stylistic device but instead simply used the "correct" form of the pronoun .

In all of the examples we have seen, there seem to be several possible explanations available for the deviations in the Gothic text. In each case, however, we can see that certain explanations can give a better account of the deviation. While the specter of variant texts can never be dispelled, we cannot give up as a lost cause the endeavor to understand Gothic more fully. Rather, we can continue to study instances of deviations and carefully consider potential explanations, and perhaps be able to identify the best possible explanation for each example. Through this we may continue to expand our knowledge of the Gothic language.

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PIE feminine '3' and '4': A critique of Snyder (1970)*

Panayiotis A. Pappas

pappas.27@osu.edu

In this brief note I take issue with Emmerick's (1992:293) statement that Snyder's (1970) explanation of the morphology of the PIE feminine forms for the numbers '3' and '4', is "The most attractive explanation so far advanced". After a brief synopsis of the morphological puzzle presented by these forms I provide a detailed presentation of Snyder's explanation, as well as a critique of its methodological shortcomings.

One of the more recalcitrant morphological problems in Indo-European linguistics has been the formation of the feminine forms of the numbers '3' and '4' in Sanskrit (**tisrás** and **cátasras**, respectively), Avestan (**tisr**-and **cataŋr**-) and Old Irish (disyllabic **teuir**, monosyllabic **téoir** and **cethéoir** with the second syllable monosyllabic and-much rarer-disyllabic). These forms are so similarly different from their masculine counterparts (**tráyas-catváras** for Sanskrit, **θráyah- caθβār**- for Avestan, and **tri-cethair** for Old Irish) that their construction begs explaining. A satisfactory explanation has not been given yet, as can be witnessed by the continuous resurfacing of the subject in the literature. Since Meringer's (1904) complete account of these forms, the subject has also been discussed by Cowgill (1957), Szemerényi (1967, 1977), Hamp (1973, 1988), Snyder (1970), Oettinger (1986), and Emerick (1992).

If we were to concetrate on the Indic forms (represented here by the Sanskrit in Table 1), the most disputed question since Meringer's (1904) account has been the nature of the cluster '**sr**' in the feminine forms for these two numbers.

'3'	Masc	Fem	Neuter
Nom	tráyas	tisrás	trī́ṇi
Acc	trī́n	tisrás	trī́ṇi
Instr	tribhís	tisṛbhis	tribhís
Dat	tribhyás	tisṛbhyas	tribhyás
Gen	triṇā́m	tisṛṇā́m	triṇā́m
Loc	triṣú	tisṛṣu	triṣú
'4'	Masc	Fem	Neuter
Nom	catvā́ras	cátasras	catvā́ri
Acc	catúras	cátasras	catvā́ri
Instr	catúrbhis	catasṛbhis	catúrbhis
Dat	[1]catúrbhyas	catasṛbhyas	catúrbhyas
Gen	caturṇā́m	catasṛṇā́m	caturṇā́m
Loc	catúrsu	catasṛṣu	catúrsu

Table 1. The Sanskrit paradigm for numbers '3' and '4'

Most analyses (Meringer, Szemerényi, Hamp, Oettinger) have proposed that the cluster **sr** has its origin in *sor (zero grade **sṛ**) the PIE word for "woman", which has also been posited in *swe-sōr (explained as self+woman-"own's woman"-extended to mean "sister"), Greek ὄαρ "wife" which Meringer derives from *so-sṛ. Meringer would also like to identify it with Latin **series**, Greek εἴρω "to connect" (both from *ser), thus getting the full ablaut pattern *sor-ser-sṛ. Later (cf. Benveniste (1969)) this element was also cited in:

Latin **uxor** "wife"<*euk-sor (know+woman)

Avestan **hāirisī** "woman"<*sor-is-i (woman-neuter abstract-feminine suffix)

Sanskrit **strī** "woman"<*sri, the **t** being epenthetic[2].

Cowgill (1957) in a similar vein proposed that the cluster **sr** was a feminine ending, but disputed its connections to PIE *sor.

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[1] Underlined forms are not attested in the Rigveda.

[2]However, some of these citings are controversial; cf. Benveniste (1969), Szemerényi (1977).

On the other hand, Snyder's (1970) account, breaks with tradition as it does not try to link
–sr- to *sor, or even assign it the status of a feminine ending. Snyder assumes that the
stem of four is *kʷétwer- (whereas the other accounts assume *kʷét- for mas. stem and
*kʷéte- for fem. stem). If *sor had to attach to this stem, it would yield the unwieldly
*kwetwersores, from which cátasras could never arise. .

 In order to explain the appearance of –sr- in the feminine forms Snyder draws our
attention to the folowing Sanskrit nouns: masculine dātṛ "giver" (nom. pl. dātāras
which is similar to catváras), and the feminine usṛ "dawn" (nom. pl. usáras which is
similar to cátasras). For Snyder, this reflects a PIE differentiation between the two
genders, so he proposes an alternation between masculine *kʷétwóres and feminine
*kʷétweres. Through regular sound change the latter would yield cátvaras (nom.) and
cáturas (acc.). From here Snyder proposes the following labyrinth of analogical
influence:
1) Based on acc. caturas the nom. loses the v giving cataras
2) Based on nom. cataras the acc. caturas changes u to a giving cataras
3) The r of cataras gets analyzed as a feminine suffix
4) The r is attached to tris (for "three times") yielding tris-ras for fem '3'
5) Under the influence of trisras the accusative of '4' cataras changes to catasras
6) The accusative of '4' spreads to the nominative giving catasras there also.

The appealing quality of this account is that it does not posit *sor in the formation and thus
does not need to explain how and why a phrase that originally had the meaning "four
women" (or "three women") came to mean '4' (or '3') of the feminine gender.
Unfortunately, however, Snyder's account is problematic from a methodological point of
view because in order for it to work, there have to be at least 6 different instances of
analogical influence between the numbers '3' and '4', which constitutes an abuse of 'the
change by analogy' mechanism. More importantly, this account begs a number of
questions. For instance, why should -r- be interpreted as feminine (see step 3) if it also
exists in the masculine? And why should the multiplicative tris be involved in the
formation of the feminine gender? Both of these proposals are umotivated and, thus,
lacking in explanatory force. These problems make Snyder's account no more attractive
than any of the ones that came before or after it. In fact its excessive use of analogy, and
unmotivated reinterpretation of segments make it even less plausible than any other account
so far proposed. Alas, it seems that the puzzle of the formation of PIE feminine '3' and '4'
still remains unsolved.

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Word order, negation, and negative polarity in Hindi

Shravan Vasishth

Abstract

In Hindi certain word ordering possibilities that are grammatical in non-negative sentences become ungrammatical in the presence of sentential negation. In movement-based accounts of such negation-induced word order constraints, the restricted word order has been argued to provide evidence that negative polarity items (NPIs) in Hindi are licensed at LF and s-structure while in English NPI licensing occurs at s-structure. I argue for a non-movement-based, uniformly monostratal (s-structure) account for the word order facts in Hindi, cast in the multimodal categorial grammar framework. The NPI licensing issue is dealt with independently following Dowty's monotonicity marking analysis.

This paper presents a uniform treatment of two related phenomena in Hindi: word order constraints imposed by sentential negation, and an asymmetry between Hindi and English negative polarity items (NPIs). I develop a theory set in multimodal categorial grammar (see e.g., (Moo97)) and argue that my treatment has several advantages over existing transformational accounts.

The structure of the paper is as follows. Section 1 presents the word order and NPI facts, and Section 2 discusses two transformational analyses of the related issue of NPI licensing, and points out several problems with these. Sections 3 and 4 present an alternative, monostratal account set in categorial grammar for the word order and negative polarity problems, and Section 5 concludes the paper.

1 Constraints on word order

Mahajan (Mah88) discusses the various ordering possibilities for a sentence with an intransitive or transitive verb and negation. Although he presents examples of both intransitive and transitive verbs, we will consider only transitive verbs here since the facts for these subsume those for intransitives. Let us first look at a representative set of acceptable and unacceptable sentences with a transitive main verb and its arguments, an auxiliary, and negation (I do not consider all possible word orders here due to space limitations). Although the facts presented below correspond to Mahajan's, the generalizations I give are my own.

(1)   (a) *raam roṭii nahī̃ khaataa   thaa*
          Ram bread neg eat-imp-part-masc be-past-masc
          'Ram did not (use to) eat bread.'

    (b) *raam roṭii khaataa nahī̃ thaa*
         Subj Obj V   Neg Aux

    (c) *roṭii raam nahī̃ khaataa thaa*
         Obj Subj Neg V   Aux

    (d) *roṭii nahī̃ khaataa thaa raam*
         Obj Neg V   Aux Subj

    (e) *roṭii khaataa nahī̃ thaa raam*
         Obj V   Neg Aux Subj

    (f) *raam nahī̃ khaataa thaa roṭii*
         Subj Neg V   Aux Obj

All these are instances of sentential negation, provided no special prosodic contour is employed (as discussed further on). Examples such as these show that the Subj(ect) and Obj(ect) can appear freely around the Neg-V-Aux or V-Neg-Aux cluster. By contrast, the following ungrammatical possibilities show that neither the Subj nor the Obj can appear anywhere within the Neg-V-Aux or V-Neg-Aux cluster (see (2a-d)). In each case, the relevant element is underlined (all these are intended to be cases of sentential negation, not constituent negation–this is discussed in the next sub-section).

(2)   (a) **raam nahī̃ roṭii khaataa thaa*
         Subj Neg Obj V   Aux

    (b) **nahī̃ raam roṭii khaataa thaa*
         Neg Subj Obj V   Aux

    (c) *raam nahĩĩ khaataa roṭii thaa
        Subj Neg V <u>Obj</u> Aux

    (d) *roṭii nahĩĩ khaataa raam thaa
        Obj Neg V <u>Subj</u> Aux

Furthermore, the following examples show that Aux cannot precede the Neg-V complex (see (3a,b)), and that it cannot intervene between the Neg and V (see (3c-e)).

(3)   (a) *raam roṭii thaa nahĩĩ khaataa
           Subj Obj <u>Aux</u> Neg V

    (b) *raam roṭii thaa khaataa nahĩĩ
        Subj Obj <u>Aux</u> V Neg

    (c) *raam roṭii khaataa thaa nahĩĩ
        Subj Obj V <u>Aux</u> Neg

    (d) *raam khaataa roṭii thaa nahĩĩ
        Subj V <u>Obj</u> <u>Aux</u> Neg

    (e) *raam khaataa thaa roṭii nahĩĩ
        Subj V <u>Aux</u> <u>Obj</u> Neg

Examples such as these allow us to conclude that V(erb) and Neg(ation) form an inseparable cluster in which internal order is free, the Aux(iliary) must appear to the immediate right of this complex, and Subject and Object may occur in any permutation outside this Neg-V-Aux complex.

1.1   Some apparent counterexamples

There are several apparent counterexamples to the generalizations I present above based on Mahajan's data. However, these turn out not to be cases of sentential negation, but involve either metalinguistic negation, constituent negation, or pragmatics-dependent auxiliary- or negation-fronting. In each case, a special prosodic contour is necessary (shown here simply by capitalization of the prosodically marked word).

Sentential negation is contrasted with constituent (contrastive) negation in (4) below. In (4b), the negated constituent can have the negation to its immediate right, thereby apparently violating the constraint regarding Verb-Negation contiguity. The same holds for instances of metalinguistic negation.

(4)   (a) *Siitaa-ne kitaab nahĩĩ khariidii*
        Sita-erg book neg bought
        'Sita didn't buy a/the book.'

    (b) *SIITAA-ne nahī̃ kitaab khariidii (kisii-aur-ne   khariidii)*
        Sita-erg neg book bought someone-else-erg bought
        'SITA didn't buy a/the book (someone else did).'

Similarly, although based on the earlier data we have claimed that the Auxiliary appears to the right of the verb (independent of whether negation is present or not), it can appear sentence-initially. But in this case as well, a special prosodic contour accompanies this auxiliary fronting. Consider the following sentences.

(5)   (a) **hai mere-pas kitaab*
         is   me-with book
         (Intended) 'I have a/the book.'

        (b) *HAI mere-pas kitaab*
         was me-with book
         'I DO have the book.'

        (c) *hai MERE-pas kitaab*
         was me-with   book
         'It is me (and not someone else) who has the book.'

(5b) is fine just in case in a preceding discourse someone has directly or indirectly suggested that the current speaker doesn't have the book. The speaker could then utter (5b) to deny this previous assertion. (5c) is self-explanatory. Gambhir (Gam81) has also noted this kind of unusual word order in special contexts involving certain presuppositions.

Next, consider the following contrast:

(6)   (a) **nahī̃ siitaa-ne kitaab khariidii*
         neg   Sita-erg book bought
         (Intended) 'Sita didn't buy a/the book.'

        (b) *NAHĪ̃ siitaa-ne kitaab khariidii*
         neg   Sita-erg book bought
         'Sita didn't buy a/the book <u>after all</u>.'

(6a), uttered with normal intonation, is ungrammatical as sentential negation, but in (6b), which is fully acceptable, there is a presupposition to the effect that either someone tried to persuade Sita to buy a book or she was supposed to buy it for whatever reason, but she didn't buy it.

The above apparent counterexamples do not exhaust such "pragmatically driven" violations of the constraints mentioned above; see Bhatia (Bha95) and Gambhir (Gam81) for

further details. Prosody is clearly implicated in these marked orders. In this paper I do not discuss anything other than sentences with sentential negation, uttered with normal intonation (see (Har96) for more details regarding what I mean by normal intonation in Hindi). The role of prosody will be addressed in future work.

Putting aside the above cases, in the next section I first summarize Mahajan's barriers-based account of these word order facts and the related NPI facts, and then Bhandari's (Bha98) minimalist treatment of Hindi and English NPI. I then try to show that neither of these provides a satisfactory account.

2   Subject vs. non-subject NPIs in Hindi and English

2.1   Mahajan on word order and negation

Mahajan ((Mah88), (Mah90)) has argued as follows. The direct object (DO) *sabzii*, 'vegetables', in (7a) cannot be scrambled from its canonical position to the right of the main verb *khaatii* when negation is present, as in (7b), but can be without the negation (see (7c)).

(7)   (a) *siitaa   sabzii   nahīī khaat-ii   thii*
           Sita(fem) vegetables neg   eat-imp-fem be-past-fem
           'Sita did not use to eat vegetables.'

       (b) **siitaa t_i nahīī khaat-ii   sabzii$_i$ thii*
           Sita(fem)   neg   eat-imp-fem vegetables   be-past-fem
           'Sita did not use to eat vegetables.'

       (c) *siitaa t_i khaat-ii   sabzii$_i$ th-ii*
           Sita(fem)   eat-imp-fem vegetables   be-past-fem
           'Sita used to eat vegetables.'

In (7a), " ... negation is adjoined to the right of the VP and V to AGR to I raising in Hindi gives the relevant word order ... " (Mah90, 337). (7b) above is ruled out by assuming that negation must raise at LF to adjoin to a finite IP for independent reasons; the DO, scrambled to a position below IP, is then a barrier to this LF movement since " ... adjunction to a maximal projection creates a barrier for any further extractions from within that maximal projection" (Mah90, 338-339).

Now consider these examples (also due to Mahajan (Mah90)), and the simplified tree diagrams for (8b) and (8c) below:

(8)   (a) *siitaa t_i nahīī khaat-ii   th-ii   sabzii$_i$*
           Sita(fem)   neg   eat-imp-fem be-past-fem vegetables
           'Sita did not use to eat vegetables.'

(b) *koi-bhii t_i nahīī khaat-aa   sabzii$_i$ th-aa
anyone(masc)   neg   eat-imp-masc vegetables be-past-masc
(Lit.) 'Anyone did not use to eat vegetables.'
(Intended) 'No-one used to eat vegetables.'

(c) koi-bhii t_i nahīī khaat-aa   th-aa   sabzii$_i$
anyone(masc)   neg   eat-imp-masc be-past-masc vegetables
'Anyone did not use to eat vegetables.' (='No-one used to eat vegetables.')
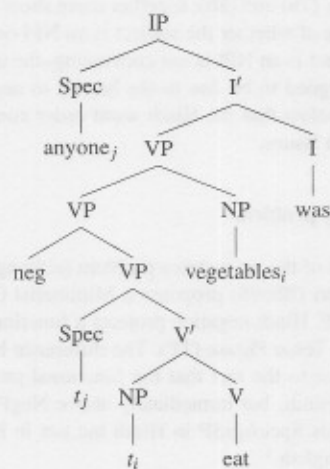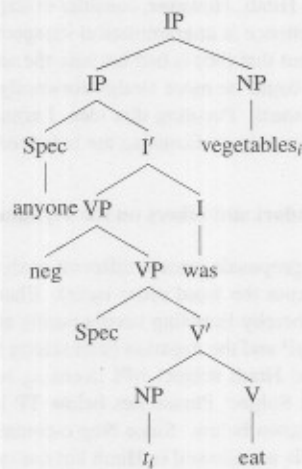
Figure 1: (8b)   Figure 2: (8c)

According to Mahajan, (8a) is allowed because the DO is adjoined higher than I (to IP) and thus is not a barrier to LF movement of negation as it adjoins to IP above the scrambled DO. (8b) is ruled out as in the case of (7b), but (8c)'s grammaticality is taken to indicate that negative polarity items (NPIs) in Hindi must be licensed at LF, since both the scrambled DO and negation adjoin to IP (the former at s-structure, and the latter at LF), as shown in Figure 1 and Figure 2 (adjunction by negation at LF is not shown here).

Similarly, in the case of the transitive verb constructions given earlier, the subject and/or object may scramble to the right of the main verb and the auxiliary, and the ungrammatical possibilities are ruled out as in the case of (7) and (8).

There are two problems with this analysis. First, Kim and Sag (KS95), and Abeillé and Godard (AG97), among others, have convincingly shown that the functional projection approach is both empirically and theoretically inadequate. Although this may eventually

turn out to be a moot point (see (SR99) and (Ver99)), I explore the possibility of accounting for the facts without assuming functional projections.

The second problem relates to the connection between word order variation and NPI licensing. Mahajan (Mah90) proposes that NPIs must be c-commanded by negation and that there must not be any intervening barriers between negation and the NPI. This condition applies at both LF and S-structure in English, while in Hindi it applies only at LF. These different licensing conditions in Hindi versus English are ascribed to a parametric difference. Under this view, (8b,c) are taken to indicate that LF is the relevant licensing condition on NPIs in Hindi. However, consider examples (7b) and (8b); together these show that the negated sentence is ungrammatical irrespective of whether the subject is an NPI or not, so the argument that (8b) is bad because the subject is an NPI is not convincing—the ungrammaticality could be more straightforwardly argued to be due to the barrier to negation's (LF-)movement. Pursuing this idea, I argue below that the Hindi word order constraints and negative polarity licensing are independent issues.

2.2   Bhandari and others on the asymmetry problem

Two other proposals present different analyses of the asymmetry problem (although these do not discuss the word order issue): Bhandari (Bha98) proposes a Minimalist (Cho95) solution whereby licensing occurs purely at LF. Hindi negation projects a functional projection NegP and the negation head selects for Tense Phrase (TP). The difference between English and Hindi subject NPI licensing is due to the fact that the functional projection Agreement Subject Phrase lies below TP in Hindi, but immediately above NegP in English, as shown below. Since Neg c-commands SpecAgrSP in Hindi but not in English, subject NPIs are allowed in Hindi but not in English.[1]

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[1]Dwivedi (Dwi91), although not concerned with the asymmetry problem, also proposes a functional projection NegP for Hindi negation, but in her case the negation head selects for VP and is selected for by Aspect Phrase, which is further selected by TP.

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        NegP                                    AgrSP

  [OP]       Neg'                                     AgrS'

        TP        Neg                          AgrS        NegP

          T'    nahīī                            not         Neg'

     AgrSP                                              Neg       TP

      Hindi                                          English
```
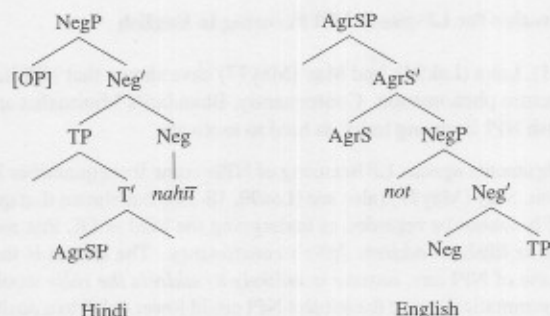
Figure 3

Vasishth (Vas97) presents a purely s-structure account of the asymmetry problem where NegP plays a crucial role in NPI licensing. Here, Brody's (Bro95) representational chains and Haegeman's Neg-criterion are the licensing mechanisms. All these analyses make several problematic assumptions, which I discuss next.

2.3 Problems with existing analyses

2.3.1 No NegP in Hindi

Mahajan (Mah88) has shown that Hindi negation cannot project a functional projection, so any account, such as Bhandari's or Vasishth's, both relying on functional projections, will first have to demonstrate that these are in fact sufficiently motivated in Hindi.

Mahajan's argument against NegP as a functional projection is that, given the fact that the main verb can move past negation, as in (9), we have to assume that the head movement constraint (Tra84) is not violated when the verb moves. This means that negation is not a head.

(9)   (a) *raam   aayaa   nahīī*
            Ram   came   neg
            'Ram didn't come.'

       (b) *raam t_i nahīī   aayaa$_i$*
            Ram   neg   came
            'Ram didn't come.'

2.3.2   No motivation for LF-based NPI licensing in English

Culicover (Cul81), Laka (Lak94), and May (May77) have shown that NPI licensing in English is an s-structure phenomenon. Consequently, Bhandari's Minimalist analysis, which carries out English NPI licensing to LF, is hard to motivate.

Two of the arguments against LF licensing of NPIs come from quantifier lowering (QL) and reconstruction. May (May77) (also see (Las99, 18-19)) has shown that quantificational elements like NPIs cannot be regarded as undergoing the kind of QL that *some* undergoes in *some politican is likely to address John's constituency*. The reason is that if QL were to occur in the case of NPI *any*, *anyone is unlikely to address the rally* would be wrongly predicted to be grammatical, since the subject NPI could lower at LF to a position below the negative element *unlikely*. Laka (Lak94, 123) also argues that reconstruction (see (Cho77), (vRW86)) cannot allow LF licensing of NPIs since reconstruction would incorrectly predict *anybody wasn't arrested by the police* to be grammatical, as well as preposed VPs like *buy any records is what she refused to do*.

2.3.3   The role of downward monotonicity

The accounts of Mahajan, Bhandari, and Vasishth don't address the fact that downward monotonicity of the NPI licensor plays a central role in NPI licensing. In these analyses, downward monotonicity may be integrated by other means, of course, but it is merely a structural mechanism that ensures that only the grammatical sentences like (8c), and not (8b), are produced. We will assume that downward monotonicity is relevant for NPI licensing, at least in English and Hindi (see, e.g., (Lad79) and (Vas98)).

2.4   Desiderata for a theory of NPI licensing

To summarize the above discussion, existing analyses of the subject-object NPI asymmetry in Hindi and English have the problems that (i) the functional projection NegP is not motivated for Hindi, (ii) English NPI licensing cannot happen at LF, and (iii) the role of downward monotonicity in NPI licensing needs to be taken into account. In response to these issues, I present an alternative analysis of NPI licensing based primarily on Dowty's work (Dow94).

3   Multimodal categorial grammar

Categorial Grammar (CG) is a monostratal, strictly lexical framework for linguistic theory, a characteristic feature of which is the close interaction between the syntax and semantics of linguistic objects. Categorial type-logics (see (Car97) and (Moo97) for their relation

to categorial grammar) build up complex syntactic units from atomic lexical entries using purely logical derivations. In the type-logical variant I adopt in this paper, I use the calculi **L**, the Lambek calculus, and **LP**($\diamond$), the Lambek calculus with permutation and modalities. Given certain empirical facts, the aim is to build a deductive system allowing the composition of form and meaning, treating the grammar as a system of logic, i.e., a system for reasoning about structured linguistic resources. The central idea is that the lexicon contains all the information needed for building up grammatical sentences, and the combination of words to form sentences is effected by means of a set of logical inference rules. Below, I give a brief overview of the way the system is built up. For a more detailed discussion, see (Moo97).

TYPES AND CONNECTIVES

We define basic types like $s, n, \ldots$, along with binary and unary connectives, both of which will serve as building blocks for lexical entries, as we presently show.

$\mathcal{B}$, the set of basic types, $\mathcal{B} = \{det, s, n, \ldots\}$

$\mathcal{C}$, the set of connectives, $\mathcal{C} = \{\bullet, /, \backslash, -\!\circ, \diamond, \square^{\downarrow}\}$

$\mathcal{T}$, the set of types, $\mathcal{T} ::= \mathcal{B} \mid \mathcal{T} \bullet \mathcal{T} \mid \mathcal{T} \backslash \mathcal{T} \mid \mathcal{T}/\mathcal{T} \mid \mathcal{T} -\!\circ \mathcal{T} \mid \diamond \mathcal{T} \mid \square^{\downarrow} \mathcal{T}$

The above definition for types $\mathcal{T}$ says that a legal type is either a member of the set of basic types, or some type(s) defined as in $\mathcal{T}$ related by any of the binary connectives $\bullet$, $\backslash$, $/$, $-\!\circ$, or the unary connectives $\diamond$ and $\square^{\downarrow}$.

In addition to these, the Gentzen sequent system we use here requires that for every class of n-ary *logical* connectors, there be an n-ary *structural* connector. For example, for the unary logical connectors $\diamond$ and $\square^{\downarrow}$, we have the structural connector $(.)^{\circ}$.

SEQUENTS

A set of sequents $\mathcal{S}$ is defined as follows: $\mathcal{S} ::= \mathcal{T} \mid (\mathcal{S}, \mathcal{S}) \mid (\mathcal{S})^{\circ}$.

Object-level statements are expressed by sequents $\Gamma \vdash A$, where $\Gamma \in \mathcal{S}$ and $A \in \mathcal{T}$. In $\Gamma \vdash A$, Γ is the ANTECEDENT, A is the SUCCEDENT; we read $\Gamma \vdash A$ as "A may be proven from Γ". So, for example, the sequent $\Gamma_1, \Gamma_2, \Gamma_3, \ldots \vdash A$ amounts to saying that the Γ_i's can be concatenated to give an expression of category A. A simple linguistic example would be *mary sleeps* $\vdash s$, where *mary* has type s/vp and *sleeps* has type vp (with appropriate λ-terms associated with each category), so that the sequent looks like $s/vp \; vp \vdash s$.

In the model theory, the categorial connectives are treated as modal operators, the type formulae being interpreted in the powerset algebra of Kripke-style relational structures (Moo97, 101-115).

THE ASSOCIATIVE LAMBEK CALCULUS: **L**

L has the following inference schemas:

$$\frac{}{A \vdash A} \; Axiom$$

$$\frac{\Gamma, A, B, \Delta \vdash C}{\Gamma, A \bullet B, \Delta \vdash C} \bullet L \qquad\qquad \frac{\Gamma \vdash A \quad \Delta \vdash B}{\Gamma, \Delta \vdash A \bullet B} \bullet R$$

$$\frac{\Gamma \vdash A \quad \Delta, B, \Delta' \vdash C}{\Delta, B/A, \Gamma, \Delta' \vdash C} /L \qquad\qquad \frac{\Gamma, A \vdash B}{\Gamma \vdash B/A} /R$$

$$\frac{\Gamma \vdash A \quad \Delta, B, \Delta' \vdash C}{\Delta, \Gamma, A \backslash B, \Delta' \vdash C} \backslash L \qquad\qquad \frac{A, \Gamma \vdash B}{\Gamma \vdash A \backslash B} \backslash R$$

These inferences are read from bottom to top. In any of the above inference schemas, the sequent(s) above the line are the PREMISES, and the sequent below the line is the CONCLUSION. The variables Γ, Δ, Δ' stand for possibly empty sequences (actually, the sequences contain category-meaning pairs; discussion of the semantic component associated with each syntactic operation is suppressed in this paper). I treat the binary structural connectives as implicitly associative.

I explain next some of these schemas that we will use. $\backslash L$ and $/L$ above allow a slash connective to be eliminated from the left-hand side. For example, the $/L$ says that if we want to analyze a sequence with a forward slash "/", e.g., B/A, possibly preceded or followed by some material (hence the variables Γ, Δ and Δ'), and we can find a sub-sequence Γ that rewrites B, then we can get the result by analyzing Δ, B, Δ'. Similarly for the right slashes, except that in these the derived category contains a slash. See (Car97) for a more detailed discussion.

Finally, the *Axiom* rule comes into play in the sequent proofs. A sequent proof in this system is a finite tree such that every local subtree matches one of the schemas, and a sequent is derivable if (and only if) it forms the root of a tree whose leaves are instances of the axiom rule.

THE LAMBEK CALCULUS WITH PERMUTATION: **LP**

LP is simply **L** with the structural rule of Permutation (Permute) added on:

$$\frac{\Gamma[(\Delta_2, \Delta_1)] \vdash C}{\Gamma[(\Delta_1, \Delta_2)] \vdash C} \; Permute$$

Permutation is also compiled away in the Gentzen presentation by treating sequents as multisets. The linguistic relevance of Permutation will become clear when we look at some example derivations.

$$A \vdash A$$

$$\frac{\Gamma, A, B \vdash C}{\Gamma, A \bullet B \vdash C} \bullet L \qquad\qquad \frac{\Gamma \vdash A \quad \Delta \vdash B}{\Gamma, \Delta \vdash A \bullet B} \bullet R$$

$$\frac{\Gamma \vdash A \quad \Delta, B, \Delta' \vdash C}{\Delta, \Gamma, A \multimap B, \Delta' \vdash C} \multimap L \qquad\qquad \frac{A, \Gamma \vdash B}{\Gamma \vdash A \multimap B} \multimap R$$

$$\frac{\Gamma \vdash A \quad \Delta, A \vdash B}{\Delta, \Gamma \vdash B} \; Cut$$

With the inference rules involving the directionally insensitive connective $\multimap$, and treating the sequents as multisets, we now allow the argument A of a functor like $A \multimap B$ to appear to the left or right of the functor; this contrasts with our directional slashes in **L**, where $A \backslash B$ requires its argument A to be to its left.

THE MODALITIES $\Diamond$ AND $\Box^{\downarrow}$

The unary operators $\Diamond$ and $\Box^{\downarrow}$ are related to each other by the following equivalence (also see (Moo97)).

$$\Diamond A \vdash B \text{ iff } A \vdash \Box^{\downarrow} B$$

The interpretation of these two operators is defined by a binary accessibility relation R^2:

$$[\![\Diamond A]\!] = \{b \mid \exists a (R^2 ba \wedge a) \in [\![A]\!]\}$$

$$[\![\Box^{\downarrow} A]\!] = \{a \mid \forall b (R^2 ba \rightarrow b) \in [\![B]\!]\}$$

$$\frac{\Gamma[(A)^{\circ}] \vdash B}{\Gamma[\Diamond A] \vdash B} \Diamond L \qquad\qquad \frac{\Gamma \vdash A}{(\Gamma)^{\circ} \vdash \Diamond A} \Diamond R$$

$$\frac{\Gamma[A] \vdash B}{\Gamma[(\Box^{\downarrow} A)^{\circ}] \vdash B} \Box^{\downarrow} L \qquad\qquad \frac{(\Gamma)^{\circ} \vdash A}{\Gamma \vdash \Box^{\downarrow} A} \Box^{\downarrow} R$$

$\Gamma[A]$ in the above rules means that the material A in square brackets is some sub-structure (respecting structural bracketings of the left-hand side Γ of a sequent. We will use the $\Box^{\downarrow}$ modality to handle the word order facts. The basic idea is that sequents are in general permutable, but any types marked with the $\Box^{\downarrow}$ (and the (.)° structural marking) do not allow permutation outside the boxed ($\Box^{\downarrow}$'ed) type.

With this brief introduction to the underlying framework, we turn to the empirical issues discussed above.

3.1   Getting the right word order

We can capture the word ordering facts by defining the lexicon as follows.

(10)   (a) *nahīī*, 'not' $\leadsto (vp \multimap \Box^{\downarrow}vp) : \lambda P \neg P$

     (b) *siitaa*, 'Siitaa' $\leadsto np : sita'$

     (c) *sabzii*, 'vegetables' $\leadsto np : vegetables'$

     (d) *khaatii*, 'ate' $\leadsto np \multimap np \multimap s : \lambda x \lambda y. eat(x, y)$

     (e) *thii*, 'had' $\leadsto (vp \backslash \Box^{\downarrow}vp) : \lambda P. had(P)$

Some of these entries need explanation. The syntactic category of the negative *nahīī* is lexically specified as in (10a); *vp* is an intransitive or transitive verb phrase. The non-directional implication $\multimap$ indicates that the VP argument for negation may occur either to the left or the right of the negation. The result category $\Box^{\downarrow}vp$ ensures that after the verb and negation have combined together, nothing may intervene between them. The λ-term corresponding to the negation functor is the standard one and should be self-explanatory. In (10d), The lexical entry for *khaatii*, 'ate', says that it needs two *np*s as arguments in order to form an *s*, but that the ordering is free: the *np*s can occur before or after the verb (I ignore agreement issues here for expository purposes). The entry for the auxiliary verb *thii*, on the other hand, says that it needs some kind of verb to its immediate left in order to form a 'boxed' category of the same type, the $\Box^{\downarrow}$ ensuring that no argument of the verb can appear inside the cluster of negation-verb-auxiliary.

Let us work through a derivation to see how this works. In the following discussion, $np \multimap np \multimap s$ is abbreviated as *tv*. The sentence we derive is (7a). We will ignore the corresponding semantic operations of functional application of λ-terms and subsequent β-conversions for reasons of space.

First, we replace the lexical items with their syntactic types.

$$\frac{np \; np \; ((tv \multimap \Box^{\downarrow}tv \; tv)^{\circ} \; tv \backslash \Box^{\downarrow}tv)^{\circ} \vdash s}{siitaa \; sabzii \; ((nah\bar{\imath}\bar{\imath} \; khaatii)^{\circ} \; thii)^{\circ} \vdash s} \tag{11}$$

After that, the $\multimap L$ rule applies: the negation functor consumes its transitive verb argument, resulting in a $\Box^{\downarrow}tv$ category.

$$\frac{\dfrac{}{tv \vdash tv} \; Axiom \qquad np \; np \; ((\Box^{\downarrow}tv)^{\circ} \; tv \backslash \Box^{\downarrow}tv)^{\circ} \vdash s}{np \; np \; ((tv \multimap \Box^{\downarrow}tv \; tv)^{\circ} \; tv \backslash \Box^{\downarrow}tv)^{\circ} \vdash s} \; \multimap L \tag{12}$$

Next, the $\Box^{\downarrow}tv$ is reduced to tv by rule $\Box^{\downarrow}L$ and can now serve as an argument to the auxiliary $tv\backslash\Box^{\downarrow}tv$.

$$\frac{np\ np\ (tv\ tv\backslash\Box^{\downarrow}tv)^{\circ}\vdash s}{np\ np\ ((\Box^{\downarrow}tv)^{\circ}\ tv\backslash\Box^{\downarrow}tv)^{\circ}\vdash s}\ \Box^{\downarrow}L \tag{13}$$

Then, the auxiliary consumes the verb, and we again get a boxed category, $\Box^{\downarrow}tv$, which can be reduced to tv as shown above using the $\Box^{\downarrow}L$ rule. The result of these operations is the top-most line in the derivation below. The topmost 'deduction' below is simply a substitution of $np\multimap np\multimap s$ for tv.

$$\frac{\overline{tv\vdash tv}\ Axiom\quad\dfrac{\dfrac{np\ np\ np\multimap np\multimap s\vdash s}{np\ np\ tv\vdash s}}{np\ np\ (\Box^{\downarrow}tv)^{\circ}\vdash s}\ \Box^{\downarrow}L}{np\ np\ (tv\ tv\backslash\Box^{\downarrow}tv)^{\circ}\vdash s}\ \backslash L \tag{14}$$

The final deduction is a simple application of $\multimap L$ twice to give axioms.

$$\frac{\overline{np\vdash np}\ Axiom\quad\overline{np\vdash np}\ Axiom\quad\overline{s\vdash s}\ Axiom}{np\ np\ np\multimap np\multimap s\vdash s}\ \multimap L\times 2 \tag{15}$$

The entire derivation is shown below:

$$\frac{\overline{tv\vdash tv}\ Axiom\quad\dfrac{\overline{tv\vdash tv}\ Axiom\quad\dfrac{\dfrac{\dfrac{\overline{np\vdash np}\ Axiom\quad\overline{np\vdash np}\ Axiom\quad\overline{s\vdash s}\ Axiom}{np\ np\ np\multimap np\multimap s\vdash s}\ \multimap L\times 2}{np\ np\ tv\vdash s}}{np\ np\ (\Box^{\downarrow}tv)^{\circ}\vdash s}\ \Box^{\downarrow}L}{np\ np\ (tv\ tv\backslash\Box^{\downarrow}tv)^{\circ}\vdash s}\ \backslash L}{\dfrac{np\ np\ ((\Box^{\downarrow}tv)^{\circ}\ tv\backslash\Box^{\downarrow}tv)^{\circ}\vdash s}{\dfrac{np\ np\ ((tv\multimap\Box^{\downarrow}tv\ tv)^{\circ}\ tv\backslash\Box^{\downarrow}tv)^{\circ}\vdash s}{siitaa\ sabzii\ ((nah\bar{u}\ khaatii)^{\circ}\ thii)^{\circ}\vdash s}}\ \multimap L}$$

The derivation detailed above illustrates how we can account for the word order facts using these strictly lexically driven deductions. The ordering of negation with respect to the main verb is free, but the auxiliary verb must appear to the right of the result of the combination of the verb with negation. Thereafter, the arguments of the verb may combine

in any possible permutation. The ungrammatical derivations are ruled out by the fact that any structural marking using $(.)^\circ$ other than the ones shown in the above example will lead to a failure in derivation, modulo the refinement discussed below.

One kind of illegal derivation allowed by the system as set up above is the following. Recall the ungrammatical (7b):

(16) *Siitaa nahīī khaatii <u>sabzii</u>   thii
       Sita   neg   eat   vegetables was
       'Sita did not use to eat vegetables.'

We can actually derive this ungrammatical sentence with the structural marking shown below (in the following derivation, $tv = np \multimap np \multimap s$ (transitive verb); $iv = np \multimap s$ (intransitive verb); and Der means "derivable").

$$\cfrac{\cfrac{\overline{np \vdash np}\; Axiom \quad \overline{np\; ((iv \multimap \Box^{\downarrow}iv\; \boxed{iv})^\circ iv \backslash \Box^{\downarrow}iv)^\circ \vdash s}}{np\; ((iv \multimap \Box^{\downarrow}iv\; \boxed{tv\; np})^\circ iv \backslash \Box^{\downarrow}iv)^\circ \vdash s}\; \multimap L}{siitaa((nah\bar{\imath}\bar{\imath}\; khaatii\; sabzii)^\circ\; thii)^\circ \vdash s}\; Der$$

Notice that the transitive verb can first combine with one of its arguments (the lower boxed material in the derivation above), and then can combine with negation as an intransitive verb (the higher boxed element). The way to prevent this is to ensure that negation looks for a *lexical verb*, i.e., a verb with none of its arguments satisfied. Since we are working in a multimodal system, this constraint can be incorporated straightforwardly. Instead of having only one modal operator $\Box^{\downarrow}$, we can also have a second one, say $\Box^{\downarrow}_{lex}$, which is defined similarly to $\Box^{\downarrow}$. We then mark a lexical verb with this new modal operator $\Box^{\downarrow}_{lex}$, and alter the lexical entries as shown below.

The revised lexical entries are as follows:

(17) (a) nahīī, 'not' $\leadsto \Box^{\downarrow}_{lex} vp \multimap \Box^{\downarrow} vp : \lambda P \neg P$

      (b) khaatii, 'ate' $\leadsto \Box^{\downarrow}_{lex}(np \multimap np \multimap s) : \lambda x \lambda y.eat(x,y)$

4 Constraining NPI licensing

4.1 Dowty's reformulation of Monotonicity Logic

The main goal in (Dow94) is to try to answer the question: why do NPIs exist? His answer is that NPIs and negative concord (NC) facilitate natural language semantic processing

and inference by explicitly marking downward monotone contexts (cf. (Isr98)). Since in this paper I am not concerned with the above question, but rather with the NPI licensing asymmetry discussed above, I present a highly abbreviated account of Dowty's theory, discussing only those elements that are relevant to our discussion.

Dowty begins by presenting a linguistically more suitable version of Sánchez-Valencia's (Val91) Natural Logic (but cf. (Ber99)). Lexical items are assumed to have monotonicity marking as indicated by the recursive definition for syntactic categories and types.

(18) (a) NP (= type e), S (= type t) and CN (= type (e,t)) are (primitive) categories.

  (b) If A and B are any categories, so are A/B and $A\backslash B$.

  (c) If A/B is a category, so are $A^+/B^+, A^+/B^-, A^-/B^+, A^-/B^-$.

  (d) If $A\backslash B$ is a category, so are $A^+\backslash B^+, A^+\backslash B^-, A^-\backslash B^+, A^-\backslash B^-$.

For complex categories, the monotonicity marking on the result category of a functor is the complex category's marking.

(19) (a) $(A/B)^+ =_{def} (A^+/B)^+ =_{def} (A^+/B)$

  (b) $(A/B)^- =_{def} (A^-/B)^- =_{def} (A^-/B)$

Most lexical categories appear in two formulations but with the same semantic interpretation. For example, $eat \in (NP^+\backslash S^+)/NP^+$ and $eat \in (NP^-\backslash S^-)/NP^-$. Upward and downward monotone functors, however, are special. They are constrained to appear as shown below (with similar definitions for $A\backslash B$):

(20) (a) Upward monotone functors appear in a pair of categories of the forms A^+/B^+ and A^-/B^-.

  (b) Downward monotone functors appear in a pair of categories of the forms A^+/B^- and A^-/B^+.

Furthermore, NPIs are specified to have only negative monotonicity marking (with a similar statement for $A\backslash B$):

(21) NPIs appear in a category of the form A^-/B^- (or C^-).

Finally, a well-formed non-embedded sentence is defined as follows:

(22) If ϕ is of category S^+, ϕ is a well-formed non-embedded sentence.

In the following subsections, I show how this system, with some modifications, allows a straightforward treatment of the asymmetry problem.

4.2   Subject NPIs in English

As discussed earlier, polarity reversing elements like negative quantifiers, e.g., *nobody*,[2] only have the entry S^+/VP^- (or, of course, S^-/VP^+; see (20b)) for subject position and $TV^-\backslash VP^+$ for the object position.[3]

On the other hand, NPIs like *anyone* have only the entries S^-/VP^- and $TV^-\backslash VP^-$ for subject and object positions, respectively. The downward monotonicity constraints on NPIs are then enforced in an obvious way: *Anyone didn't come* is correctly ruled out, while *Nobody came*, *John didn't see anyone*, and *Nobody saw anything* are allowed, as shown in Derivations A, B, C, D, respectively.

I illustrate the way this works using Derivation A below. The other derivations proceed in a similar fashion.

$$\cfrac{\cfrac{}{vp^+ \vdash vp^+}\ Axiom \quad \cfrac{\cfrac{}{vp^- \vdash vp^-}\ Axiom \quad \cfrac{FAIL}{s^- \vdash s^+}}{s^-/vp^-\ vp^- \vdash s^+}\ /L}{\cfrac{s^-/vp^-\ vp^-/vp^+\ vp^+ \vdash s^+}{anyone\ \ didn't\ \ come \vdash s^+}\ /L}$$

Derivation A

Derivation A shows the final monotonicity marking on the lexical items; let us unpack the derivation to show how we got there. Only the lexical entries for *anyone* and *didn't* have fixed monotonicity markings; the one for *come* is underspecified and could be VP^+ or VP^-. *Anyone* must have the entry S^-/VP^-, since it is an NPI (see (21)), and *didn't* must either be VP^+/VP^- or VP^-/VP^+, since it is a polarity reversing functor (see (20b)). Since *anyone* is the main functor, for the derivation to be legal, its argument, to its immediate right, is determined to be of the form VP^-. In order for this to happen, VP^-/VP^+ is chosen for *didn't* (this is because the result category in VP^-/VP^+ is VP^-). Now, since *come* is underspecified for monotonicity marking, it can serve as an argument for *didn't*, i.e., VP^-/VP^+, with a positive marking and will therefore be instantiated as VP^+. When *didn't* (VP^-/VP^+) combines with VP^+, the result is a VP^-, which can serve as an argument for the main functor S^-/VP^- to yield S^-. But this leads to a failure because of (22).

The other examples given below are self-explanatory.

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[2]In this paper, we assume that such n-words are in fact negative quantifiers. Cf. (Acq97).

[3]" ... each determiner in category $\langle S^\alpha/VP^\beta \rangle/CN^\gamma$ above is assumed to have an object counterpart in $(TV^\beta\backslash VP^\alpha)/CN^{r}$, Dowty, seminar handout, Winter 1999.

$$\frac{\dfrac{}{vp^- \vdash vp^-} \; Axiom \quad \dfrac{}{s^+ \vdash s^+} \; Axiom}{\dfrac{s^+/vp^- \;\; vp^- \vdash s^+}{nobody \;\; came \vdash s^+}} /L$$

Derivation B

$$\frac{tv^- \vdash tv^-}{Axiom} \quad \frac{\dfrac{vp^- \vdash vp^-}{Axiom} \quad \dfrac{\dfrac{vp^+ \vdash vp^+}{Axiom} \quad \dfrac{}{s^+ \vdash s^+}\,Axiom}{s^+/vp^+ \;\; vp^+ \vdash s^+}/L}{\dfrac{s^+/vp^+ \;\; vp^+/vp^- \;\; vp^- \vdash s^+}{\dfrac{s^+/vp^+ \;\; vp^+/vp^- \;\; tv^- \;\; tv^-\backslash vp^- \vdash s^+}{John \;\; didn't \;\; see \;\; anyone \vdash s^+}}\backslash L}/L$$

Derivation C

$$\frac{tv^- \vdash tv^-}{Axiom} \quad \frac{\dfrac{vp^- \vdash vp^-}{Axiom} \quad \dfrac{\dfrac{}{s^+ \vdash s^+}\,Axiom}{s^+/vp^- \;\; vp^- \vdash s^+}/L}{\dfrac{s^+/vp^- \;\; tv^- \;\; tv^-\backslash vp^- \vdash s^+}{nobody \;\; saw \;\; anything \vdash s^+}}\backslash L$$

Derivation D

4.3 Hindi NPIs

Hindi NPIs like *koii-bhii* are derived from the existential quantifier *koii*, 'some, a', by the suffixation of the focus particle *-bhii*, 'also/even' (see Lahiri (Lah98), and Lee and Horn (LH95)). *Koii* displays the same quantifier scope ambiguity as in English in conjunction with, e.g., a universal quantifier or negation ($X > Y$ means X outscopes Y):

(23) (a) *sab logõ-ne   kisii-ko   maaraa*
          all   people-erg someone-acc beat
          'Everyone beat someone.' $\forall > \exists$ or $\exists > \forall$

   (b) *koi   nahĩĩ aayaa*
          someone neg   came
          'Someone didn't come.' $\exists > \neg$ or $\neg > \exists$

However, when *-bhii* is suffixed, the polarity sensitive item is obtained.

(24) (a) *koii-bhii aayaa
     anyone came
     'Anyone came.'

   (b) koii-bhii nahī̃ aayaa
     anyone neg came
     'No-one came.' $\neg > \exists$

I assume here that NPIs like *koi-bhii* are lexically of a lower type, NP^-, than the generalized quantifier *koii* or *kisii* (which have the type S^-/VP^- in subject position), thereby ensuring that NPIs are never the main functors and must appear in the scope of negation. This lower type allows them to appear more liberally, both in subject and object positions.

Support for treating *-bhii* marked NPIs as more liberal in nature comes from the fact that *-bhii* allows a wide range of NPIs to appear in many more licensing environments than that NPI might otherwise appear in (Vas98). For example, *uf karnaa*, 'to express distress', is a 'strong' NPI when it appears without any suffix; it is 'strong' in the sense that it appears only in strongly negative or antimorphic contexts like negation and not in other weaker negative contexts like the monotone decreasing NPI licensor *few people* and the anti-additive licensor *if … then* (see (vdW97) for details regarding the properties of these licensors). Notice that in (25a) and (25b) only the literal reading, not the NPI interpretation, is available, which is consistent with the fact that *uf karnaa* is a minimizer (Hor89, 399-400).

(25) (a) #*gaṇit-mẽ* *fel* *hone-par* **kam-hii** *vidyaarthii* uf *kartee* *haĩ*
     mathematics-in fail become-on few-encl students onom do are
     'It matters to few students if they fail in mathematics.'

   (b) #**agar** *tum-ne* *injekshan* *lagne-par* uf *kii* *to* *mai* *tum-he*
     if   you-erg injection apply-on onom do then I you-to
     ḍarpok *samjhuun-gaa*
     coward consider-will
     'I'll consider you a coward if you make even a sound when you get the injection.'

   (c) *us-ne* *sab-kuch* *bec* *ḍaalaa* *lekin* *vimlaa-ne* uf **naa** *kii*
     (s)he-erg everything sold gave but Vimla-erg onom not did
     '(S)he sold off everything, but Vimla didn't show even the slightest distress.'

However, suffixing *-bhii* to *uf karnaa* transforms it into a weak NPI:

(26) (a) *gaṇit-mē*   *fel hone-par* **kam-hii** *vidyaarthii* uf-bhii   kartee
         mathematics-in fail become-on few-encl students   onom-even do
         haĩ
         are

         'It matters to few students if they fail in mathematics.'

     (b) **agar** *tum-ne injekshan lagne-par* uf-bhii   kii *to*   mai *tum-he*
         if   you-erg injection apply-on onom-even do then I   you-to
         ḍarpok samjhuun-gaa
         coward consider-will

         'I'll consider you a coward if you make even a sound when you get the
         injection.'

     (c) *us-ne   sab-kuch   bec ḍaalaa lekin vimlaa-ne* uf-bhii   **naa** kii
         (s)he-erg everything sold gave   but   Vimla-erg onom-even neg did

         '(S)he sold off everything, but Vimla didn't show even the slightest distress.'

Assuming, then, that NPIs like *koi-bhii* are of a lower, more liberally occurring type,
NPI licensing in Hindi proceeds as shown in Derivation E for the sentence *kisii-ne-bhii
kuch-bhii nahĩ khaayaa*, literally, 'anyone anything not ate' (='nobody ate anything'),
where two NPIs occur, one in subject position, and the other in an object position. (tv^+
abbreviates $np^- \multimap vp^+$, which expands to $np^- \multimap np^- \multimap s^+$.)

$$\frac{\dfrac{}{np^- \vdash np^-}\ Axiom \quad \dfrac{}{np^- \vdash np^-}\ Axiom \quad \dfrac{}{s^+ \vdash s^+}\ Axiom}{\dfrac{np^-\ np^-\ tv^- \multimap tv^+\ tv^- \vdash s^+}{kisii\text{-}ne\text{-}bhii\ kuch\text{-}bhii\ nahĩ\ khaayaa \vdash s^+}} {\multimap}L \times 3$$

Derivation E

4.4 An advantage of this analysis: wider coverage

This licensing mechanism generalizes to NPI licensors of differing strengths. For example,
consider the monotone decreasing NPI licensor *kam-hii log*, 'few-encl people', and the
anti-additive licensor *agar ... to*, 'if ... then' (see (Vas98) for details of NPI licensing in
the scope of these and other licensors). Assigning the type (s^+/vp^-) to *kam-hii log*, 'few
people', and $s^+ \multimap s^-$ to *agar*, we get the correct possibilities for *kam-hii log kuch-bhii
khaayenge*, literally, 'few people anything will-eat', ('few people will eat anything'), and
agar koi-bhii kuch-bhii maange, literally, 'if anyone anything wants ... ' ('if anyone wants
anything ... ').

$$\frac{\dfrac{\overline{np^- \vdash np^-}\ Axiom \quad \overline{vp^- \vdash vp^-}\ Axiom \quad \overline{s^+ \vdash s^+}\ Axiom}{s^+/vp^-\ np^-\ np^- \!-\!\!\circ vp^- \ \vdash s^+}\ {-\!\!\circ,/E}}{\textit{kam-hii log}\ \ \textit{kuch-bhii}\ \ \textit{khaayenge} \vdash s^+}$$

<div align="center">Derivation F</div>

$$\frac{\dfrac{\overline{np^- \vdash np^-}\ Axiom \quad \overline{np^- \vdash np^-}\ Axiom \quad \dfrac{\overline{s^- \vdash s^-}\ Axiom \quad \overline{s^+ \vdash s^+}\ Axiom}{s^+ \!-\!\!\circ s^-\ \ s^- \vdash s^+}\ {-\!\!\circ}}{s^+ \!-\!\!\circ s^-\ np^-\ np^-\ np^- \!-\!\!\circ vp^- \ \vdash s^+}\ {-\!\!\circ \times 2}}{\textit{agar}\ \ \textit{koi-bhii}\ \ \textit{kuch-bhii}\ \ \textit{maange} \vdash s^+}$$

<div align="center">Derivation G</div>

The direction-sensitive slash in the lexical entry for *kam-hii log* rules out the word order variations shown in (27a,b) below, while the non-directional implication for *agar* allows the possibility of scrambling, as shown in (27c-e).

(27) (a) **kuch-bhii khaaenge kam-hii log*
          anything   will-eat   few-encl people
          ' ... '

      (b) **kuch-bhii kam-hii log   khaaenge*
          anything   few-encl people   will-eat
          ' ... '

      (c) *kuch-bhii maange koii-bhii agar*
          anything   asks   anyone   if
          'If anyone asks for anything ... '

      (d) *kuch-bhii maange agar koii-bhii*
          anything   asks   if   anyone
          'If anyone asks for anything ... '

      (e) *kuch-bhii agar maange koii-bhii*
          anything   if   asks   anyone
          'If anyone asks for anything ... '

Existing transformational accounts only discuss NPI licensing in the context of negation, not these other licensing contexts. It remains to be seen whether a transformation-based theory could adequately cover data such without introducing new constraints and mechanisms; the present treatment has the advantage that it requires no extra machinery to handle the word order variation discussed above.

5 Concluding remarks

This treatment of word order variation constrained by negation, and of NPI licensing has several advantages over a purely or partly LF-based, transformational account: (i) negation-constrained word order variation is treated independently of the negative polarity facts, as I have argued it should be, and moreover, word order variation is constrained lexically, not by invoking functional projections, whose general theoretical status has been called into question in the literature; (ii) a monostratal theory is developed in which NPIs are licensed due to the downward monotone property of their licensors, not mere c-command by the licensor; (iii) diverse licensing facts can be captured easily in this analysis; and (iv) due to the Curry-Howard correspondence, semantics is obtained compositionally without any extra machinery.

Acknowledgements

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A Categorial Treatment of Bare-NP Adverbs[1]

Neal Whitman

A select set of English nouns can head bare-NP adverbs – NPs that can act as adverbs without being preceded by a preposition. These 'BNPA nouns' also can be modified by prepositionless adverbial non-*wh* relative clauses. An analysis is presented in a categorial grammar framework, employing a conjunctive type structure to describe the behavior of BNPA nouns. It is suggested that non-*wh* relative clauses are selected by BNPA nouns (and ordinary nouns as well) as complements; lexical rules are written to allow such selection. Finally, some remaining issues are surveyed.

0   Introduction

Bare-NP adverbs are discussed in Larson (1983, 1985), and are NPs that can act as locative, temporal, or manner adverbs without any kind of morphological marking, as in the following examples:

(1)   a. We visited Mary *last Thursday/one day/this week/that year*.
       b. I lived *every place that I could afford*.
       c. Tom worked the problem *every possible way*.

In short, these phrases have the internal structure of a regular NP, but the external syntax of VP modifiers. Bare-NP adverbs also include lexical items like *today, yesterday, tomorrow,* and *then* for the temporal cases, and *there, here* for locative adverbs. However, the bare-NP adverbs that interest us here are the phrasal ones, as in (1). Larson

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also notes that nouns that can head bare-NP adverbs are a very restricted set. For example, although most nouns denoting periods or instances of time can head a temporal bare-NP adverb, not all of them can, as seen in (2a). For bare-NP adverbs of location or manner, only the specific words *place* and *way* are eligible, as seen in (2b,c).

(2)   a. *We visited Mary *that occasion/that period.*
        b. *I lived *every location/home that I could afford.*
        c. *Tom worked the problem *every possible method.*

For this reason, Larson favors an explanation in which eligibility to form bare-NP adverbs is part of these particular nouns' lexical entries.

Larson discusses a second property that this set of words possesses: they "can head non-*wh* adverbial relatives without preposition stranding." (Larson (1985), p. 616) Examples are shown in (3):

(3)   a. the {day, *occasion} (that) the music died
        b. the {place, *town} (that) I grew up
        c. every {way, *method} (that) Tom worked the problem

This second property is not exclusive to this set of words; it is possible for a word to be modifiable relative clause like those seen in (3), but not be usable as a BNPA, as shown in (4). The main example, noted by Larson (1983), is *reason*, though *spot* is another example, and there may be others.

(4)   a. the {reason, *cause) (that) Kim fired Robin
        b. Kim fired Robin *(for) this reason.
        c. a shady (spot, place, *area) to sit
        d. Kim sat *(in) that spot.

The question to be investigated here is how to formally characterize this select set of words, which I will call bare-NP adverb (BNPA) nouns, and allow for BNPA-like behavior in adverbial relative clauses for non-BNPA words, such as *reason*.

Whatever property it is that BNPA nouns possess, the basic problem is that this property needs to be specified at the lexical level, but come into play only at the NP level. On the way from N to NP, though, a BNPA noun might combine with a determiner, or

some kind of modifier: prenominal adjective, postnominal adjective phrase, prepositional phrase, or relative clause, as diagrammed in (5).

(5)
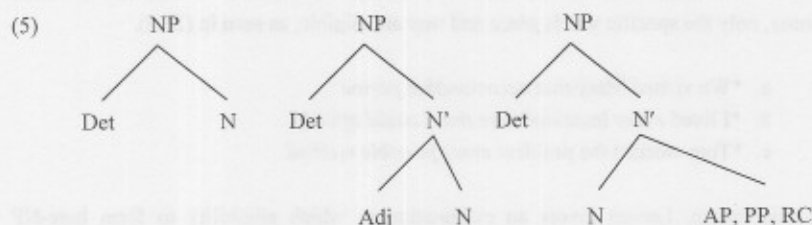
The question is how to allow the crucial information associated with the BNPA noun to percolate up to the NP, past any Det or modifier. In section 1, I review some previous analyses of BNPA nouns. Section 2 develops this paper's basic approach to BNPA nouns, covering the case of the leftmost tree in (5), where a BNPA noun combines with a Det and no modifiers. Section 3 deals with the middle tree in (5) and most cases of the rightmost one, proposing means to allow for prenominal and postnominal modification of BNPA nouns. Section 4 focuses on a subset of cases with postnominal modification, specifically, non-*wh* relative clauses. Sections 5 and 6 discuss some unresolved issues and offer some concluding thoughts.

1   Previous work[2]

1.1   Larson (1983-87)

Larson proposes that the selected words that can head BNPAs assign a case to themselves, instead of having it assigned to them by a verb or preposition. Specifically, (according to the most recent version of his explanation) they optionally self-assign a general "Oblique" case, which can then be further specified as +TEMP(oral), +LOC(ation), +DIR(ection)or +MAN(ner), depending on the context (Larson (1985, 1987)). With case thus assigned, a BNPA is allowed to take its place in a sentence. Furthermore, with case assigned, BNPA words can participate in adverbial relative clauses in the same way that ordinary words with, say, an +ACC case-marking can participate in an object-modifying relative clause (as in *a book to read*). The optionality of this case-marking keeps open the possibility of using BNPA words in non-adverbial relative clauses, as in *the place we visited.* Though this system covers the linguistic facts that Larson brings up, it is

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[2] The summaries of the following analyses are taken from Whitman (1998).

somewhat informal, with the context that differentiates between the different varieties of Oblique case not formally spelled out.

An earlier proposal in Larson (1983) has BNPAs subordinate to prepositionless PP nodes, a strategy that deserves further comment. Although putting a node of one syntactic category underneath another one of a different category (as Larson does by putting the adverbial NP under a PP node) is not done very much anymore, there is still an intuitive appeal to positing something like an "understood" preposition in front of a bare-NP adverb, or at the end of a non-*wh* relative adverbial clause. However, taking such a tack would not really save any work. To mention the lesser problem first, there is first the issue of what null preposition should be posited. *In* or *on* would be appropriate for locative adverbials, but not always for temporal adverbials. Even if we hypothesize some kind of general spatiotemporal preposition that does not correspond to any one preposition in the lexicon, the issue gets murkier when manner adverbials are considered. Manner adverbs seem quite different semantically from spatiotemporal ones; whereas adverbs of location and time can be seen as referring to actual areas of the space-time continuum, manner adverbs cannot. Let us assume, though, that there is such a null, spatiotemporal/manner preposition. The larger problem is that this null preposition has to be linked to the BNPA noun somehow. If it is not, then any noun will work, not just the special set of lexically marked ones that we are interested in, and ungrammatical phrases like *we stayed every location* and *every hotel that we stayed* would be licensed. So even with a null preposition, some of the work will have to be done by the individual lexical items, and therefore we might as well see if they can be made to do all of the work.

1.2   Kasper (1998)

Kasper (1998) also addresses bare-NP adverbs, in the larger context of how, in general, to modify words and phrases that have a uniform "internal semantics" but a "combinatory semantics" that varies according to their syntactic placement. One of the claimed advantages of Kasper's system is the ability to represent in a single definition words that may (despite having the same basic meaning) behave quite differently depending on syntactic usage. The prime example of such words is attributive vs. predicative adjectives. Kasper then shows how his approach could be applied to other modifiers, including adverbs and (the relevant part for our purposes) BNPA words, which, like attributive and predicative adjectives, have basically the same core meaning wherever they appear, but have radically different combinatorial semantics depending on how they are used. For instance, *place* always has the same basic meaning of "place," even though it functions as a direct object in *Search the place* and as an adverb in *live someplace*. The

basic, constant meaning is what Kasper (working within the HPSG framework) calls a sign's ICONT (mnemonic for *internal content*), while the ECONT (*external content*) carries the more specific meaning contribution that will depend on how the sign is used.

Kasper's characterization of BNPA nouns works well for the cases that he considers, i.e., those corresponding to the first two trees in (5). He does not, however, consider modification of BNPA nouns by adverbial relative clauses, such as those seen in (3). In this paper, I will explore how the BNPA facts that Larson and Kasper have written about might be described in a type-logical framework. Although this analysis will cover more ground than Kasper's, in that non-*wh* relative adverbial clauses will be considered, the basic proposals concerning them can be easily transported into the HPSG framework to form an extension to Kasper's analysis[3].

2   Encoding basic BNPA behavior

As stated in the introduction, the question is how to endow BNPA nouns with their special property at the lexical level and allow it to percolate up to the NP level. One way might be to assign a BNPA noun some feature value, which will then be inherited by its projections. Although this is not the strategy that will be taken here, a brief exploration of why it is less than optimal will help motivate the approach that will be taken.

Simple feature-passing can be handled in CG by means of what are known as dependent types, a kind of shorthand representation of categories that must share feature specification(s) with their arguments. An example of a dependent type is $\wedge n(NP(n)/N(n))$, for the determiner *the* (taken from Morrill (1994), p.173). The variable n is mnemonic for number; the way this type assignment works is that the n feature can be instantiated as singular or plural, and the number value for the NP must be that of the N. The rule that allows this instantiation is the $\wedge$E rule:

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[3] Actually, Whitman (1998) attempts to extend Kasper's treatment to cover these cases, but his proposal has a problem. Specifically, although it allows a BNPA noun to be used adverbially in a main clause, or as the head of a non-*wh* adverbial relative clause without preposition stranding, it does not allow both usages at once. For instance, *We had fun every place* would be licensed, as would the phrase *every place that we stayed,* but the sentence *We had fun every place that we stayed* would not.

(6)   (from Morrill (1994), p. 172)

         ⋮

         ⋮

      $\wedge vA$

    —————— $\wedge$E

  $A[v \leftarrow t]$

This says that $\wedge vA$ can be realized as something of category A, with any v's replaced by the value t. Thus, *the*: $\wedge n(NP(n)/N(n))$ could be instantiated as *the*: (NP(sg)/N(sg)) or as *the*: (NP(pl)/N(pl)). Where this becomes important is when *the* combines with a noun. If the noun is a plural one, for example, *dogs*: N(pl), then it can combine only with the (NP(pl)/N(pl)) version of *the,* to yield *the dogs*: NP(pl).

Suppose, then, that we call the feature that indicates whether a noun can become a bare-NP adverb head *adv,* with ordinary nouns having a (-) value for this feature, and BNPA nouns having (+). To allow nouns to pass this feature value up to the NP level, determiners would be specified thus: $\wedge adv(NP(adv)/N(adv))$. Attributive adjectives would be of category $\wedge adv(N(adv)/N(adv))$; relative clauses of category $\wedge adv(N(adv)\backslash N(adv))$.

Now consider the VP *stay every place*. The NP *every place* will be of type NP(*adv* +), but I have not said how an NP's having a (+) value for its *adv* feature actually translates into its behaving as an adverb. To combine with *stay,* the NP *every place* needs to be of type VP\VP; it is not sufficient to be of type NP(*adv* +). In order for an analysis using dependent types to work, then, I will need to have a rule like the following:

(7)   NP(*adv* +)
       ————————

       VP\VP

The same effect can be achieved, however, without having to stipulate an extra rule of inference like that in (7), by using the already defined logical inference rules for types with Boolean conjunction. It is these that will form the basis for my analysis. As presented in Morrill (1994), a conjunctive type is of form $A \wedge B$, with the following interpretation and rules of introduction and elimination:

(8)   (from Morrill (1994), p. 162)

$D(A \wedge B) = \{<s, <m1, m2>> \mid <s, m1> \in D(A) \wedge <s, m2> \in D(B)\}$,

where s is a prosodic form, and $m1$ and $m2$ are semantic terms.

(9)   (from Morrill (1994), p. 163)

$$
\begin{array}{ccccc}
\vdots & & \vdots & & \dfrac{\quad}{\Gamma \quad \Gamma}\,n \\
\vdots & & \vdots & & \vdots \quad \vdots \\
A \wedge B & & A \wedge B & & A \quad B \\
\dfrac{\quad}{A}\,\wedge Ea & & \dfrac{\quad}{B}\,\wedge Eb & & \dfrac{\quad}{A \wedge B}\,\wedge In
\end{array}
$$

The rule in (8) states that any element of category A∧B will be a string s, which has an ordered pair of meanings, $m1$ and $m2$, such that $m1$ is in the domain for type A, and $m2$ is in the domain for the type B. Another way to read this is that elements of type A ∧ B are in the intersection of the set of elements of type A, and elements of type B. The rules of elimination (∧Ea and ∧Eb) in (9) state that given an element of category A ∧ B, it can be considered an A or a B. The rule of introduction states that if the categories A and B can each be derived from the same sequence Γ, then Γ can be given category A ∧ B. Morrill uses such a type assignment for prepositions, giving them the type ((N\N) ∧ (VP\VP))/NP, indicating that after they take an NP argument, they can be both nominal modifiers (N\N), and adverbs (VP\VP).

A simple conjunctive type assignment would work well for the single-word bare-NP adverbs, such as *yesterday* or *here*, which could be assigned the category NP ∧ (VP\VP). For BNPA nouns, however, which form bare-NP adverbial phrases after combining with a determiner, the category assignment would be N ∧ Det\(VP\VP) – in other words, something that is a common noun (N), and also can combine with a determiner (Det) to form a verbal modifier (VP\VP).

The category for the specific BNPA noun *place*, then, will be N ∧ Det\(VP\VP), and the term will be an ordered pair. The first element of the ordered pair will correspond to the N category: **place'**. The second element will correspond to the Det\(VP\VP) category, with the meaning $\lambda \mathcal{D} \lambda Q \lambda y.\textbf{in'}(\mathcal{D}(\textbf{place'}))Q(y)$[4]. For illustration, the derivation of *We stayed every place* is shown below:

---

[4] Issues of quantifier scope will not be considered here.

(10) *we*   *stayed*   *every*   *place*
      NP: VP: NP/N: N ∧ Det\(VP\VP):
      we'   **stay'** $\lambda P.\textbf{every}(P)$ < **place'**,
                                                          $\lambda \mathcal{D}\lambda Q\lambda y.\textbf{in'}(\mathcal{D}(\textbf{place'}))Q(y)$ >
                                                          ────────────── ∧E
                                                          Det\(VP\VP):
                                                          $\lambda \mathcal{D}\lambda Q\lambda y.\textbf{in'}(\mathcal{D}(\textbf{place'}))Q(y)$
                                          ────────────────────────────────── \E
                      VP\VP: $\lambda Q\lambda y.\textbf{in'}(\textbf{every})(\textbf{place'})Q(y)$
                ── \E
           VP = NP\S: $\lambda y.\textbf{in'}(\textbf{every})(\textbf{place'})\textbf{stay'}(y)$
      ── \E
           S: **in'(every)(place')stay'(we')**

Notice that the category for the phrase *every place* in the above derivation is not the same as for a lexical BNPA. A lexical BNPA like *here* is of category NP ∧ (VP\VP), with two meaning packed into an ordered-pair semantic term, but in (10), the phrase *every place* is associated with only a single semantic term (i.e., the adverbial one). Of course, *every place* <u>is</u> ambiguous, between an NP and a VP\VP reading, but the ambiguity will turn up as two separate parses, not as a single parse with an ordered-pair semantic term for the phrase. The choice as to whether *place* will ultimately be part of an NP or a VP\VP has to be made at the ∧E step. For the sake of parallelism, it might be argued that *place* should be assigned the category Det\(NP ∧ (VP\VP)), so that after it combines with a determiner, it will have category NP ∧ (VP\VP), like a one-word BNPA. However, such a move causes trouble when modification of BNPA nouns is considered (as will be seen in the next section), and therefore N ∧ (Det\(VP\VP)) will remain as the chosen categorization for BNPA nouns.

3   Modification of BNPA nouns

3.1   The problem

My category assignment for BNPA nouns in their adverbal incarnation is Det\(VP\VP), which I will abbreviate as N-*bnpa*. Prenominal adjectives, of category N/N, will also need to be of category N-*bnpa*/N-*bnpa*, if they are ever to modify a BNPA noun that is used adverbially. Likewise, a postnominal modifier (for example, a prepositional phrase, or a longer adjective phrase, or a relative clause), usually of category N\N, will also have to belong to category N-*bnpa*\N-*bnpa*. This can be achieved in short order by simply

giving appropriate additional type assignments to adjective, prepositions, etc., but in the case of prenominal modifiers, it turns out that no additional type assignments are necessary, since N-*bnpa*/N-*bnpa* is derivable from N/N, as shown in (11):

(11)
$$
\begin{array}{ccccc}
\overline{\quad\quad\;\;2\quad\quad} & & \overline{\quad\;1\quad} & & \overline{\quad\quad\;\;3\quad\quad} \\
[(NP)/N] & N/N & [N] & & [Det\backslash(VP\backslash VP)]
\end{array}
$$

$$
\cline{} \quad N \qquad /E
$$

$$
\cfrac{}{\quad NP \quad} \;/E
$$

$$
\cfrac{}{\quad (NP)/N = Det \quad} \;/I1
$$

$$
\cfrac{}{\quad VP\backslash VP \quad} \;\backslash E
$$

$$
\cfrac{}{\quad (Det)\backslash(VP\backslash VP) = N\text{-}bnpa \quad} \;\backslash I2
$$

$$
\cfrac{}{\quad N\text{-}bnpa/N\text{-}bnpa \quad} \;/I3
$$

A derivation of a BNPA phrase with an adjective given this category is shown in (12), where $\mathcal{B}$ is a metavariable for elements of type N $\wedge$ N-*bnpa*:

(12)

every	*available*	*place*
Det/N:	N-*bnpa*/N-*bnpa*:	N $\wedge$ N-*bnpa*:
$\lambda P.\mathbf{every}(P)$	$\lambda\mathcal{B}\lambda\mathcal{D}.\mathcal{B}(\lambda P(\mathcal{D}$	$< \mathbf{place'}, \lambda\mathcal{D}''\lambda Q\lambda y$
	$(\mathbf{available'}(P))))$	$[\mathbf{in'}(\mathcal{D}\,''(\mathbf{place'}))Q(y)]>$

$$
\overline{\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad} \wedge E
$$

$$
\text{N-}bnpa:\; \lambda\mathcal{D}''\lambda Q\lambda y
$$
$$
[\mathbf{in'}(\mathcal{D}\,''(\mathbf{place'}))Q(y)]
$$

$$
\overline{\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad} \backslash E
$$

N-*bnpa* = Det\(VP\VP):

$\lambda\mathcal{B}\lambda\mathcal{D}(\mathcal{B}(\lambda P(\mathcal{D}(\mathbf{available'}(P))))(\lambda\mathcal{D}''\lambda Q\lambda y[\mathbf{in'}(\mathcal{D}\,'')(\mathbf{place'})Q(y)])$

$\Leftrightarrow \quad \lambda\mathcal{D}(\lambda\mathcal{D}''\lambda Q\lambda y[\mathbf{in'}(\mathcal{D}''(\mathbf{place'}))Q(y)])(\lambda P(\mathcal{D}(\mathbf{available'}(P))))$

$\Leftrightarrow \quad \lambda\mathcal{D}\lambda Q\lambda y[\mathbf{in'}(\lambda P(\mathcal{D}(\mathbf{available'}(P)))(\mathbf{place'}))Q(y)]$

$\Leftrightarrow \quad \lambda\mathcal{D}\lambda Q\lambda y[\mathbf{in'}(\mathcal{D}(\mathbf{available'}(\mathbf{place'})))Q(y)]$

$$
\overline{\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad} \backslash E
$$

VP\VP: $\lambda Q\lambda y[\mathbf{in'}(\mathbf{every}(\mathbf{available'}(\mathbf{place'})))Q(y)]$

However, there are signs that the category N-*bnpa*/N-*bnpa* is not what we ultimately want for doing the job of prenominal modification. First of all, the analogous category of N-*bnpa*\N-*bnpa* for postnominal modifiers is not derivable from N\N[5] (proof given in Appendix), and would therefore have to be built into the lexical category assignments (for example, (N-*bnpa*\N-*bnpa*)/NP for prepositions). Given the close relationship between many prenominal and postnominal modifiers (in particular, the pre- and postnominal positioning of English adjectives without and with complements, respectively), a more uniform solution should be preferred.

Second, as with the derivation for *every place*, the ambiguity between the NP and VP\VP readings of this phrase will show up as two separate parses, not as a pair of semantic terms in a single parse. This state of affairs is not terribly expensive when all we are concerned with is determiners, but when adjectives enter the picture, the cost increases. If *every place* were parsed with a chart parser, there would be two edges spanning *every* and *place*, one with category NP, and the other with VP\VP. Likewise, for *available place*, there would be two edges, labeled N and N-*bnpa*. But there can be in theory any number of adjectives, and for a BNPA noun preceded by a sequence of *n* adjectives, there will be 2*n* edges spanning the various adjectives in the sequence and the cumulative noun category to their right. For example, for the phrase *available smoke-free place,* there would be two edges spanning *smoke-free* and *place,* and two edges spanning *available* and *smoke-free place.*

Finally, we have an extension of a problem raised by Sadler and Arnold (1994), and elaborated by Kasper (1998) in motivating his system for recursive modification. As Kasper points out, in a phrase like *apparently available,* it is unknown whether *available* is predicative or attributive. Therefore, *apparently* as an adjectival modifier will have to have two lexical specifications, one that takes a predicative adjective as an argument, and one that takes an attributive. In type-logical terms, *apparently* would have to be assigned to both Adj/Adj and (N/N)/(N/N) categories, where Adj is the atomic category given to predicative adjectives. This system becomes even more complicated in the case of a phrase like *apparently permanently available.* Here, *permanently* would have categories Adj/Adj and (N/N)/(N/N), and since *apparently* takes *permanently* as its argument, *apparently* will also have to be assigned to the categories (Adj/Adj)/(Adj/Adj) and ((N/N)/(N/N))/((N/N)/(N/N)). Since the depth of this recursive modification is theoretically unbounded, adverbs will have to be assigned to an infinite number of categories. In our case, the extension of this problem is that adjectives would now have a

---

[5] At least, not without having Associativity as a structural rule in our calculus.

third category, N-*bnpa*/N-*bnpa*, in addition to the other two, resulting in a corresponding multiplication of categories for adverbs that modify them. If only for the convenience of grammar writers, it would be more desirable to have some means of allowing modifiers of adjectives and adverbs to be underspecified for what kind of adjectival or adverbial arguments they take, and to pass on whatever categorial ambiguity there is.

3.2   Solution: the © variable

3.2.1   Definition

In fact, there is already one method of underspecifying a set of categories. Specifically, since Ades and Steedman (1982), $A\$$ has been used to represent any category from the set $\{A, X \rightarrow A, X \rightarrow Y \rightarrow A, \ldots\}$, that is, any category which becomes category A after all its arguments have been supplied. I propose a variable similar to the $\$$ variable: ©. $A©$ will represent any category from the set $\{A, A \wedge B, A \wedge B \wedge C, \ldots\}$. A formal definition of this variable is given in (13):

(13)   Definition of the © variable

$$A©0 = A$$

$$A©1 = \bigvee_{X \in \mathcal{I}} (A \wedge X)$$

$$A©2 = \bigvee_{Xi \in \mathcal{I}} (A \wedge X1 \wedge X2)$$

$$A©n = \bigvee_{X \in \mathcal{I}} (A \wedge X1 \wedge \ldots \wedge Xn)$$

$$A© = \bigvee_{i=0}^{\infty} A©i$$

With this variable defined, attributive adjectives can be assigned the category N©/N© instead of N/N; appropriate adjustments to lexical items such as prepositions and relative pronouns will yield the category N©\N© for (most) postnominal modifiers. If N© is instantiated as N ∧ N-*bnpa,* then attributive adjectives can modify BNPA nouns while preserving the categorial ambiguity between N and N-*bnpa.* And for the general problem of modification of attributive and predicative adjectives, since adjectives are of category Adj ∧ N©/N©, adverbs that modify them can be assigned the category Adj©/Adj©.

The semantics for adjectives of category Adj ∧ N©/N© (and adverbs of category Adj©/Adj©) remains to be spelled out. I will consider adjectives first, via the specific case of *available place*. As an N ∧ N-*bnpa,,* this phrase would have the meaning < **available'(place')**, $\lambda\mathcal{D}$ $\lambda Q\lambda y$[**in'**($\mathcal{D}$ (**available'(place')**))$Q(y)$]>. The following semantic term assigned to the attributive (N©/N©) version of *available* would yield this ordered-pair semantics when applied to the term for *place*: λw< **available'**($\pi 1 w$), $\pi 2 w$[$\pi 1 w \rightarrow$ **available'**($\pi 1 w$)], ...>. In other words, the meaning **available'** is applied to the argument element that is of category N (i.e., $\pi 1 w$), while all other elements (in this case, only $\pi 2 w$) are unchanged except for the replacement of any instances of $\pi 1 w$ with **available'**($\pi 1 w$). The predicative (Adj) term would be simply **available'**. Putting together predicative and attributive terms for *available*, we get the ordered-pair term: < **available'**, λw< **available'**($\pi 1 w$), $\pi 2 w$[$\pi 1 w \rightarrow$ **available'**($\pi 1 w$)], ...>>.

Now consider the adjective phrase *apparently available*. With the term for *available* as given above, the term for *apparently available* would be: < **apparent'(available')**, λw<**apparent'(available')**($\pi 1 w$), $\pi 2 w$[$\pi 1 w \rightarrow$ **apparent'(available')** ($\pi 1 w$)], ...>>. The semantics for *apparently* would then be λv< **apparent'**($\pi 1 v$), $\pi 2 v$[$\pi 1 v \rightarrow$ **apparent'**($\pi 1 v$)], ...>; that is, the meaning **apparent'** would apply to the first term for *available* ($\pi 1 v$ = **available'**), while the other terms (in this case, only $\pi 2 v$) are copied over, replacing **available'** with **apparent'(available')**. The derivation of *apparently available place* in (14) illustrates the mechanics of both N©/N© and Adj©/Adj©.

(14)   Derivation of *apparently available place* with © variable

PART A:

apparently   *available*

Adj©/Adj©:   Adj ∧ N©/N©:

λv< **apparent'**$(\pi 1 v)$,   < **available'**, λw< **available'**$(\pi 1 w)$,

$\pi 2v[\pi 1v \rightarrow$ **apparent'**$(\pi 1 v)]$, …> $\pi 2w[\pi 1w \rightarrow$ **available'**$(\pi 1 w)]$, …>>

—————————— © instantiation

(Adj ∧ N©/N©)/(Adj ∧ N©/N©):

λv< **apparent'**$(\pi 1 v)$,

$\pi 2v[\pi 1v \rightarrow$ **apparent'**$(\pi 1 v)]$>

——————————————————————————————————————/E

Adj ∧ N©/N©:   < **apparent'(available')**,

                      λw<**apparent'(available')**$(\pi 1 w)$,

                           $\pi 2w[\pi 1w \rightarrow$ **apparent'(available')** $(\pi 1 w)]$, …>>

——————— ∧E

N©/N©: λw< **apparent'(available')**$(\pi 1 w)$,

                    $\pi 2w[\pi 1w \rightarrow$ **apparent'(available')** $(\pi 1 w)]$, …>

———————————————————————————————— © instantiation

(N ∧ N-*bnpa*)/(N ∧ N-*bnpa*): λw< **apparent'(available')**$(\pi 1 w)$,

                         $\pi 2w[\pi 1w \rightarrow$ **apparent'(available')** $(\pi 1 w)]$ >

PART B:

apparently available   *place*

(N ∧ N-*bnpa*)/(N ∧ N-*bnpa*):   N ∧ N-*bnpa*:

λw< **apparent'(available')**$(\pi 1 w)$,   < **place'**, $\lambda \mathcal{D} \lambda Q \lambda y.$ **in'**

$\pi 2w[\pi 1w \rightarrow$ **apparent'(available')** $(\pi 1 w)]$ > $(\mathcal{D}(\textbf{place'}))Q(y)$ >

——/E

N ∧ N-*bnpa*:   < **apparent'(available')(place')**,

             $\lambda \mathcal{D} \lambda Q \lambda y.$**in'**$(\mathcal{D}(\textbf{apparent'(available')(place')}))Q(y)$ >

3.2.2   Other thoughts

The © variable, then, allows a succinct characterization of modification of BNPA nouns by adjective and prepositional phrases and (most) relative clauses, and further, provides a CG analog of Kasper's HPSG treatment of recursive modification in general.   Also, it can now be seen why choosing Det\(NP ∧ VP\VP) for the category for BNPA nouns would have caused trouble when modification was considered.   Under the analysis

presented here, BNPA nouns can be modified only by virtue of their N $\wedge$ N-*bnpa* categorization, which is a possible realization of N©. The category Det\(NP $\wedge$ VP\VP) does not fit this description.

However, an assumption that was made in the presentation of the © variable needs to be made explicit. Specifically, it has been assumed that in the tuple assigned to a lexical item belonging to a conjunctive category, all the elements share a core meaning, which can be written as the first element; for example, general template for an attributive adjectives (N©/N©) would have the semantics $\lambda w < \alpha(\pi 1w)$, $\pi 2w[\pi 1w \rightarrow \alpha(\pi 1w)]$, ...>, which assumes that if any other categories than N are associated with the noun modified by the adjective, the corresponding terms will contain as a subterm the term associated with the N. In other words, $\pi 2w$ and $\pi 3w$ and $\pi 4w$, etc., will all contain at least one instance of $\pi 1w$, which can be replaced by $\alpha(\pi 1w)$. Considering whether this sharing of a core meaning is generally true for conjoined types brings up the question of exactly how much meaning two words or phrases must share in order to be combined under one lexical entry.

Bayer (1996) addresses this issue. He reminds the reader that Morrill (1994) actually defines two kinds of conjunctive constructor, semantically active and semantically inactive. For the former, the component terms of the tuple need not share a core meaning; for the latter, the word's meaning must be the same, regardless of the category (and as a consequence, the conjoined categories must all have the same semantic type). Bayer's stance is that semantically inactive conjunction conforms best to the linguistic evidence; after all, if semantically active conjunction is allowed, one can write a single lexical entry for *can* as a transitive verb and a modal auxiliary, thus licensing sentences like this one from Pullum and Zwicky (1986):

(15)   *I can tuna for a living and get a job if I want.

The above example notwithstanding, Morrill does have a good reason for wanting semantically active conjunction: to allow lexical entries to capture (for example) the adnominal and adverbial uses of prepositions, which have intuitively a single meaning, but must formally have two meanings. The assumption that has been made here of a shared core meaning strikes a middle ground: semantically semi-active conjunction, as it were. It will trivially cover semantically inactive conjunction, and will also allow for the cases that Morrill wanted to include.

One final point about semantically semi-active bears discussion. It may seem that I am demanding that the ∧ type constructor be noncommutative, since it relies crucially on the difference between $\pi1\alpha$ and other elements in the semantic tuple. However, this is actually not the case. The only requirement being made is that the elements CAN be written such that the core meaning appears as $\pi1\alpha$, not that it must.

4   BNPA nouns modified by non-*wh* relative clauses

4.1   The problem

Now that the general ideas about modification of BNPAs have been covered, I turn to modification by non-*wh* relative clauses (RCs) in particular. Unlike *wh*- RCs, where the relative pronoun can be assigned a category like (N©\N©)/(S/NP)[6], in non-*wh* RCs there is no easy place to install the semantic machinery that changes a clause into a nominal modifier. Indeed, in RCs not introduced by a relative pronoun, there is no place at all! And even in RCs introduced by *that*, we would not want to treat *that* just like a *wh*-pronoun, although this is often done in simple illustrations, because of the trouble we encounter when adverbial *that* RCs are considered. For example, in a phrase like *place that we stayed*, we would need *that* to have a category like (N-*bnpa*\N©)/S, or possibly (N-*bnpa*\N©)/(S/(VP\VP)) if we consider there to be an adverbial gap. If we were to write such an entry for *that*, though, we would need to include prepositional information in the semantic term: **in'** for locative and temporal adverbials; something else for manner adverbials. In other words, we would actually have to write several more entries for *that*, thus duplicating the information supplied by individual BNPA nouns and missing the generalization that we have been trying to capture all along. In the following section, an analysis will be developed that covers non-*wh* RCs, both adverbial and nonadverbial, for BNPA nouns and ordinary nouns alike.

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[6] Actually, this category as given would allow only for right-peripheral extraction. To allow for nonperipheral extraction as well, a category like (N©\N©)/(S/ΔNP), where a category tagged with Δ has access to a commutative modality. For simplicity, however, I will not show the Δ in my notations.

4.2   The solution: background and basic idea

The proposed solution requires some background discussion and motivation, which will take up sections 4.2.1 and 4.2.2, with the basic proposal laid out in 4.2.3, and the details in 4.2.4.

4.2.1   Non-*wh* relative clauses: a natural class

The first thing to note is that non-*wh* RCs, introduced by *that* or by no relativizer at all, form a natural class.   First of all, unlike *wh*- relative pronouns, *that* and the null relativizer are used exclusively for restrictive RCs.   Furthermore, unlike *wh*- relative adverbs (such as *where* and *when*), *that* and the null relativizer can head adverbial RCs only when it is a BNPA noun that is being modified, as was seen in (3). Given this unity, we can think of non-*wh* RCs as clauses preceded by an optional *that*. If *that* is optional, having the same semantic effect whether or not it is present, the most logical semantics to assign it is the identity function: $\lambda X.X$.

4.2.2   Relativizer *that* and complementizer *that*

There is, of course, another *that* which is optional, and which contributes no meaning to phrases that contain it: the complementizer *that*. Since complementizer and relativizer *that* have the same phonology and the same meaning, the default assumption would be that they are the same lexical item. In fact, this is not a new proposal. In a survey of a century's worth of literature on this hypothesis, Van der Auwera (1985) credits Jespersen with first expressing it, in an 1885 grammar textbook. Van der Auwera presents 24 arguments for the unity of "R(elativizer)-*that*" and "C(omplementizer)-*that*" that he has found in the literature, including those mentioned here and in 4.2.1. Van der Auwera himself, however, does not believe these arguments, and sets about refuting them. Some of the arguments that he refutes truly are weak, but others deserve comment.

I cited the optionality of R-*that* and C-*that* as a reason for merging them. This argument appears in van der Auwera's synthesis, as Argument 11: "Both R-*that* and C-*that* are deletable; if we say that they are the same, we arrive at a generalization" (p. 159). Van der Auwera argues quite logically against the argument as just stated: an RC with no relativizer could just as easily have deleted a *wh*-pronoun as a *that*; furthermore, the conditions for deleting R-*that* are completely different from the conditions for deleting C-*that*. However, in my analysis there will be no appeal to underlying structure, and hence no deletion, so this refutation loses much of its basis.

Diachronic evidence is the basis of Argument 15 in the survey: earlier in the history of English, *that* seems to have been only a complementizer (p. 162). For specifics on this line of argumentation, Allen (1977, 102-105) is recommended. Van der Auwera's response to the diachronic argument is the same as mine: accepting that complementizer *that* can introduce RCs in OE does not necessarily mean that it can still do so in Modern English. However, as corroborative evidence, it does show that unity of R-*that* and C-*that* is not such an improbable idea.

In response to the facts about *that* when it introduces adverbial RCs for BNPA nouns, Van der Auwera makes his own proposal for keeping R-*that* and C-*that* distinct, but it is rather informal, and explicitly allows non-BNPA nouns to be modified by prepositionless *that* RCs every now and then. He offers the sentences in (16) as evidence of non-BNPA nouns being modified in this way:

(16)   (from van der Auwera (1985), (77), (80), (29))
      a. This is the reason that/why/for which I did it.
      b. I saw Fred in the street that/where/in which John lived.
      c. We parted in the same cordial fashion that we had met.

Of these sentences, however, (16.b) and (16.c) are just instances of antecedent-contained deletion: the missing preposition *in* is present elsewhere in the sentence. Substitute another preposition, and the sentences are bad once again, as in **I saw Fred near the street that John lived.* Van der Auwera is correct, however, that (16.a) is a clear case of a non-BNPA noun being modified by a prepositionless adverbial *that* RC. But *reason* is the only word I know of that allows this, and on the whole it seems preferable to say something specific about *reason* (which I will do in section 4.6) than to have the massive overgeneration with all the other nouns that van der Auwera's proposal will allow.

Having identified R-*that* with C-*that*, I will adopt Morrill's (1994) treatment of C-*that* and extend it to cover R-*that*. In Morrill's analysis, complementized sentences are of category CP, and thus *that* is given category CP/S. To capture this fact, Morrill makes use of disjunctive types, the dual of the conjunctive types. The rules of introduction are presented below:

(17)   (from Morrill (1994), p. 168)

$$
\begin{array}{cc}
\vdots & \vdots \\
A & B \\
\hline \quad \lor Ia & \hline \quad \lor Ib \\
A \lor B & A \lor B
\end{array}
$$

A verb like *say* or *believe* would be assigned category VP/(CP $\lor$ S). If it is followed by a CP, for example, *that Robin is a spy*, the $\lor Ib$ rule can derive a CP $\lor$ S, which can then combine with the verb. Similarly, if the verb is followed by an S (*Robin is a spy*), the $\lor Ia$ rule can derive the CP $\lor$ S. As for the semantics, Morrill assumes that both CP and S are type-mapped into the same set of semantic objects – in other words, $T(CP \lor S) = T(CP) = T(S)$, where $T(A)$ is the set of semantic terms of the category A. The semantic part of the rules for disjunctive types is in general more complex than for conjunctive types, but in cases like this, when the meaning is the same for both disjuncts (or in Morrill's words, when we have semantically inactive disjunction), nothing special need be said.

Turning to RCs, nonadverbial RCs introduced by *that* would be of category CP/NP. That is, the CP/S (*that*) would combine with the S/NP (for example, *we found*) via Function Composition to yield a CP/NP (*that we found*). Those without a relativizer would simply be S/NP. As for the category for adverbial RCs, there is room for discussion. In a phrase like *place that we believe Elvis slept*, the adverbial RC *that Elvis slept* could be considered a CP, or it could be considered a CP/(VP\VP), depending on the grammar-writer's beliefs about adjunct extraction. The stance taken here will be that adverbial RCs do have an extracted adverb, and so their category will be taken to be CP/(VP\VP). (For evidence of the syntactic unity between adverbial extraction and subject and object extraction, see Hukari and Levine (1995).) The CP/S would combine with an S/(VP\VP) via Function Composition, resulting in a CP/(VP\VP). Adverbial RCs with no relativizer would have the category S/(VP\VP)

4.2.3   Non-*wh* relative clauses as complements

So far, it has been determined that non-*wh* RCs will be of category CP/NP or S/NP (for the nonadverbial RCs); or CP/(VP\VP) or S/(VP\VP) (for the adverbials RCs). In other words, the question of how to acquire the category N©\N© (or N-*bnpa*\N-*bnpa*) for non-*wh* RCs has been sidestepped: they will not have that category at all. The question now is how these RCs will be connected with the nouns they modify.

The answer is that they will be connected in the same way that the CP or S *(that) Robin is a spy* was connected to *believe* in the previous example: they will be selected as complements. For example, if *book* takes a complement of category (CP ∨ S)/NP, the meaning will be the same whether the complement is *I read* or *that I read.* Or in the case of a BNPA noun, if *place* takes a complement of category (CP ∨ S)/(VP\VP), the meaning will be the same whether the complement is *Elvis slept* or *that Elvis slept.*

There is actually some independent motivation for having non-*wh* RCs (actually, restrictive RCs in general) as complements instead of adjuncts. As McCawley (1988) notes, "One serious problem for an analysis of restrictive clauses as adjuncts to N-[bar]s is that they can appear in combination with words such as *someone, anything, nobody,* and *who* that appear to be not N-[bar]s but whole NPs" (p. 423). Alone, this problem might not be enough to show that all *that* RCs are complements instead of adjuncts, but taken in conjunction with the evidence from BNPA nouns, the case for *that* RCs as complements becomes much stronger. In the next section, I will lay out the lexical rules to accomplish this.

Before doing so, however, one obstacle to the unified analysis of non-*wh* RCs should be addressed. Specifically, I have no way of ruling out subject extraction in RCs without a relativizer, as in **There was a farmer had a dog.* I do not have an explanation for this fact. I will observe that sentences like *There was a farmer had a dog* are understood by most speakers, and are even grammatical in certain dialects (and in the occasional folksong). It may be that there are problems in processing *that*-less subject RCs, especially when they appear in contexts other than following expletive *there.* For example, *A farmer had a dog came to town* is much more difficult to get than **There was a farmer had a dog.* Bolinger (1972) writes, "… it appears that the reason why *that* as a subject cannot normally be omitted is not because it is a subject but because without it the constituents are too hard to identify," and to support this conclusion offers nonsubject RCs where omission of *that* is grammatically questionable. The most interesting examples involve sentential adverbs; when the adverb comes before the verb, omission of the *that* creates such a severe garden-path effect as to make the sentence ungrammatical, as seen in *The oranges (*generally) he ate were navels.* Therefore, I suspect that this problem is not really a big one for the analysis here. However, the worst-case scenario is that RCs introduced by *that* and RCs with no relativizer will have to be handled separately. All this means is that every lexical rule I write that involves CP ∨ S, I will have to split into two or more rules. One of them will involve CPs, while the other(s) will involve Ss, encoding somehow the constraint against subject extraction. The claim that non-*wh* RCs need to be taken as complements, though, will not be affected.

4.3   The solution: mechanics

4.3.1   Adverbial relative clauses

I will begin with BNPA nouns, positing a rule that allows them to take an adverbial non-*wh* RC as an argument. In this and other rules, **prep** stands for whatever prepositional relation appears in the BNPA noun's lexical semantics.

(18)   Adverbial RC addition lexical rule for BNPA nouns

$$N \wedge \text{N-}bnpa: \quad <\pi 1\alpha, \pi 2\alpha> \Rightarrow$$

$$(N \wedge \text{N-}bnpa)/((CP \vee S)/(VP\backslash VP)): \quad \lambda S<\lambda x[S\ (\textbf{prep}\ (x))\ \&\ \pi 1\alpha(x)],$$
$$\pi 2\alpha[\pi 1\alpha \rightarrow \lambda x[S\ (\textbf{prep}\ (x))\ \&\ \pi 1\alpha(x)]]>$$

For *place*, $\pi 1\alpha$ is **place'**; $\pi 2\alpha$ is $\lambda \mathcal{D}\lambda Q\lambda y.\textbf{in'}(\mathcal{D}\ (\textbf{place'}))Q(y)$; the output lexical entry for (18) is therefore $\lambda S< \lambda x[S(\textbf{in'}(x))\ \&\ \textbf{place'}(x)], \lambda \mathcal{D}\lambda Q\lambda y.\textbf{in'}$
$(\mathcal{D}(\lambda x[S\ (\textbf{in'}(x))\ \&\ \textbf{place'}(x)]))Q(y) >$. A derivation of *place (that) we stayed* is shown in (19), where it can be seen that the phrase has the conjunctive type $N \wedge \text{N-}bnpa$, as desired. The step labeled with an asterisk would be omitted if *that* did not appear. Also, the line labeled $\vee I$ would be more specifically labeled $\vee Ia$ or $\vee Ib$, depending on whether $CP \vee S$ is being derived from a CP or an S.

(19)   Derivation of *place (that) we stayed*

```
place                                (that)        we       stayed           ——————1
(N ∧ N-bnpa)/            CP/S:        NP:      VP:        [VP\VP]:
((CP ∨ S)/(VP\VP)):      λX.X         we'      stay'         α
λS< λx[S (in'(x)) & place'(x)],                          ———————————————\E
λ𝒟λQλy.in'( 𝒟(λx[S (in'(x))                      VP: α stay'
        & place'(x)]))Q(y) >                    ———————————————\E
                                                  S: α stay'(we')
                          ———————————————————————————————————————/E*
                                              CP: α stay'(we')
                          ———————————————————————————————————————∨I
                                            CP ∨ S: α stay'(we')
                          ———————————————————————————————————————/I1
                                    (CP ∨ S)/(VP\VP): λα.αstay'(we')
——————————————————————————————————————————————————————————————————/E
        N ∧ N-bnpa: < λx[in'(x)stay'(we') & place'(x)],
                        λ𝒟λQλy.in'( 𝒟(λx[S (in'(x)) & place'(x)]))Q(y) >
```

4.3.2   Nonadverbial relative clauses

The analog of rule (18) to allow for nonadverbial non-*wh* RCs as arguments to BNPA nouns would be as shown in (20):

(20)   Nonadverbial RC addition lexical rule for BNPA nouns

$N \wedge N\text{-}bnpa$: $\alpha \Rightarrow (N \wedge N\text{-}bnpa)/((CP \vee S)/NP)$:
$$\lambda P < \lambda x[P(x) \ \& \ \pi 1\alpha(x)], \ \pi 2\alpha[\pi 1\alpha \rightarrow \lambda x[P(x) \ \& \ \pi 1\alpha(x)]]>$$

Inputting *place* to rule (20), we would obtain the output $\lambda P < \lambda x[P(x) \ \& \ \mathbf{place'}(x)]$, $\lambda \mathcal{D}\lambda Q\lambda y.\mathbf{in'}(\mathcal{D}(\lambda x[P(x) \ \& \ \mathbf{place'}(x)]))Q(y) >$. A derivation for *place (that) we found* is shown in (21). As with the derivation in the previous section, the step labeled with an asterisk would be omitted in the absence of *that*.

(21)   Derivation of *place (that) we found*

place		*(that)*	*we*	*found*		
$(N \wedge N\text{-}bnpa)/$		CP/S:	NP:	VP/NP:	$[NP]$:	1
$((CP \vee S)/NP)$:		$\lambda X.X$	$\mathbf{we'}$	$\mathbf{find'}$	x	

$\lambda P < \lambda x[P(x) \ \& \ \mathbf{place'}(x)]$,
$\lambda \mathcal{D}\lambda Q\lambda y.\mathbf{in'}(\mathcal{D}(\lambda x[P(x) \ \&$
$\qquad \mathbf{place'}(x)]))Q(y) >$

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ —————— /E

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ VP: $\mathbf{find'}(x)$

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ \E

$\qquad\qquad\qquad\qquad\qquad\qquad$ S: $\mathbf{find'}(x)(\mathbf{we'})$

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ /E*

$\qquad\qquad\qquad\qquad\qquad\qquad$ CP: $\mathbf{find'}(x)(\mathbf{we'})$

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ ∨I

$\qquad\qquad\qquad\qquad\qquad\qquad$ $CP \vee S$: $\mathbf{find'}(x)(\mathbf{we'})$

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ /I1

$\qquad\qquad\qquad\qquad\qquad$ $(CP \vee S)/NP$: $\lambda x.\mathbf{find'}(x)(\mathbf{we'})$

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ /E

$N \wedge N\text{-}bnpa$: $< \lambda x[\mathbf{find'}(x)(\mathbf{we'}) \ \& \ \mathbf{place'}(x)]$,
$\qquad\qquad \lambda \mathcal{D}\lambda Q\lambda y.\mathbf{in'}(\mathcal{D}(\lambda x[\mathbf{find'}(x)(\mathbf{we'}) \ \& \ \mathbf{place'}(x)]))Q(y) >$

The corresponding lexical rule for ordinary nouns would be as follows:

(22)   Nonadverbial RC addition lexical rule for ordinary nouns

N: $\alpha \Rightarrow N/((CP \vee S)/NP)$: $\lambda P\lambda x[P(x) \ \& \ \alpha(x)]$

These two rules have not been written as a single rule because they take different input types. Still, since they do essentially the same thing, finding a way to combine them should be done in the interest of capturing a generalization. Another reason to combine these rules is that they may even generate spurious ambiguity with BNPA nouns. Consider the phrase *the place we found.* Rule (21) would be the appropriate one here, taking *place,* of category N ∧ N-*bnpa*, and returning something of category (N ∧ N-*bnpa*)/((CP ∨ S)/NP) to allow for the *we found* RC. However, if lexical rules are considered to be part of the rules of inference for a grammar (instead of simply expressing relations that hold among lexical items), then (22) could produce the same result as (21). Specifically, ∧E would take *place* from type N ∧ N-*bnpa* to N, and (22) could then operate.

I have already introduced the device that will allow us to combine rules (21) and (22): the variable ©. Using ©, the syntactic portion of the combined (21) and (23) would be:

(24)   Nonadverbial RC addition lexical rule for all nouns (preliminary)
       N© ⇒ N©/((CP ∨ S)/NP)

The question now is how to specify the semantic portion of this rule. First, my assumption of semantically semi-active type conjunction should be recalled. That is, given a word of category A ∧ B ∧ … and meaning $< \pi 1\alpha, \pi 2\alpha, … >$, there will be a shared core meaning in all the list elements. That core meaning will be $\pi 1\alpha$, which will appear as a subterm somewhere in $\pi 2\alpha$ and each other element in the list. A rule can now be formulated for how lexical rules are to be interpreted when they take an argument with a conjunctive type.

(25)   **Convention for lexical rules involving conjunctive types**
       Given a lexical rule R that operates on words of type A ∧ B ∧ … ,
       and given a word of type A ∧ B, with meaning $< \pi 1\alpha, \pi 2\alpha, … >$,
       the input to R will be $\pi 1\alpha$; the output of R will be known as $r(\pi 1\alpha)$;
       and the meaning of the newly generated word will be
       $\lambda x1 … \lambda xn < r(\pi 1\alpha), \pi 2\alpha[\pi 1\alpha \rightarrow r(\pi 1\alpha)], … >$,
              where $x1 … xn$ are any variables free in $r(\pi 1\alpha)$.

With this convention stated, the nonadverbial RC addition rule with semantics included can now be written:

(26)   Nonadverbial RC addition lexical rule for all nouns
        N©: $\alpha \Rightarrow$ N©/(((CP $\vee$ S)/NP): $\lambda x[P(x) \& \alpha(x)]$

With *place*, © will be $\wedge$ N-*bnpa*; the input will be $\pi 1\alpha$, **place'**, following the convention since *place* has a conjunctive type. $r(\pi 1\alpha)$ will then be $\lambda x[P(x) \& $ **place'**$(x)]$. Once the new variable, *P*, is abstracted, the semantics of the RC-taking version of *place* will then be (N $\wedge$ N-*bnpa*)/(((CP $\vee$ S)/NP): $\lambda P < \lambda x[P(x) \& $ **place'**$(x)]$, $\lambda \mathcal{Q}\lambda Q\lambda y[$**in'**$(\mathcal{Q}(\lambda x[P(x) \& $ **place'**$(x)]))Q(y)] >$, the meaning seen in the earlier derivations.

This concludes my discussion of non-*wh* RCs, both nonadverbial and adverbial, for BNPA nouns and ordinary nouns. In the remaining parts of section 4, I will extend the analysis to infinitival RCs, and consider the lexical item *reason*, which acts like a BNPA noun with respect to RCs, but not otherwise.

4.4   Infinitival relative clauses

Infinitival RCs are particularly suited to the approach developed in the previous sections, since most infinitival RCs are not introduced by a relativizer (the exceptions being *wh*-RCs with pied piping, such as *topic about which to write*, about which I will have nothing to say). I will take the RC addition lexical rules of the previous section as the starting point for this one. Although the focus of this paper is BNPA nouns, it will be convenient to begin with the lexical rules for ordinary nouns, and then extend from there to the BNPA nouns. Starting with ordinary nouns entails starting with nonadverbial RCs, which is therefore the topic in section 4.4.1.

4.4.1   Nonadverbial infinitival relative clauses

Recall the nonadverbial RC addition lexical rule for ordinary nouns from section 4.4:

(27)   Nonadverbial RC addition lexical rule for ordinary nouns
        N: $\alpha \Rightarrow$ N/(((CP $\vee$ S)/NP): $\lambda P\lambda x[P(x) \& \alpha(x)]$

For maximum generality, it would be nice if this rule could account for both infinitival and finite RCs as it is written. This, however, is not to be. If we consider *for* to be a complementizer, then, for example, *for Kim to read* would be a CP/NP, which would work. But then *Kim to read* would be an S/NP, and a phrase like **a book Kim to read* would be licensed. Therefore, the infinitival version of the above rule will be written as two rules:

(28)   Nonadverbial infinitival RC addition lexical rules for ordinary nouns

    a.   With *for* complementizer

          N: $\alpha \Rightarrow$ N/(CP*inf*/NP): $\lambda P \lambda x[P(x) \;\&\; \alpha(x)]$

    b.   Without *for* complementizer

          N: $\alpha \Rightarrow$ N/(VP*inf*/NP): $\lambda R \lambda x[\exists y R(x)(y) \;\&\; \alpha(x)]$

Here I will assume that *for* is in fact a complementizer, with meaning $\lambda X.X$. I take *to* to be of category VP*inf*/VP, with meaning $\lambda P \lambda x[\lozenge P(x)]$. The $\lozenge$ is the modal operator for possibility, indicating that the action in an infinitive does not necessarily take place. The lexical entries are summarized in (29):

(29)   *for* – CP*inf*/S*inf*: $\lambda X.X$

      to – VP*inf*/VP: $\lambda P \lambda x[\lozenge P(x)]$

Derivations for *book for Kim to read* and *book to read* are shown in (30) and (31). For ease of readability, the *inf* subscripts are omitted from the categories.

(30)   Derivation of *book for Kim to read*

book	for	Kim	to		read		1
N/(CP/NP):	CP/S:	NP:	VP/VP:		VP/NP:		NP:
$\lambda P \lambda x[P(x) \;\&\;$	$\lambda X.X$	**kim**	$\lambda P \lambda x[\lozenge P(x)]$		**read'**		y
book'$(x)]$							

$$\text{VP: } \textbf{read'}(y) \qquad\qquad /E$$

$$\text{VP: } \lambda x[\lozenge\textbf{read'}(y)(x)] \qquad\qquad /E$$

$$\text{S: } \lozenge\textbf{read'}(y)(\textbf{kim}) \qquad\qquad \backslash E$$

$$\text{CP: } \lozenge\textbf{read'}(y)(\textbf{kim}) \qquad\qquad /E$$

$$\text{CP/NP: } : \lambda z[\lozenge\textbf{read'}(z)(\textbf{kim})] \qquad\qquad /I1$$

$$\text{N: } \lambda x[\lozenge\textbf{read'}(x)(\textbf{kim}) \;\&\; \textbf{book'}(x)] \qquad\qquad /E$$

(31)   Derivation of *book to read*

$$
\begin{array}{lll}
\textit{book} & \textit{to} & \textit{read} \quad \rule{1cm}{0.4pt}\,1 \\[4pt]
\text{N/(VP/NP):} & \text{VP/VP:} & \text{VP/NP:} \qquad \text{NP:} \\[4pt]
\lambda R\lambda x[\exists y R(x)(y) & \lambda P\lambda x[\Diamond P(x)] & \textbf{read'} \qquad\quad y \\
\quad\&\ \textbf{book'}\ (x)] & & \rule{4cm}{0.4pt}\, \text{D}
\end{array}
$$

$$\text{VP:}\ \ \lambda x[\Diamond\textbf{read'}(y)(x)]$$
$$\rule{5cm}{0.4pt}\,/\text{I}1$$
$$\text{VP/NP:}\ \ \lambda z\lambda x[\Diamond\textbf{read'}(z)(x)]$$
$$\rule{5cm}{0.4pt}\,/\text{E}$$
$$\text{N:}\ \ \lambda x[\exists y\,\Diamond\textbf{read'}(x)(y)\ \&\ \textbf{book'}(x)]$$

Moving on to BNPA nouns, the corresponding lexical rules would be:

(32)   Nonadverbial infinitival RC addition lexical rule for BNPA nouns
    a.   With *for* complementizer

$$\text{N} \wedge \text{N-}\textit{bnpa}:\ \alpha \Rightarrow (\text{N} \wedge \text{N-}\textit{bnpa})/(\text{CP}\textit{inf}/\text{NP}):$$
$$\lambda P{<}\lambda x[P(x)\ \&\ \pi 1\alpha(x)],\ \pi 2\alpha[\pi 1\alpha \rightarrow \lambda x[P(x)\ \&\ \pi 1\alpha(x)]]{>}$$

    b.   Without *for* complementizer

$$\text{N} \wedge \text{N-}\textit{bnpa}:\ \alpha \Rightarrow (\text{N} \wedge \text{N-}\textit{bnpa})/(\text{VP}\textit{inf}/\text{NP}):$$
$$\lambda R{<}\lambda x[\exists y R(x)(y)\ \&\ \pi 1\alpha(x)],$$
$$\pi 2\alpha[\pi 1\alpha \rightarrow \lambda x[\exists y R(x)(y)\ \&\ \pi 1\alpha(x)]]{>}$$

Derivations for *place for Kim to find* and *place to find* will not be given, since they parallel the last two derivations.

4.4.2   Adverbial infinitival relative clauses

The appropriate modifications have been made to the nonadverbial infinitival RC addition lexical rules from the previous section, and are given in (33):

(33)   Adverbial infinitival RC addition lexical rule for BNPA nouns

    a.   With *for* complementizer

$$N \wedge N\text{-}bnpa: \; <\pi1\alpha, \pi2\alpha> \Rightarrow (N \wedge N\text{-}bnpa)/(\text{CP}inf/(\text{VP}\backslash\text{VP})):$$

$$\lambda S < \lambda x[S\,(\mathbf{prep}(x)) \& \pi1\alpha(x)],$$

$$\pi2\alpha[\pi1\alpha \rightarrow \lambda x[S\,(\mathbf{prep}(x)) \& \pi1\alpha(x)]] >$$

where $\pi2\alpha = \lambda \mathcal{D}\lambda Q\lambda y.\mathbf{prep}(\mathcal{D}(\pi1\alpha))Q(y)$

    b.   Without *for* complementizer

$$N \wedge N\text{-}bnpa: \; <\pi1\alpha, \pi2\alpha> \Rightarrow (N \wedge N\text{-}bnpa)/(\text{VP}inf/(\text{VP}\backslash\text{VP})):$$

$$\lambda V < \lambda x[\exists y V(\mathbf{prep}(x))(y) \& \pi1\alpha(x)],$$

$$\pi2\alpha[\pi1\alpha \rightarrow \lambda x[\exists y V(\mathbf{prep}(x))(y) \& \pi1\alpha(x)]] >$$

where $\pi2\alpha = \lambda \mathcal{D}\lambda Q\lambda y.\mathbf{prep}(\mathcal{D}(\pi1\alpha))Q(y)$

Derivations for *place for Kim to stay* and *place to stay* follow:

(34)   Derivation for *place for Kim to stay*

PART A:

for	*Kim*	*to*	*stay*	————1
CP*inf*/S*inf*:	NP:	VP*inf*/VP:	VP:	VP\VP:
$\lambda X.X$	**kim**	$\lambda P\lambda x[\Diamond P(x)]$	**stay'**	α

$$\text{————————————————} \backslash E$$
$$\text{VP: } \alpha\mathbf{stay'}$$
$$\text{————————————————} / E$$
$$\text{VP}inf\text{: } \lambda x[\Diamond\alpha\mathbf{stay'}(x)]$$
$$\text{————————————————} \backslash E$$
$$\text{S}inf\text{: } \Diamond\alpha\mathbf{stay'}(\mathbf{kim})$$
$$\text{————————————————} / E$$
$$\text{CP}inf\text{: } \Diamond\alpha\mathbf{stay'}(\mathbf{kim})$$
$$\text{————————————————} / I1$$
$$\text{CP}inf/(\text{VP}\backslash\text{VP})\text{: } \lambda\alpha[\Diamond\alpha\mathbf{stay'}(\mathbf{kim})]$$

PART B:

place		*for Kim to stay*
(N ∧ N-*bnpa*)/(CP*inf*/(VP\VP)):		CP*inf*/(VP\VP):
$\lambda S < \lambda x[S(\mathbf{in'}(x)) \& \mathbf{place'}(x)],$		$\lambda\alpha[\Diamond\alpha\mathbf{stay'}(\mathbf{kim})]$
$\lambda \mathcal{D}\lambda Q\lambda y.\mathbf{in'}(\mathcal{D}(\lambda x[S(\mathbf{in'}(x)) \& \mathbf{place'}(x)]))Q(y)] >$		

$$\text{——————————————————————————————————} / E$$

N ∧ N-*bnpa*: $< \lambda x[\Diamond\mathbf{in'}(x)\mathbf{stay'}(\mathbf{kim}) \& \mathbf{place'}(x)],$

    $\lambda \mathcal{D}\lambda Q\lambda y.\mathbf{in'}(\mathcal{D}(\lambda x[\Diamond\mathbf{in'}(x)\mathbf{stay'}(\mathbf{kim}) \& \mathbf{place'}(x)]))Q(y) >$

(35)   Derivation for *place to stay*

place   *to stay*

$(N \wedge \text{N-}bnpa)/(\text{VP}inf/(\text{VP}\backslash\text{VP}))$: $\text{VP}inf/(\text{VP}\backslash\text{VP})$:

$\lambda V <\lambda x[\exists y V(\textbf{in'}(x))(y) \ \& \ \textbf{place'}(x)$, $\lambda \alpha \lambda x[\Diamond \alpha \textbf{stay'}(x)]$

$\quad \lambda \mathcal{Z} \lambda Q \lambda y.\textbf{in'}(\mathcal{Z}(\lambda x[\exists y V(\textbf{in'}(x))(y)$

$\quad\quad \& \ \textbf{place'}(x)]))Q(y) >$

_____ /E

$N \wedge \text{N-}bnpa$: $<\lambda x[\exists w[\Diamond\textbf{in'}(x)\textbf{stay'}(w)] \ \& \ \textbf{place'}(x)]$,

$\quad\quad \lambda \mathcal{Z} \lambda Q \lambda y.\textbf{in'}(\mathcal{Z}(\lambda x[\exists w[\Diamond\textbf{in'}(x)\textbf{stay'}(w)] \ \& \ \textbf{place'}(x)]))Q(y)] >$

4.5   Overview of lexical rules

By now, I have accumulated a fair number of lexical rules concerning BNPA nouns, as
well as corresponding versions for ordinary nouns where appropriate. The aim here will
be to survey them and combine them where possible. The lexical rules that have been
introduced are summarized in (36), giving only the titles and syntactic portions:

(36)   a.   Nonadverbial RC addition for all nouns
                  $N© \Rightarrow N©/((\text{CP}fin \vee \text{S}fin)/\text{NP})$
        b.   Nonadverbial infinitival RC addition for all nouns (with *for*)
                  $N© \Rightarrow N©/(\text{CP}inf/\text{NP})$
        c.   Nonadverbial infinitival RC addition for all nouns (without *for*)
                  $N© \Rightarrow N©/(\text{VP}inf/\text{NP})$
        d.   Adverbial RC addition for BNPA nouns
                  $N \wedge \text{N-}bnpa \Rightarrow (N \wedge \text{N-}bnpa)/((\text{CP}fin \vee \text{S}fin)/(\text{VP}\backslash\text{VP}))$
        e.   Adverbial infinitival RC addition for BNPA nouns (with *for*)
                  $N \wedge \text{N-}bnpa \Rightarrow (N \wedge \text{N-}bnpa)/(\text{CP}inf/(\text{VP}\backslash\text{VP}))$
        f.   Adverbial infinitival RC addition for BNPA nouns (without *for*)
                  $N \wedge \text{N-}bnpa \Rightarrow (N \wedge \text{N-}bnpa)/(\text{VP}inf/(\text{VP}\backslash\text{VP}))$

The rules have already been compacted to some degree by means of the ©
variable. We can compact them further by collapsing some of the rules for finite RCs
with those for infinitival RCs. Consider (36.a, b, c). As was noted in section 4.4.1, these
three rules cannot be completely integrated, but we can certainly capture in one rule the
fact that a CP, whether finite or infinitival, is acceptable, by leaving it unspecified, and
thus collapse (36.a) and (36.b); likewise (36.d) and (36.e), as shown in (37):

(37)   a/b.   Nonadverbial RC addition for all nouns

$$N© \Rightarrow N©/((CP \lor Sfin)/NP)$$

d/e.   Adverbial RC addition for BNPA nouns

$$N \land N\text{-}bnpa \Rightarrow (N \land N\text{-}bnpa)/((CP \lor Sfin)/(VP\backslash VP))$$

4.6   The case of *reason*

As mentioned earlier, the set of BNPA nouns and the set of nouns that can head non-*wh* adverbial RCs without preposition stranding are not entirely the same. The data in (4), rewritten below as (38), show *reason* is in the latter set, but not the former. *Spot* is an even more specialized case: it can head infinitival adverbial relatives, as in (38.c), but not finite ones, such as **the spot that we sat*.

(38)   a.   the {reason, *cause} (that) Kim fired Robin
       b.   Kim fired Robin *(for) this reason.
       c.   a shady (spot, place, *area) to sit
       d.   Kim sat *(in) that spot.

For unique cases like these, the solution is simply to assign the appropriate category and semantics directly. There is no need for the kind of lexical rule seen in the previous sections, since it is not a whole class of words that exhibits this pattern. The lexical entry for *reason* would have to be $N \land N/((CP \lor Sfin)/(VP\backslash VP)) \land N/(VPinf/(VP\backslash VP))$, which will allow for *the reason (that) Kim fired Robin*, and also *reason for Kim to fire Robin,* and *reason to fire Robin.* The category can be written more compactly as $N \land N/((CP \lor Sfin \lor VPinf)/(VP\backslash VP))$. For *spot,* we would want $N \land N/((CPinf \lor VPinf)/(VP\backslash VP))$, to allow for *a spot (for Kim) to sit.* Neither word is eligible to undergo the lexical rules for BNPA nouns, since neither is of category $N \land N\text{-}bnpa$; both rules are still free to undergo the lexical rules for ordinary nouns, since they are both instances of $N \land N©$.

5   Possible problems

5.1   The coordination problem

In all the preceding derivations, the type $N \land N\text{-}bnpa$ undergoes $\land E$ prior to the word's incorporation into a larger block, but there is nothing that requires this to happen. If a verb took an argument that was simultaneously both N and N-*bnpa*, then a phrase of type $N \land N\text{-}bnpa$ would fill the bill without eliminating either of the type conjuncts. Thus,

phrases such as *like and live every place* would be licensed (brought to my attention by Vaillette, p.c.). (Indeed, Johnson and Bayer (1995) take advantage of this fact in developing their analysis of a similar coordination in German, where an NP needs to be both dative and accusative at once to combine with a conjoined verb.) Also derivable are RCs which contain conjoined VPs and are nonadverbial when one VP conjunct is considered, but adverbial for the other, as in *a place (that) I liked and lived*. If these examples are ungrammatical, then the BNPA analysis here has a problem.

Until recently, I did not question the ungrammaticality of such examples, but the following attestation of a nonadverbial/adverbial RC raises questions about such an assumption:

(39)   "He decided to remain because it was <u>a place he loved and</u>
<u>felt comfortable</u>." (Rich Warren, "Ghost stories: an old
friend drops in for a séance," *Columbus Alive*, 4 Nov. 1999, p. 10.)

If (39) is good for some people, perhaps *like and live every* place would be as well. On the one hand, existence of (39) is a nice confirmation of a prediction made by the BNPA analysis here; on the other hand, there is still the question of how to rule out such examples for people who do find them ungrammatical.

Finally, it should be noted that the coordination problem is not unique to analyses that make use of conjoined type structures. Similar problematic coordinations have been noted before; here are a few compiled from other sources by Carpenter (1997):

(40)   (from Carpenter (1997), p. 196)
a. *The student [who likes] and [in] the library was studying.
b. ?[I bought every red] and [Jo liked some blue] t-shirt.
c. ?[The man who buys] and [the woman who sells] rattlesnakes met
outside.
d. *I saw [a friend of] and [the manufacturer of] Dana's handbag.
e. *Sue saw the man [through the telescope] and [with the
troublesome kid].

Consider, for example, (40.b). In it, two S/Ns are being coordinated. There is no conjoined type at all here. The rules for coordination, it seems, need to be finer-grained. It is not enough for the coordinated items to have the same type; they must be alike in other ways as well. For instance, there seems to be some kind of parallelism constraint at

work that rules out coordinations like *the trips from Boston to New York by train and from LA by plane.* The coordination is good only if the *from, to,* and *by* PPs in the first conjunct are mirrored in the second, as in *the trips from Boston to New York by train and from New York to LA.* Examples like this one were pointed out to me by Dowty (p.c.), who speculates that when the features for the various types are specific enough, then coordination will, after all, be as simple as taking two elements of type Y to yield an element of type Y, with the requirement that all (or some subset of) the feature values of Y match up. Such a theory is beyond the scope of this paper, but has been mentioned just to show that problems like those mentioned need not be terminal for conjunctive types, and in particular for the conjunctive-type analysis of BNPA nouns.

5.2 Other questions to resolve

In addition to the coordination problem, there are a few other issues that were not discussed here. One is covering the facts for scoping phenomena; presently, all quantified BNPAs must take narrow scope. Restrictive *wh-* RCs are another question: I used McCawley's argument in favor of all restrictive RCs being complements to bolster our case for the complementhood of just non-*wh* RCs. As to the status of restrictive *wh-* RCs, I make no claim.

Two other BNPA-related issues have not been mentioned here, but are discussed in Whitman (1998). The first concerns determiners. All the examples with determiners presented here have used *every* with the idea that the same approach could be used with any determiner. However, not all determiners are equally good with BNPA nouns. For example, *the* is usually bad; consider *We stayed the place, *We did it the way,* etc. It is tempting to say that what determiners are allowed is a pragmatic matter when examples like those mentioned and *We did it a way* are considered, but one conclusion Whitman draws is that pragmatics alone will not explain all the data. The other issue concerns prepositions. Although BNPA nouns have been assumed to be able to function as ordinary nouns, there are some cases where an ordinary noun can be modified by an RC with a stranded preposition, while a BNPA noun cannot. To illustrate, consider first *a place to eat.* This is grammatical by virtue of the N-*bnpa* part of the type for *place,* but *a place to eat at* is also good, since *place* is after all, an N as well as an N-*bnpa*. But with temporal BNPA nouns, the preposition is not so acceptable: *?the day the music died on.* And for manner BNPA nouns, it is definitely bad: **the way they did it in.* For a detailed discussion of both issues, the reader is referred to Whitman (1998).

5   Conclusion

I have presented an analysis of BNPA nouns that accounts for their two characteristic properties: the ability to form adverb phrases without use of prepositions, and the ability to head non-*wh* adverbial RCs without preposition stranding. The core of the analysis is the use of a conjunctive category, N ∧ Det\(VP\VP), abbreviated as N ∧ N-*bnpa*, with a variable, ©, introduced to allow for modification of words and phrases with conjunctive categories. This variable not only allows for modification of BNPA nouns, but also provides a rough type-logical equivalent of Kasper's HPSG system for recursive modification. The account for non-*wh* adverbial RCs leads to a unified account of all non-*wh* RCs (adverbial and nonadverbial, both finite and infinitival, for BNPA nouns and for ordinary nouns alike), in addition to collapsing the definitions of relativizer and complementizer *that*. Thus, aside from capturing the relevant facts about BNPAs, the analysis here enjoys a measure of independent motivation.

Appendix
Proving that N\N \$\Rightarrow$ ((NP/N)\(VP\VP))\((NP/N)\(VP\VP))

Start

$$\frac{\text{Two possibilities: [1], [2]}}{\text{N\N} \Rightarrow ((NP/N)\backslash(VP\backslash VP))\backslash((NP/N)\backslash(VP\backslash VP))}$$

Possibility [1]

$$\frac{\text{Three possibilities: [1.1], [1.2.1], [1.2.2]}}{\frac{\text{(NP/N)\backslash(VP\backslash VP), N\backslash N} \Rightarrow \text{(NP/N)\backslash(VP\backslash VP)}}{\text{N\backslash N} \Rightarrow ((NP/N)\backslash(VP\backslash VP))\backslash((NP/N)\backslash(VP\backslash VP))}} \backslash R$$

Possibility [1.1]

$$\frac{\text{Four possibilities: [1.1.1], [1.1.2.1], [1.1.2.2], [1.1.2.3]}}{\frac{\text{NP/N, (NP/N)\backslash(VP\backslash VP), N\backslash N} \Rightarrow \text{VP\backslash VP}}{\text{(NP/N)\backslash(VP\backslash VP), N\backslash N} \Rightarrow \textbf{(NP/N)\backslash(VP\backslash VP)}}} \backslash R$$

Possibility [1.1.1]

$$\frac{\text{Three possibilities: [1.1.1.1], [1.1.1.2], [1.1.1.3]}}{\frac{\text{VP, NP/N, (NP/N)\backslash(VP\backslash VP), N\backslash N} \Rightarrow \text{VP}}{\text{NP/N, (NP/N)\backslash(VP\backslash VP), N\backslash N} \Rightarrow \textbf{VP\backslash VP}}} \backslash R$$

Possibility [1.1.1.1]

$$
\frac{(NP/N)\backslash(VP\backslash VP),\ N\backslash N \Rightarrow N \quad \dfrac{\textbf{fail}}{\rule{0pt}{0pt}}\quad VP,\ NP \Rightarrow VP}{VP,\ \textbf{NP/N},\ (NP/N)\backslash(VP\backslash VP),\ N\backslash N \Rightarrow VP} \ /L
$$

Possibility [1.1.1.2]

$$
\frac{VP,\ NP/N \Rightarrow NP/N \qquad \dfrac{\textbf{fail}}{\rule{0pt}{0pt}}\quad VP\backslash VP,\ N\backslash N \Rightarrow VP}{VP,\ NP/N,\ \textbf{(NP/N)}\backslash\textbf{(VP}\backslash\textbf{VP)},\ N\backslash N \Rightarrow VP} \ \backslash L
$$

Possibility [1.1.1.3]

$$
\frac{VP,\ NP/N,\ (NP/N)\backslash(VP\backslash VP) \Rightarrow N \qquad \dfrac{\textbf{fail}}{\rule{0pt}{0pt}}\quad N \Rightarrow VP}{VP,\ NP/N,\ (NP/N)\backslash(VP\backslash VP),\ \textbf{N}\backslash\textbf{N} \Rightarrow VP} \ \backslash L
$$

Possibility [1.1.2.1]

$$
\frac{\dfrac{\dfrac{\textbf{fail}}{\Rightarrow NP/N} \qquad \dfrac{\textbf{fail}}{VP\backslash VP \Rightarrow N}}{(NP/N)\backslash(VP\backslash VP) \Rightarrow N \qquad NP,\ N\backslash N \Rightarrow VP\backslash VP} \backslash L}{\textbf{NP/N},\ (NP/N)\backslash(VP\backslash VP),\ N\backslash N \Rightarrow VP\backslash VP} \ /L
$$

Possibility [1.1.2.2]

$$\cfrac{\cfrac{}{NP/N \Rightarrow NP/N}\text{Ax} \qquad \cfrac{\textbf{fail}}{VP\backslash VP, N\backslash N \Rightarrow VP\backslash VP}}{NP/N, \textbf{(NP/N)}\backslash\textbf{(VP}\backslash\textbf{VP)}, N\backslash N \Rightarrow VP\backslash VP}\backslash L$$

Possibility [1.1.2.3]

$$\cfrac{\cfrac{\cfrac{\textbf{fail}}{\Rightarrow NP/N} \qquad \cfrac{\textbf{fail}}{VP\backslash VP \Rightarrow N}}{(NP/N)\backslash(VP\backslash VP) \Rightarrow N \qquad NP/N, N \Rightarrow VP\backslash VP}\backslash L}{NP/N, (NP/N)\backslash(VP\backslash VP), \textbf{N}\backslash\textbf{N} \Rightarrow VP\backslash VP}\backslash L$$

Possibility [1.2.1]

$$\cfrac{\cfrac{\textbf{fail}}{\Rightarrow NP/N} \qquad (VP\backslash VP), N\backslash N \Rightarrow (NP/N)\backslash(VP\backslash VP)}{\textbf{(NP/N)}\backslash\textbf{(VP}\backslash\textbf{VP)}, N\backslash N \Rightarrow (NP/N)\backslash(VP\backslash VP)}\backslash L$$

Possibility [1.2.2]

$$\cfrac{\cfrac{\cfrac{\textbf{fail}}{\Rightarrow NP/N} \qquad VP\backslash VP \Rightarrow N}{(NP/N)\backslash(VP\backslash VP) \Rightarrow N \qquad N \Rightarrow (NP/N)\backslash(VP\backslash VP)}\backslash L}{(NP/N)\backslash(VP\backslash VP), \textbf{N}\backslash\textbf{N} \Rightarrow (NP/N)\backslash(VP\backslash VP)}\backslash L$$

Possibility [2]

$$
\frac{
\quad\quad
\begin{array}{cc}
\textbf{fail} & \textbf{fail} \\
\hline
\Rightarrow N & N \Rightarrow ((NP/N)\backslash(VP\backslash VP))\backslash((NP/N)\backslash(VP\backslash VP))
\end{array}
}{
N\backslash N \Rightarrow ((NP/N)\backslash(VP\backslash VP))\backslash((NP/N)\backslash(VP\backslash VP))
}\ \backslash L
$$

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Turning Phonology Inside Out,
or Testing the Relative Salience of Audio-Visual Cues for Place of Articulation[*]

Steve Winters
swinters@ling.ohio-state.edu

Jun (1995) and Hume (1998) motivate phonological analyses of cross-linguistic trends in place assimilation and consonant/consonant metathesis by appealing to putatively universal rankings of the perceptual salience of stop place cues. Experimental support for such salience rankings is sparse, perhaps because of the difficulty of eliminating "inside-out" effects in establishing the *inherent* salience of phonetic cues. This study attempted to explicitly test speculative claims about cue salience for stop place using audio-visual stimuli in an experimental paradigm that minimized the "inside-out" effects of linguistic structure on speech perception. Salience was gauged by evaluating the perceptual effects of adding acoustic or visual information to experimental stimuli. Results showed that labials have the most salient place cues in either the auditory or visual modality, contrary to what some theoreticians would have predicted. However, dorsals gain the most salience from adding acoustic information to the signal, suggesting that perhaps only acoustic cues have "outside-in" effects on phonological structure.

INTRODUCTION

Recent work in Optimality Theory has suggested that certain cross-linguistic phonological processes may be based on aspects of speech perception. Jun (1995), for instance, proposes a meta "preservation" constraint of the following form:

(1)   Pres(X(Y)): Preserve perceptual cues for X (place or manner of articulation) of Y
       (a segmental class)

Furthermore, Jun proposes that all preservation constraints for some place or manner of articulation are universally ranked with respect to each other:

(2)   Universal ranking: Pres(M(N)) >> Pres(M(R)), where N's acoustic cues are

       stronger than R's cues for M.

For instance, some of the universal rankings for place preservation include:

(3)   Pres(pl(dor⁻)) >> Pres(pl(lab⁻)) >> Pres(pl(cor⁻))

(4)   Pres(pl(onset)) >> Pres(pl(coda))

(5)   Pres(pl(stops)) >> Pres(pl(nasals))

Jun provides the following example (among others) of how such universal rankings of constraints might interact with the articulatory WEAKENING constraint to account for place assimilation in Korean:

(6) Example (Korean): /ip + ko/ → [ikko]   'wear and...'

	/ip + ko/	Pres (pl(onset))	WEAKENING	Pres(pl(coda))
	ipko		**!	
☺	ikko		*	*
	ippo	*!	*	

WEAKENING is a constraint that prohibits consonantal articulations; candidates [ippo] or [ikko] are preferable to input [ipko] since they both have only one consonantal articulation as opposed to two. In general, place assimilation will occur in a language according to how it ranks WEAKENING with respect to the various preservation constraints.

        This phonological account of assimilation is a formal treatment of Kohler's (1990) production hypothesis, which states that speakers make more effort to produce stronger acoustic cues than weaker ones. The motivation for these formal structures comes from two distinct sources, the first of which is cross-linguistic patterns of place assimilation. Jun examines phonological processes in a number of languages and notes that in none of them do nasals assimilate while stops do not. In terms of place of articulation, dorsals in

coda position would never assimilate unless both labials and coronals do as well. The

rankings of preservation constraints thus read like an implicational hierarchy for place assimilation-- labials will assimilate only if coronals do as well, and so on and so forth.

The universal rankings of preservation constraints might, therefore, be completely justified from a strictly phonological point of view, but Jun goes one step further and attempts to motivate them with phonetic facts about the perceptual salience of place cues. After all, the rankings of preservation constraints should fall out from which cues are "stronger" than others (according to (2)). So, Jun bases his ranking of preservation of cues for place in coda position by appealing to a number of speculative claims about which of these cues are more salient than others. Coronals are at the bottom of the list because their transitions are shorter and have relatively "small excursions" when compared to dorsals or labials. Dorsals, in turn, have stronger cues than labials because of the supposed acoustic prominence of the "velar pinch" (as noted in Stevens (1989)).

Hume (1998) makes similar appeals to the perceptual salience of place cues in order to motivate her phonological analysis of consonant/consonant metathesis. Hume notes that labials have a unique cross-linguistic tendency to undergo this unusual process. From a phonological perspective alone, then, there is reason to believe that labials are somehow special among the various stop consonants, but Hume tries to back up this claim further by appealing to the "perceptual vulnerability" of labials. Hume does not elevate "perceptual vulnerability" to the formal status of a meta-constraint, but she does use it as the phonetic background for the relative ranking of the specific constraints that drive consonant/consonant metathesis involving labials. For instance, Hume proposes that the weak release bursts of labials do not add much to their perceptual salience (Ohala (1990)), and so it would be preferable to place them in coda position as opposed to onset position. Place cues are also (presumably) more salient in stressed syllables than in unstressed syllables. These two facts about perceptual salience together motivate the ranking of *labial/C-V >> *labial/V-C, as Hume proposes is the case in Kui, where labials undergo consonant/consonant metathesis into stressed coda position.

(7) Example (Kui): /ag + ba/ → [ábga] 'to be fitting'

	/ag + ba/	*labial/C-V	*labial/V-C	LINEARITY
☺	ábga		*	*
	ágba	*!		

Hume and Jun's analyses both refer to the perceptual "salience" of certain stop places of articulation in order to account for why metathesis and assimilation occur; interestingly, though, the two phonologists reach different conclusions about which places of articulation are more or less salient than others. In the ranking in (3), Jun proposes that dorsals are most salient, followed by labials and then coronals. For Hume, however, labials have the least salient place cues.

The fact that these phonologists come to different conclusions about the relative strength of cues for different places of articulation is no accident. Both phonologists were able to justify their analyses with claims made by different speech researchers, who should be authorities on what may or may not constitute a strong acoustic cue for a place of articulation. However, speech perception researchers have not been able to establish which stop place cues are stronger or weaker than others. This empirical question remains unanswered despite the best efforts of studies such as Miller and Nicely (1955), Malécot (1958) and Wang and Bilger (1973) (among others), which have all tried to solve this problem but yielded conflicting and inconclusive results using experimental paradigms of varying design and purpose.

Miller and Nicely (1955) presented listeners with 16 different consonant sounds (including stops, fricatives, nasals, voiced and voiceless sounds) in various levels of noise, and asked the listeners to identify them in an open-response format. From the resultant 16x16 confusion matrices, it is possible to pull out the stops and determine (using the "I" sensitivity measure described below) that their listeners found coronals more salient than both dorsals and labials, neither of which differed significantly from each other. Wang and Bilger (1973) used a similar paradigm, although they threw affricates into the consonantal mix, added productions with the vowels /i/ and /u/, put consonants in both onset and coda position, and also used sound level reduction in addition to introducing noise into the signal. Their results showed that labials and coronals were equally salient in the onset condition—and both were more salient than dorsals—and, in the coda condition, coronals were more salient than labials which, in turn, were more salient than dorsals. Malécot(1958) took a completely different tack and experimented with adding or removing bursts and transitions from stop consonants in

coda position. His results showed that labials were more salient than both coronals and

dorsals, which did not differ significantly from each other.

     Others have approached the problem of measuring place cue salience in different ways but each new attempt seems to confuse the situation more than it does to help clarify it. One good reason for this confusion may be that it is simply so difficult to determine what is *inherently* 'salient' or 'strong' about an acoustic cue as opposed to what listeners might project onto the speech signal in developing a linguistic interpretation of it. Such interpretive projections in speech perception are commonly called "top-down effects," as an extension of the metaphor that certain levels of linguistic structure are "higher up" than others. For example, a listener's upper-level semantic, pragmatic and syntactic knowledge might enable them to perceive the word "nine" before they have heard little (if any) acoustic input for that word in the following sentence (Lieberman (1963)):

(8) A stitch in time saves nine.

Top-down information has similar influences within single-word contexts as well; Warren (1970) showed that replacing the fricative /s/ with a non-linguistic noise such as a cough in a word like 'legislation' has little or no effect on listeners' perception of that word. Many listeners did not even hear the cough (as such) at all, and most of those who did interpreted it as occurring sometime after the word had ended. Phonological effects on speech perception should be familiar to anyone who has ever attempted to learn phonetic transcription; most native-English speakers hear initial /tl-/ clusters as [kl], since such clusters are not permitted by English phonology. Precisely the opposite is true of Navajo speakers, who interpret an English word like 'clock' as /tlak/. (Schaengold, 1999) Any attempt to objectively establish the inherent salience of some acoustic cue would have to eliminate the possibility of any of these top-down influences intruding in upon the perceptual task. Since speech perception science has not yet finished experimentally testing the myriad possibilities of top-down influences that may exist in perception, it is difficult to claim for certain in any experimental paradigm that such influences have been eliminated completely.

There is another way of thinking about top-down influences on speech perception; since they essentially consist of mental structures that a listener imposes on an incoming speech signal, one might think of them as "inside-out" processes. That is, they transform linguistic structures inside the mind into perceived physical realities in the outside world. Analogously, if external cues for some linguistic structure have a role in motivating some universal phonological constraint, they can only do so by virtue of what I would like to call "outside-in" effects in speech perception. These could be characterized as the internalization of perceivable structures in the external speech signal as linguistic (or phonological) structures inside the human mind.

In modern linguistics, phonologists have generally been interested in inside-out processes. In other words, most phonological analyses would hope to explain how the mind influences the patterns of sounds used in language as opposed to the other way around. With their emphasis on possible outside-in influences on phonological structures, though, the optimality theoretic analyses of Jun and Hume (among others) seem to represent a new trend in doing phonology. In Optimality Theory, phonologists are not simply content to characterize what phonological processes *may* happen in language; they want to understand and formalize *why* certain processes happen and others do not. Though cognitive coherence and simplicity may be the most fundamental force in shaping linguistic structures, most optimality theoreticians would concede that the communicative efficacy of sound structures plays an important role as well. Such theoreticians would not, therefore, strictly relegate phonological phenomena to an internal role in the mind but recognize that it has externally-based features as well, due to a language user's need to perceive as well as produce the phonological structures of their language.

This theoretical strategy can provide plenty of work for speech perception researchers even though it may unnecessarily complicate the world of phonological theory. Outside-in effects more easily submit to experimental verification than to introspective analysis (a linguist's usual scientific tool of choice). Objects and events in the external world can be manipulated and reproduced with relative ease, while it is almost impossible for an experimenter to manipulate or reproduce the internal structures of the human mind. Thus, an experimental test of the outside-in effects of speech stimuli could simply involve the presentation of such stimuli to listeners who would be asked to

categorize them in terms of some phonological structure. Since phonological structure is a necessary outcome of any speech perception task, completely eliminating the possibility of any inside-out influences in such an experiment is impossible. An experimenter could, at least, minimize the other "inside-out" influences by extracting the stimulus from any pragmatic or syntactic context and maximizing the use of "nonsense" words to avoid word-level semantic effects. An experiment of this kind could provide one empirical method of verifying what outside-in effects may exist in language (as well as their relative strengths).

Performing an experiment of this kind would also be an appropriate test of the validity of Jun's and Hume's claims about the relative salience of cues for place of articulation. There is considerable evidence, however, that empirically testing the salience of place cues--and thereby resolving the discrepancy between Jun's and Hume's salience rankings--would have to involve a perceptual experiment that used audio-visual stimuli. Many speech perception studies have shown that listeners perceive place not only through acoustic cues such as bursts or transitions, but also through visual cues, such as movements of the lips, tongue or jaw. One of the most well-known of these visual perception studies is McGurk and MacDonald (1976), in which it was shown that people's perception of audio-visually mismatched stimuli can change depending on which place of articulation is presented auditorily and which is presented visually. Some basic examples of how this phenomenon works include:

(9) Typical McGurk effects

Subject	sees:	+	hears:	⇒	perceives:
	ba	+	ga	⇒	ba
	ga	+	ba	⇒	da or bga or gba

This bizarre phenomenon significantly changes our basic understanding of speech perception not only because it incontrovertibly shows (as others have shown) that people use visual information in perceiving speech, but also that people sometimes attach more perceptual importance to visual information than to acoustic cues. The McGurk effect is especially strong in stop consonants, which have minimal acoustic cues but

comparatively noticeable visual cues for place of articulation. Jun and Hume ignored the comparative importance of visual cues in establishing hierarchies of stop place salience; they only considered the strength of a stop's acoustic cues. Whether or not visual cues for stop place motivate the phonological proposals of Jun and Hume is unclear; but it *is* certain that visual cues can contribute to the perceptual salience of stop place. An "outside-in" experimental paradigm could determine the *inherent* salience of any visual or acoustic cue for stop place and thereby determine whether the theoretical proposals of Jun and Hume actually correspond to the empirical reality of stop place salience. According to Jun, for instance, one would expect dorsals to have the most salient place cues; according to Hume, however, one would expect labials to be the least salient. In considering visual perception studies, though, one would expect labials to be the *most* salient. And yet other possibilities exist, too: coronals might be the most salient, for instance. Which one of these possibilities reflects empirical reality is unknown, however, and therefore any phonological claims that are based on assumptions about place salience remain untested conjectures.

This study attempted to explicitly test such speculative claims about the salience of stop place by using audio-visual stimuli in an experimental paradigm that minimized the "inside-out" effects of linguistic structure on speech perception. The results of this experiment could hopefully not only improve the current understanding of stop place perception but also provide the necessary empirical framework for phonological analyses that appeal to perceptual facts for motivation.

METHOD

In attempting to gauge the relative strength of cues for place of articulation, this study adopted a strategy of comparative analysis: it compared listeners' success rates at perceiving place when they were presented with normal phonetic information as opposed to little or no information. For instance, listeners heard or saw identical stimuli with both normal acoustic information and minimal acoustic information. The salience of an acoustic cue for a particular stop place, then, was considered to be how much it contributed to a listener's perception success when it was added to the minimally informative signal. The salience of visual cues, on the other hand, would correspond to

how much they helped listener performance between conditions with normal visual information and no visual information. What changes had been made in the external speech signal between the two conditions could therefore be held responsible for the changes that occurred in the perceiver's comprehension of the signal, and the resultant experimental effects could be considered genuinely "outside-in."

The first step in setting up such comparable experimental conditions was to create audio-visual stimuli for the listeners to try to perceive. Video recordings were made of both a male native speaker and a female native speaker of American English. Each speaker was instructed to read from a script that was placed just underneath the lens of the camera; the speakers sat approximately three to four feet from the camera and were shot from the shoulders up. The video recordings were made inside a sound booth with an 8 mm camcorder. An external microphone hanging from the ceiling of the sound booth above the speaker's head provided the audio portion of the recording.

The script from which the speakers read included stop productions in a variety of phonological contexts. The speakers were asked to produce voiced stops only, in labial, coronal and dorsal places of articulation, as both nasal and oral stops, in both onset and coda position, with both the vowel /a/ and /i/, and in both stressed and unstressed syllables. All of these variations were included to test Jun's and Hume's rankings of salience and preservation constraints. Production with the two different vowels was included to provide a broader and more realistic coarticulatory context and also because it was suspected that visual cues would be stronger when produced with a large jaw opening for /a/ than with the comparatively small opening for /i/. In order to simplify this multi-faceted production task, the speakers read two syllable nonsense words with one stressed and one unstressed syllable, with the same stop at both the beginning and the end of the word. The two syllables were separated with a production of /h/, which was selected because of its lack of potentially confusing place cue information. In short, this meant the speakers had to produce all of the following forms:

(10) Production script

báhab	baháb	máham	mahám
dáhad	dahád	náhan	nahán
gáhag	gahág	ŋáhaŋ	ŋaháŋ

bíhib	bihíb	míhim	mihím
díhid	dihíd	níhin	nihín
gíhig	gihíg	ŋíhiŋ	ŋihíŋ

Each speaker was asked to produce each item on the list at least three times. From the resultant video recording, one of each speaker's productions for each token was selected to become a stimulus in the place perception experiment. These tokens were digitized into 320x240 video clips using Adobe Premiere on Macintosh. Due to a glitch in Premiere's digitization algorithm, the audio and visual portions of the recording had to be aligned manually after each digitization. This was done by digitizing three consecutive tokens at a time and then realigning the audio portion of the recording so that all three tokens of the sequence appeared to be properly aligned. In general this meant delaying the beginning of the audio until the video had already played for six to eight frames (approximately .2 to .3 seconds). Judgments of proper alignment had to be made by the editor's intuition based on video landmarks like lip opening, jaw lowering and acoustic landmarks like vowel offset. Previous research (e.g., Munhall et al. (1996)) indicates that any minor misalignments in the stimuli that may have resulted from this process probably did not affect listener integration of the visual and audio signals.

After the video tokens had been digitized and properly aligned, individual CV or VC tokens were clipped for use as stimuli in the perception experiment (see Figure 1). For CV tokens, the video was cut at the last frame before the onset of frication in the medial /h/ in the original production, and for VC tokens, the video was cut so that it began with the first frame after the offset of frication for the medial /h/. Examinations of the waveform of the video's audio portion along with frame-by-frame playback of the video made it both possible and easy to determine where these audio landmarks occurred on the recording. In addition, CV tokens were cut to begin ten frames (approximately

1/3rd of a second) before the onset of the acoustic waveform on the recording, and VC

tokens were cut to end ten frames after the offset of any acoustics on the recording. The inclusion of such pre- and post-acoustic material in the tokens meant that subjects could see visible gestures in the speaker's face before or after they had made any acoustic effects.

After these digital cuts had been made, the first frame of each clip was saved as a .PICT file and expanded as a still picture to make up the entire first second of each clip. Previous experimentation (Strand and Johnson (1996)) has shown that subjects need such preparatory still shots in order to visually orient themselves to a face before they try to interpret what motions it may make afterwards. Without such orientation, subjects have difficulty perceiving the initial movements the face may make. The last frame of each clip was also copied and expanded as a still picture to give each clip a uniform length of two seconds. After editing, each video clip was saved as a Quicktime .MOV file, and its audio portion was copied into an independent .AIFF file for use in the audio-only half of the experiment.

Both video and audio clips were presented to subjects via a computer monitor and headphones in a sound-proof booth. The experiment's twenty-eight subjects were split evenly into audio-visual and audio-only groups. In the video half of the experiment, subjects would see video on the computer monitor while the corresponding audio played over the headphones. In the audio-only condition, the computer monitor went blank while the audio played over the headphones. After the subject had listened to each clip, the computer presented them with the following question: "What word did you hear?" and the subject would respond by clicking on one of three VC or CV alternatives (written on the screen in realistic English spellings), which differed only in the place of articulation of their stop consonant. After the subject had made a selection, they were given the option of either changing their selection or moving on to the next stimulus. Listeners heard the next token only after they had decided to move ahead with the experiment.
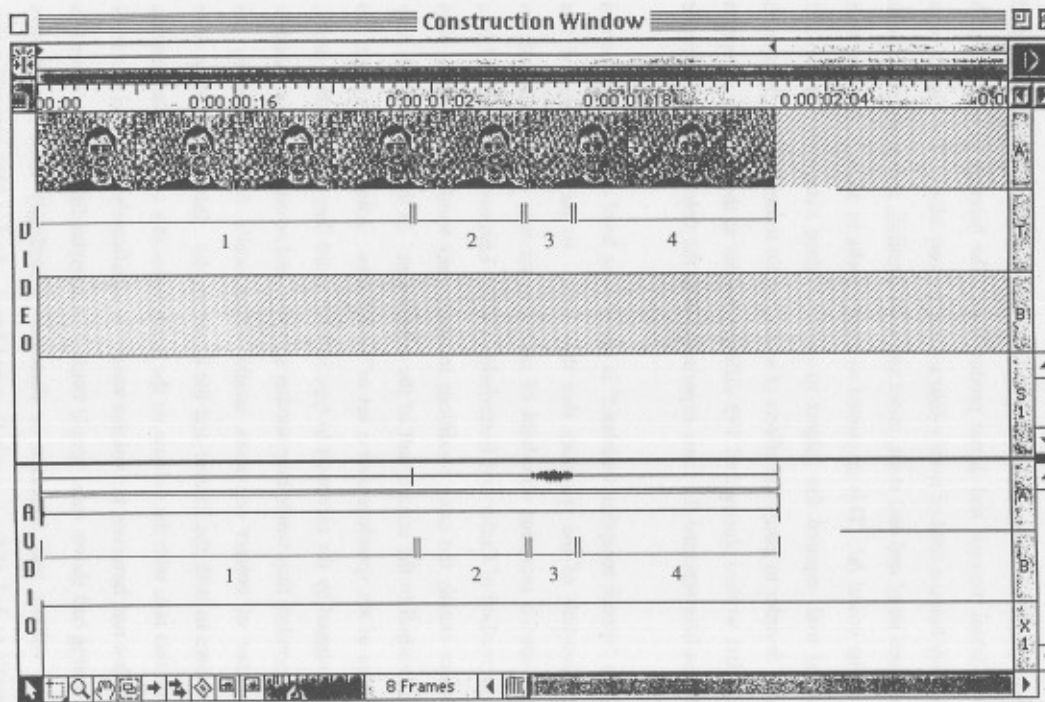
Figure 1: Four part video editing construction of "da" stimulus

1. One second still shot
2. Ten frames prior to onset of acoustics

3. Acoustic production of "da"
4. Expanded still shot to lengthen entire video to two seconds

The tokens were split up into groups with uniform manner, syllabic position and

vowel features. This was done so that the listeners would only have to make a decision
about the perceived place of articulation of any given token. Within each block, then, the
tokens were evenly split between male and female productions, stressed and unstressed
productions, and labial, coronal and dorsal productions. The listeners also heard each
token twice, so they heard a total of twenty-four tokens in every block. The blocks were
evenly split between nasal and oral stops, onset and coda position, and productions with
the vowel /i/ or the vowel /a/. This amounted to eight blocks in all, which meant that
each experimental trial required the subject to make a place categorization for 192
different tokens. In order to gauge the effects of adding audio information to the speech
signal, subjects first worked through all 192 different tokens at their speech reception
threshold, and then later repeated the same experiment with the volume at a comfortable
listening level.

A person's "speech reception threshold" is the volume level at which that person
can understand one-half of the spondees that they hear. In the first stage of this
experiment the speech reception threshold of each listener was determined with an
adaptation of the method of Cutler and Butterfield (1992). Listeners were isolated in a
sound booth, under exactly the same conditions in which they would be presented with
the audio-visual stimuli in the second half of the experiment. In the sound booth they
listened to a series of six spondees over a set of headphones. After each spondee, the
listeners were prompted by the computer to type in what word they thought they heard;
after they had responded, they would hear another spondee, and so on. After six spondaic
tokens, the number of correct responses would automatically be tabulated by the
computer and shown to both the listener and the experimenter. Initially, listeners were
familiarized with this task with the volume on the headphones at a comfortable listening
level; after their first run, however, the volume would be significantly decreased to a level
at which pilot testing had shown most people begin misunderstanding words. After this
second trial, the volume was increased or decreased accordingly until the listeners
responded correctly to 3 ± 1 of the 6 words they had heard. At this 50% comprehension
level, the volume was considered to be at the listener's speech reception threshold.

After this pre-test had established the listener's speech reception threshold, the
listener began working through the blocks of stimuli at this volume level. After the

listener had worked through all 192 stimuli, the volume was returned to the original comfortable listening level and the listener repeated the experiment again. There were fourteen subjects in each condition; the subjects were volunteer students from introductory psycholinguistics and linguistics classes. Most were remunerated for their participation and the rest participated for extra credit in their respective courses. All participants were encouraged to take breaks whenever they felt they needed one.

RESULTS AND ANALYSIS

The task that listeners were asked to perform in this experiment was simple: identify one word out of three alternatives as the word they had heard or seen being spoken. Adding a stronger or more salient cue for a certain place of articulation should have two effects with respect to this task--first, it should increase the likelihood that listeners will respond appropriately when they perceive that cue, and secondly, it should decrease the likelihood that listeners will respond incorrectly when they do not hear that cue. When a listener does respond correctly in this task, he or she has, in the battleship-like terminology of speech perception research, scored a "hit". On the contrary, when they mistakenly respond with one alternative when the stimulus was intended as another, they have registered a "false alarm" in some phonological firehouse in their minds. With stronger cues, then, their probability of registering "hits" should increase while their probability of registering false alarms should decrease. Mathematically speaking, this amounts to

(11)   I   =   P(hit) - P(fa),

where I is a measure of listener "sensitivity"--i.e., how much of an impression an external stimulus makes on a listener. Adding one to this equation and dividing the entire sum by two yields a variable that ranges from 0 to 1:

(12)   I   = $\dfrac{1 + P(hit) - P(fa)}{2}$

Green and Swets (1966) derived this definition of 1 in developing a non-parametric
equivalent of d' in their "Signal Detection Theory". Calculating listener sensitivity in this
way--instead of simply measuring hit rates--helps eliminate listener bias effects by taking
the probability of false alarms into account.

Equation (12) was used to calculate sensitivity values for every token by subject
in an attempt to quantitatively determine which place cues were more salient than others.
Across all conditions sensitivity to the labial place of articulation was highest.
Ultimately, labials came in with a sensitivity ranking of .9, followed by dorsals with .83
and coronals at .81 (see Figure 2). A repeated measures ANOVA showed that the place
factor was significant (see Appendix 1, #10).

Interestingly, the perceptual strength of labials is not simply an artifact of their
strong visual cues. Breaking down sensitivity values for both the audio-only and audio-
visual groups of listeners, labials still came out on top in both conditions (Figure 3; #11
in Appendix). With audio-only stimuli, labials are still slightly (but not significantly)
higher than dorsals, and in audio-visual stimuli, the labials' sensitivity ranking approaches
ceiling while coronals and dorsals are essentially even. The story remains the same once
the results are broken down by volume level (Figure 4; #3 in Appendix). At both speech
reception threshold and comfortable listening level, labials again show the highest
sensitivity, followed by dorsals and coronals.

These findings seem to contradict the previous suppositions of Jun, who claimed
that dorsal stops ought to have more salient cues than labials because of their
characteristic velar pinch in the transition from articulatory closure to full vocalic
opening. It also causes problems for Hume's claim that labials were "perceptibly
vulnerable" because of their lack of a salient release burst (as was hypothesized by Ohala
in earlier work). These results seem to show that, on the contrary, labials have the most
salient cues of any stop place of articulation.

The same results seem less problematic, though, when only the audio group is
taken into account (as in Figure 4b). Here labials—without the strength of their visual
cues--only have a slight advantage over dorsals in the comfortable listening level
condition, and no significant difference exists between them at speech reception
threshold. Coronal sensitivity, on the other hand, sinks lower than both dorsals and

labials. These results seem more in line with Jun's original rankings of place cue salience, even though labials are still surprisingly strong.

But comparing how results *change* between audio-visual conditions is the best way to determine which cues (for which place) really contribute the most to listener sensitivity (and could therefore be considered the most *salient* cues). In breaking the results down in this way, it is possible to see why phonologists like Jun and Hume might have made the assumptions they did. Figure 5 shows how much salience *increases* for each place of articulation whenever visual or audio information is added to the signal. These results are interesting for a number of reasons; first of all, the strength of visual cues for labial stops is dramatic, increasing salience values by .18 on the whole. Not quite as dramatic but no less significant is the fact that the salience of coronal stops increases much more than the salience of dorsals does. (.12 vs. .07) Even though coronal stops do not usually induce a McGurk effect, it seems that people are more sensitive to their visual cues than they are to dorsal visual cues.

Adding audio information to the perceptual task seems to turn things around completely, interestingly enough. Dorsals and coronals both gain significantly more salience from the addition of audio information than labials do. Since phonologists have traditionally thought of perceptual salience as limited to a speech event's acoustics, this graph may explain why labials have always gotten the short shrift in past evaluations of perceptual salience. Even though labials are, in general, more salient than coronals or dorsals, they do not seem to gain much salience through only their acoustic cues. If these were the only cues that mattered in the perception of stops, then labials might, indeed, be the most "perceptibly vulnerable" of the various places of articulation. It may also be the case that only acoustic cues have an "outside-in" effect on phonological structure.

Part of what might have reduced labial sensitivity in these comparisons, though, is the ceiling effect induced by the comparative strength of the labials' visual cues. Since labials in the audio-visual condition approximate maximum sensitivity, there is little room left for them to improve when more audio information is added to the speech reception threshold condition. Figure 5b shows a slightly modified version of Figure 5, calculating the increase in audio sensitivity by only including the differences between the two audio-only conditions. Here added audio information increases the sensitivity of labials just as much as it increases the sensitivity of coronals or dorsals. This figure

probably paints a more realistic picture, therefore, of the audio-only strength of labial cues in comparison to other places of articulation. Since there are no significant differences among acoustic cues for the three places of articulation, it seems difficult to claim that they might drive phonological rules applying to one place of articulation but not the others.

Almost all of the other factors tested in this experiment yielded significant results that might have been predicted by those familiar with phonological theory and speech perception. Besides the between-subjects video factor and the within-subjects volume factor, the syllabic position of the stop consonant also contributed significantly to cue salience. Stops in onset position were more salient than stops in coda position, in other words (Figure 6; #6 in Appendix). These results confirm Jun's ranking of preservation constraints for coda and onset position in (4). Another significant factor was stress, which implies that place cues were more salient in stressed syllables than in unstressed syllables (Figure 7; #7 in Appendix). This confirms Hume's conjecture that place cues are more salient in stressed syllables than unstressed syllables; this may, therefore, be one motivating factor in metathesis processes (as in Kui) that shift labials from unstressed to stressed syllables. However, labials lose salience in moving from onset to coda position (see Figure 6), so perceptual gain is probably not a factor in metathesizing labials between these positions.

Interestingly, the one factor which did not prove to be significant was the manner factor--sensitivity did not significantly increase in oral stops as opposed to nasal stops (Figure 8). Although sensitivity did increase somewhat between these two conditions, its F value fell just short of reaching the 1% significance level in the repeated measures ANOVA (df=1,27, F=3.375, p=.078). This result is surprising in that it contradicts Jun's ranking in (5), in which he claimed that cues for oral stop place are stronger than cues for nasal stop place. It also seems surprising given the relative susceptibility of nasals to undergo place assimilation (see Mohanon (1993)).

Figure 8 also provides some explanation for the strong position*manner factor (df=1,26, F=215.032, p=.000; #16 in Appendix). Figure 8 shows that, even though manner alone was not a significant factor, there *was* a significant difference between the sensitivity of oral dorsal stops vs. nasal dorsal stops. This difference probably arises from the fact that half of the dorsal nasal stops in this experiment were in onset position,

which is not allowed by English phonotactics. The English-speaking listeners in this experiment were therefore forced to make perceptual judgments about dorsal nasals in a completely unexpected syllabic position; their failure to perceive these segments as well as they perceived their oral counterparts may be attributed to their lack of experience in dealing with such a perceptual task. This discrepancy also reveals the insidious persistence of inside-out phonological effects even in this minimally meaningful experimental task. The fact that phonological knowledge contributed to listeners' perception of phonotactically acceptable sequences means that the judgments the listeners made in this experiment were not simply universal responses to the *inherent* cues for the different places of articulation. A true evaluation of the strength of these inherent cues would have to find some way to eliminate these language-specific phonological effects.

Neither Jun nor Hume mentioned vowel-specific effects on patterns of phonological assimilation or consonant/consonant metathesis, but this study included consonant productions with both /a/ and /i/ on a hunch that visual effects might be stronger for a more open vowel (like /a/) than for a more closed vowel (like /i/). There was a significant vowel effect in the repeated measures ANOVA (df=1,26, F=135.744, p=.000; #4 in Appendix), but this apparently had more to do with the acoustic characteristics of /a/ and /i/ than it did with their visible effects on consonant articulation. /a/ had a much higher inherent amplitude than /i/, and therefore induced much higher sensitivity scores in the audio-only conditions. In the audio-visual conditions, however, these acoustic effects disappeared and productions with /a/ and /i/ were perceived equally well. The vowel*video factor is thus significant (df=1,26, F=156.887, p=.000; #5 in Appendix), but for reasons that were not originally expected.

DISCUSSION

One reason that this experiment yielded such surprising results--and failed to justify cross-linguistic patterns in metathesis and place assimilation--may be that it oversimplified the experimental task. Though Jun and Hume both refer to the "inherent" perceptual salience of segments in motivating their phonological hypotheses, they are both concerned with processes that take place in a particular phonological environment. Hume, for instance, is concerned with consonant/consonant metathesis across a syllable

boundary while Jun is mostly preoccupied with stop place assimilation in coda position.

In an effort to simplify the perceptual task (and also eliminate potential "inside-out" influences on perception), this experiment only tested the perception of place in an isolated context in nonsense words. It did not strictly test unreleased stops or stops that were immediately followed by conflicting place information for some other consonant. It is very likely that the relative salience of certain stop cues may change in these different contexts, and it may be that this variation in salience is what motivates certain assimilatory and metathesis processes in a language's phonology. Testing this contextual salience in such a way that listeners cannot depend on internalized language-specific knowledge about place cues in context but must, rather, base their perceptual judgments only on what sounds they hear or see seems to be a daunting task for speech perception. However, only with such studies could the universal facts about place cue perception (in or out of a linguistic context) be established and thereafter used with any scientific certainty in phonological analyses.

On a more immediate note, this present study offers a new insight into the inherent salience of audio and visual cues for stop place of articulation. Some of its most interesting results involve the strength of both audio and visual cues for labial stops. The perceptual significance of visual cues for coronal stops also seems to contribute something new to our knowledge of visual speech perception, since these cues do not seem to be strong enough to induce a "McGurk effect" and have therefore gone hitherto unrecognized. The work of Hume et al. (1999) also shows that the salience of acoustic dorsal cues increases greatly when they are produced with the vowel /u/, which was not included in this study. A future replication of this study with more and different vowels may give reason to re-evaluate the tentative ranking of cue salience by place.

Hume et al. (1999) also shows that speakers of different languages may vary in sensitivity to different acoustic cues for place. Likewise, some studies by Sekiyama and Tohkura (1991 and 1993) show that the strength of the McGurk effect may differ between Japanese and American listeners. The fact that such cross-linguistic differences in perception seem to exist makes it impossible to claim that the English-only results of this experiment genuinely reflect some universal tendencies in perception. Replicating this experiment with native perceivers of other languages is only one of the many tasks that

need to be undertaken by those theorists who deem it necessary to turn phonology inside out.

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     393.

Table I
Significant effects from a repeated measures ANOVA of sensitivity (I)

Source of Variance	DF	F	P	
Position*Manner	1,26	215.032	0.000	
Vowel*Video	1,26	156.887	0.000	
Vowel	1,26	135.744	0.000	
Place	2,25	115.32	0.000	(see Figure 2)
Volume	1,26	104.204	0.000	
Vowel*Manner	1,26	34.534	0.000	
Manner*Stress	1,26	34.046	0.000	
Vowel*Position*Video	1,26	31.098	0.000	
Position*Manner*Place*Video	2,25	28.673	0.000	
Vowel*Place*Video	2,25	27.613	0.000	
Place*Video	2,25	26.586	0.000	(see Figure 3)
Position*Manner*Place	2,25	26.586	0.000	
Position*Stress	1,26	25.271	0.000	
Volume*Video	1,26	23.522	0.000	
Volume*Position*Manner	1,26	22.477	0.000	
Volume*Vowel*Place*Video	2,25	17.799	0.000	
Volume*Position*Place*Video	2,25	17.073	0.000	
Vowel*Place	2,25	16.196	0.000	(see Figure 4)
Volume*Vowel*Place	2,25	13.795	0.000	
Volume*Position*Place	2,25	12.238	0.000	
Stress	1,26	15.382	0.001	(see Figure 7)
Vowel*Position	1,26	15.078	0.001	
Volume*Place	2,25	9.023	0.001	
Vowel*Manner*Video	1,26	12.342	0.002	
Manner*Place	2,25	7.878	0.002	
Vowel*Manner*Stress*Place	2,25	7.715	0.002	
Position	1,26	10.190	0.004	(see Figure 6)
Vowel*Position*Manner	1,26	9.266	0.005	
Volume*Manner*Stress*Video	1,26	7.779	0.010	
Volume*Place*Video	2,25	5.519	0.010	(see Figure 5)

Between listeners factor:
Video: Audio-visual, Audio-only

Within listeners factors:
Place: Labial, Coronal, Dorsal
Volume: Speech reception threshold, Comfortable listening level
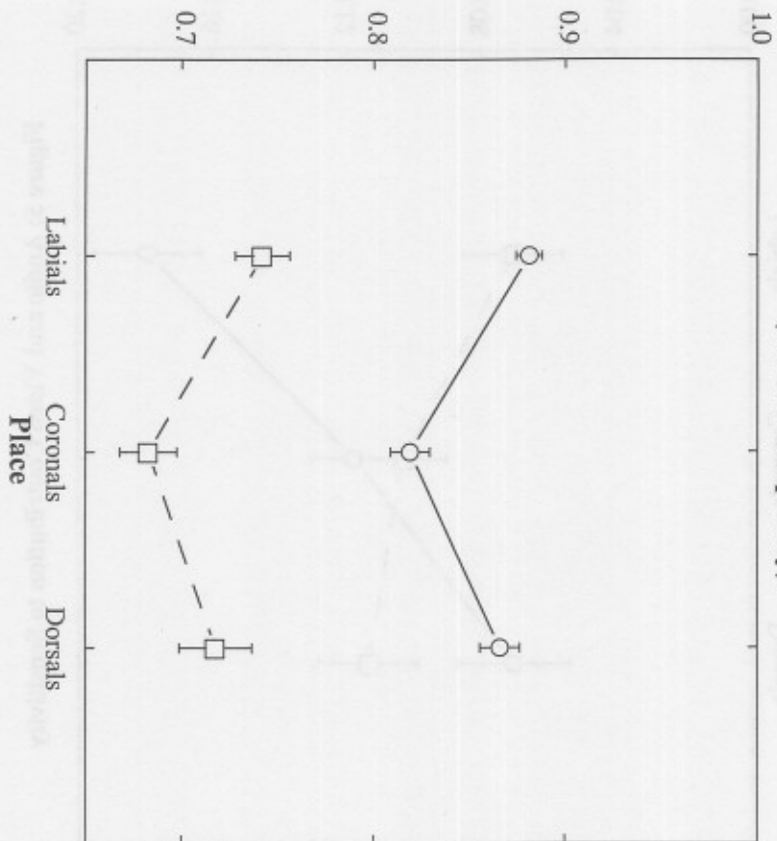Position: Onset, Coda
Stress: Stressed, Unstressed
Manner: Oral stops, Nasal stops
Vowel: [a], [i]

Figure 4b: SRT vs. CLL Sensitivity
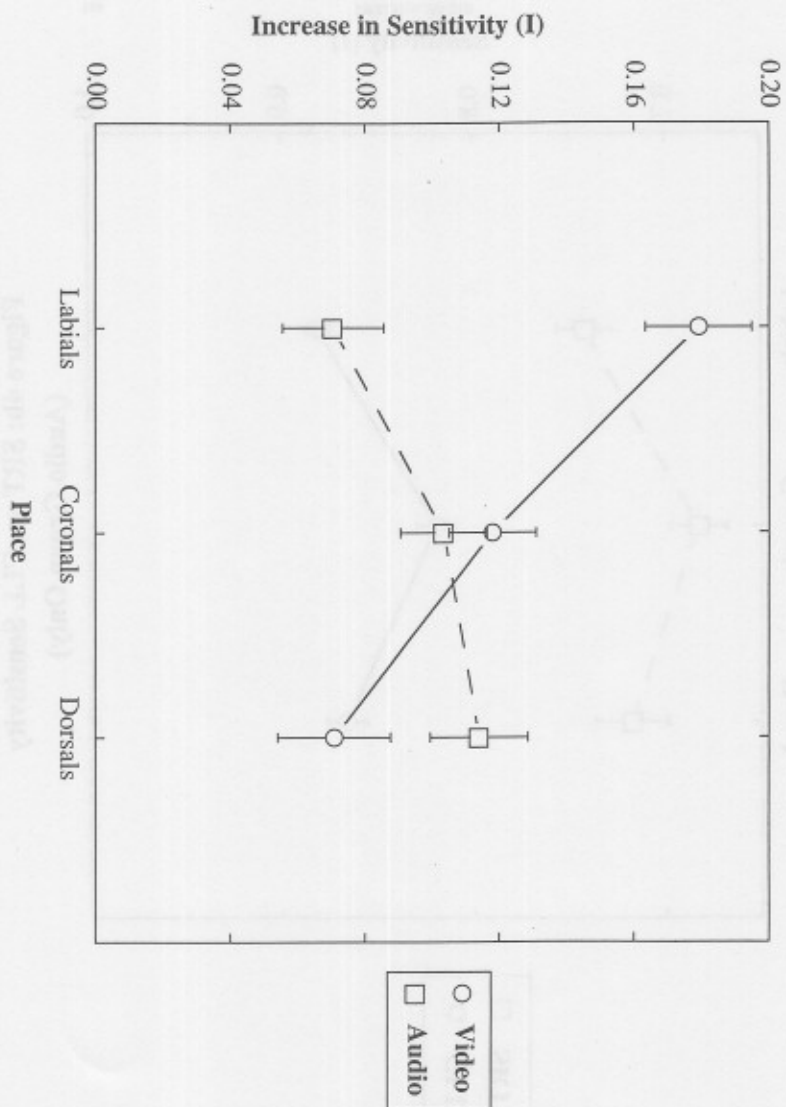(Audio Group Only)

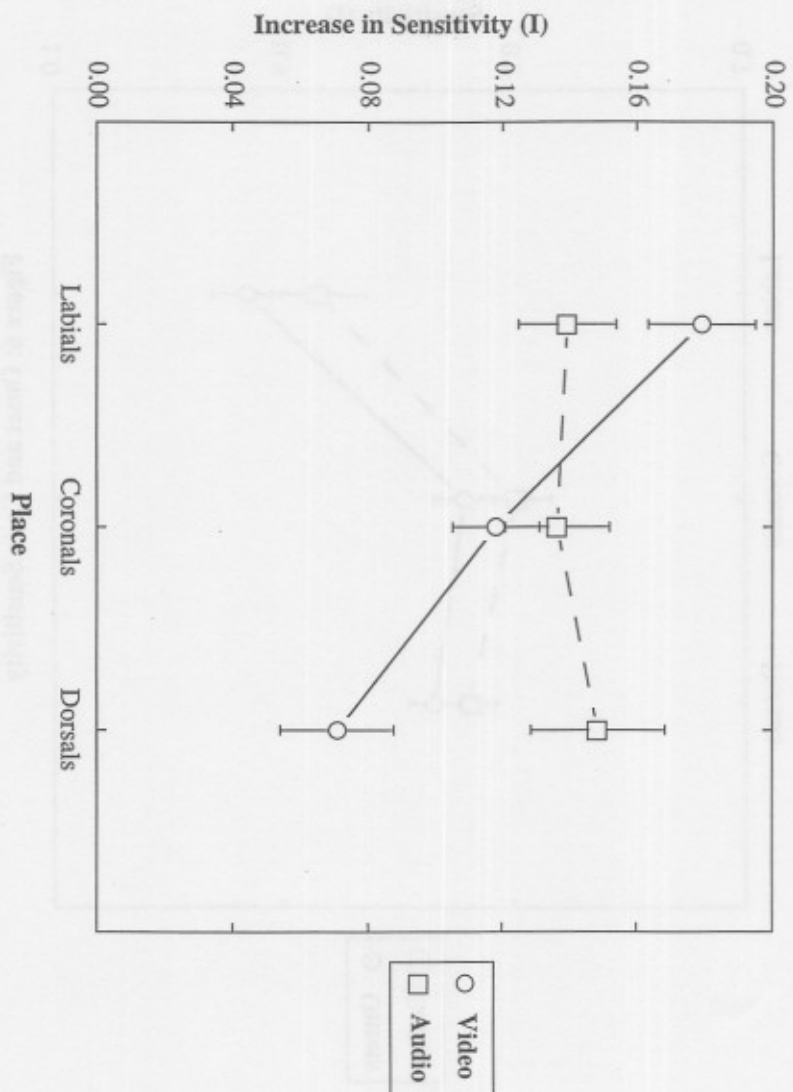Figure 5: Audio and Video Contribution to Sensitivity

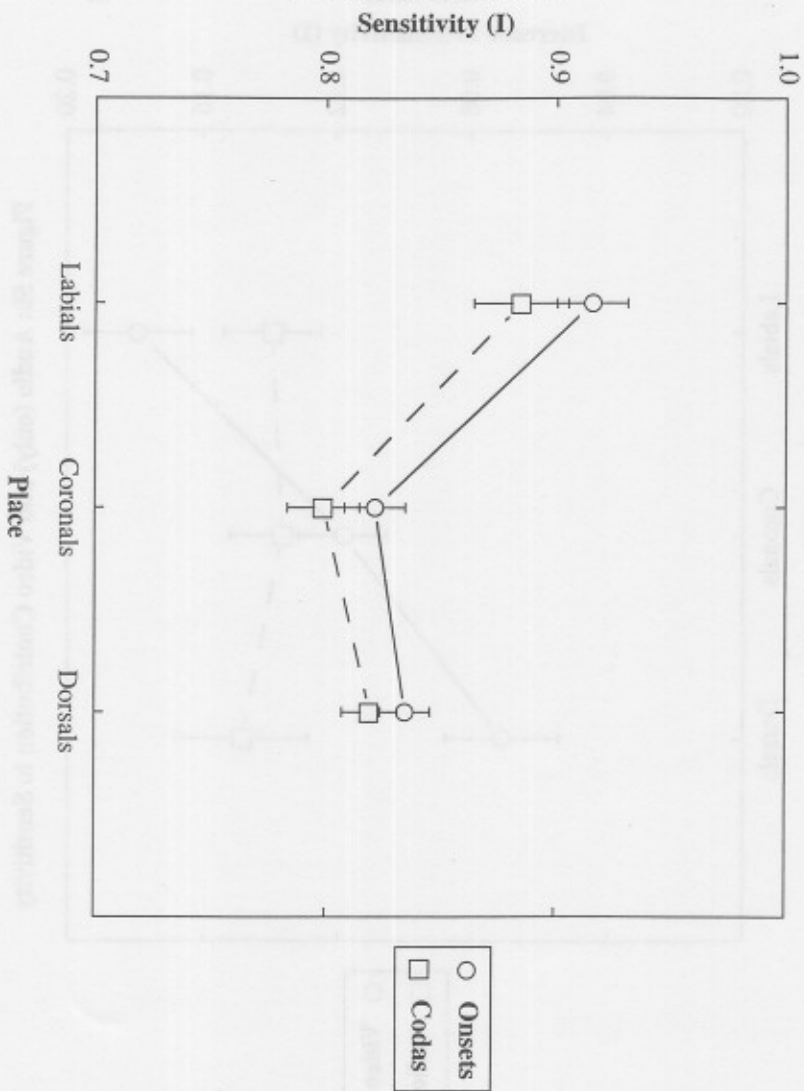Figure 5b: Audio (only) and Video Contribution to Sensitivity

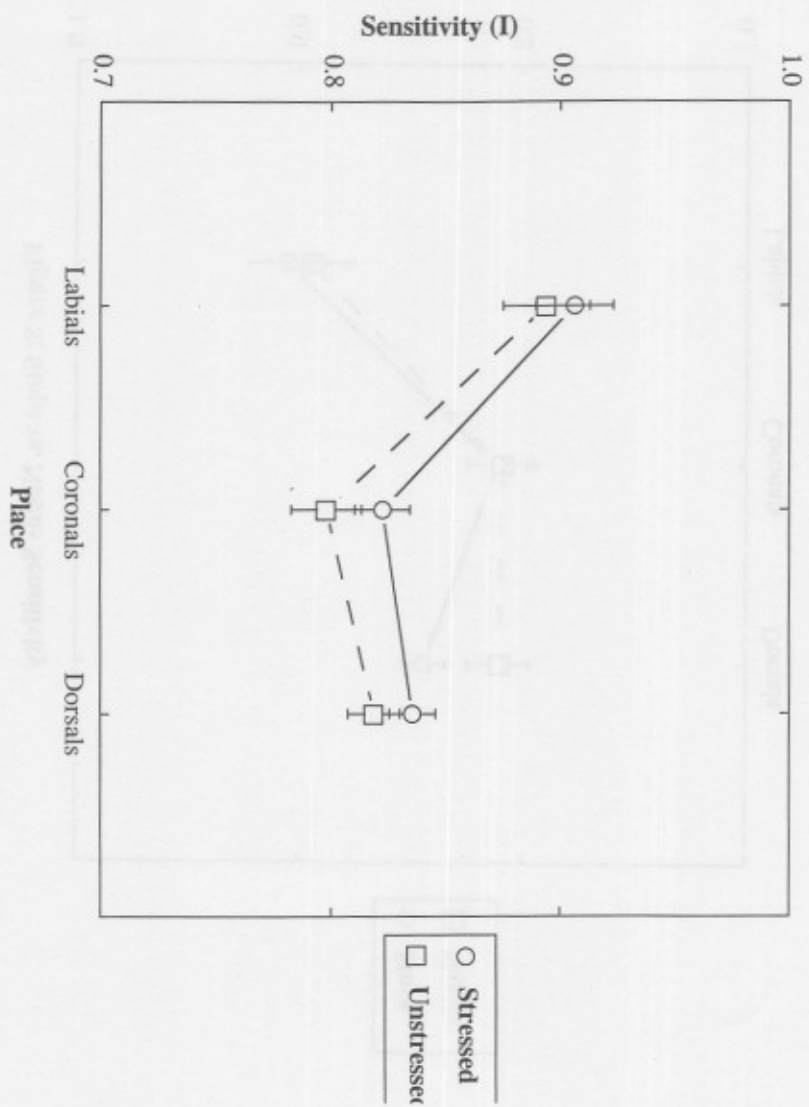Figure 6: Onset and Coda Sensitivity
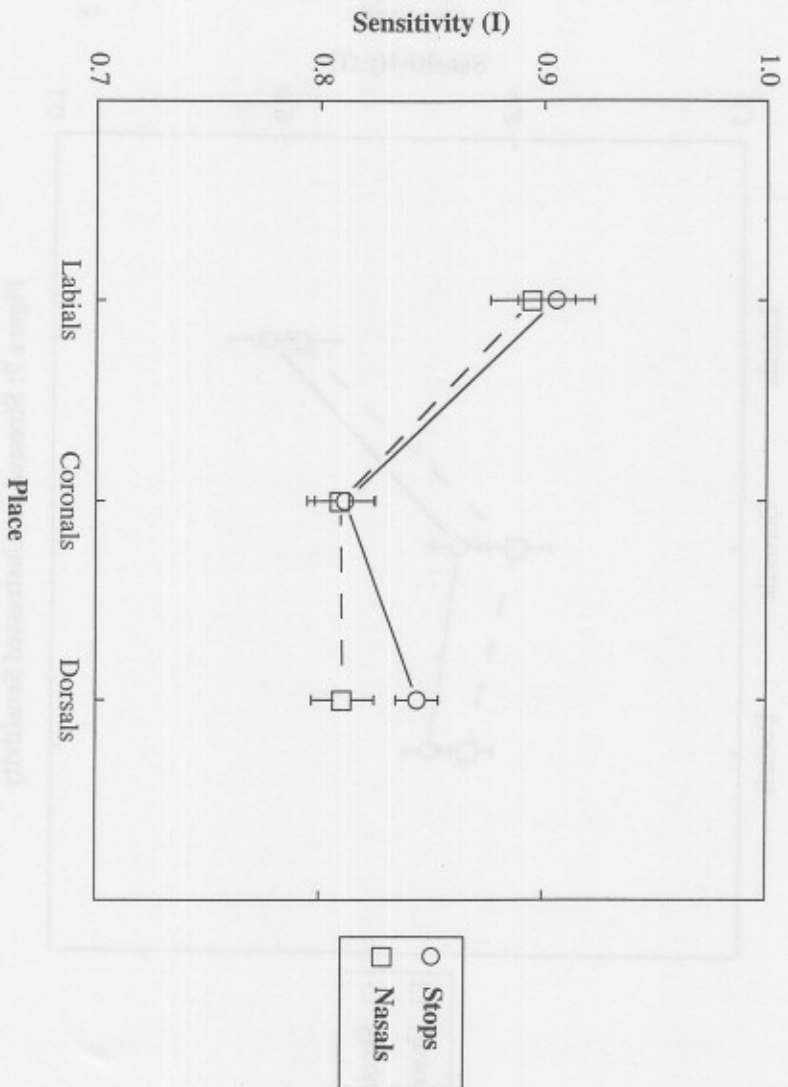
Figure 7: Stressed vs. Unstressed Sensitivity
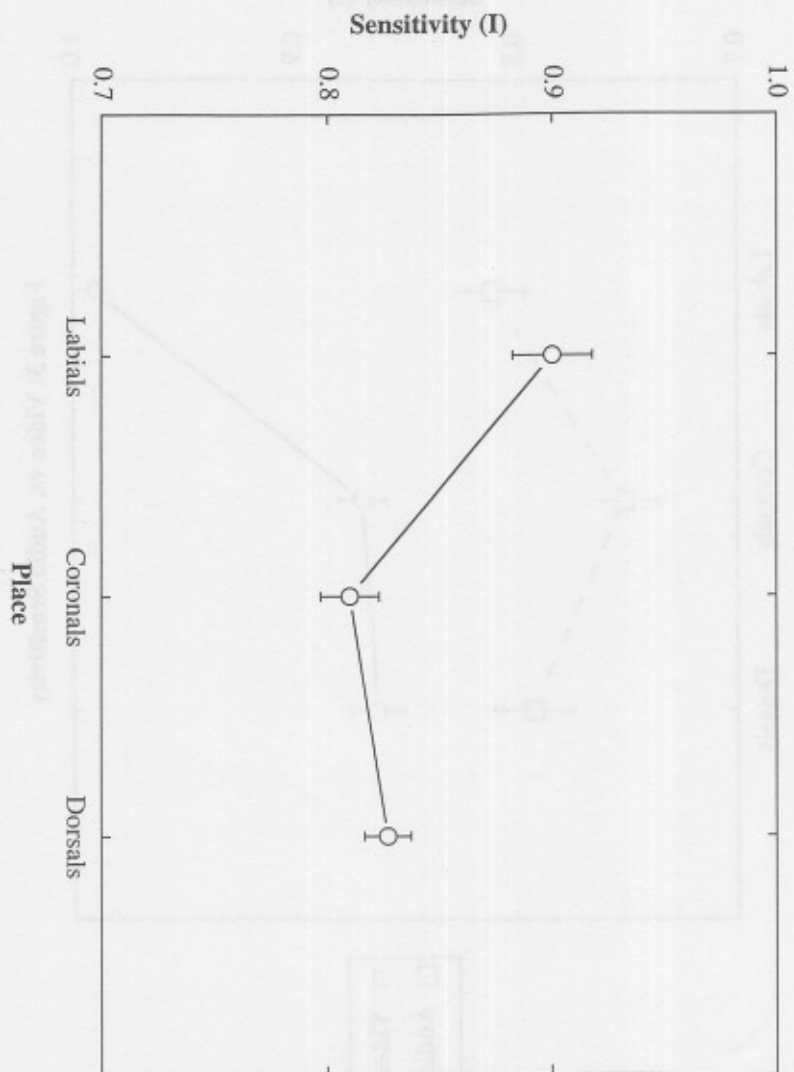
Figure 8: Stops vs. Nasals Sensitivity
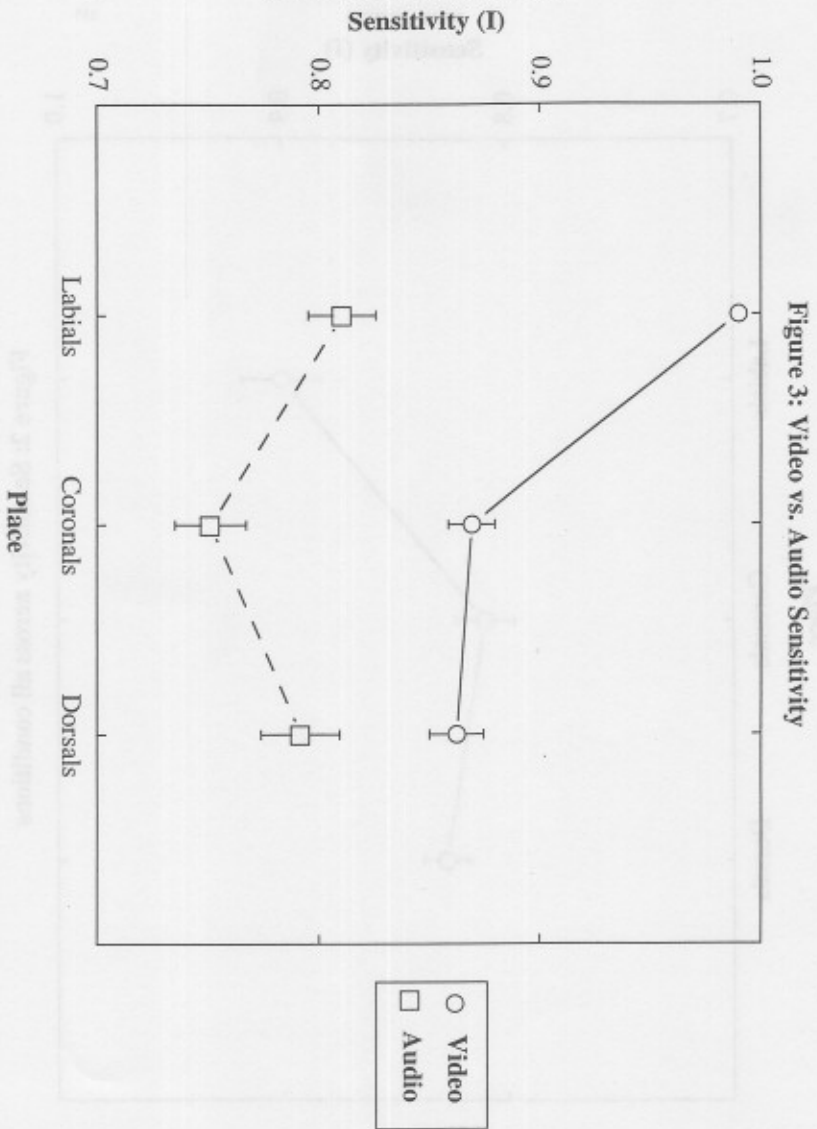
Figure 2: Sensitivity across all conditions

Sensitivity (I)

Figure 3: Video vs. Audio Sensitivity