Resolving Category Ambiguities - Evidence from Stress Shift

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ABSTRACT

This paper presents an experimental study of stress shift in category-ambiguous material. Sequences such as Chinese fan exhibit phonological evidence for two structural analyses. If Chinese is an adjective, fan is stressed; the sequence is a syntactic phrase. If Chinese is a noun, fan is deaccented and the sequence a compound. Additionally, as Chinese is a stress shift item, stress shift may apply in the phrasal interpretation. Thus, category-ambiguous sequences with a potential for stress shift might contain earlier cues to syntactic category than sequences without such a potential. Production data show that stress shift patterns do indeed map onto syntactic categories, but only if the second element in the sequence is not right-branching. A comprehension experiment suggests that stress shift may facilitate category assignment.

1. INTRODUCTION AND BACKGROUND

Syntactic, semantic, morphological and phonological information supply evidence for grammatical categories. So far, little research has been carried out to establish the nature of the phonological correlates of grammatical class (Kelly 1992). In the category-ambiguous potential stress shift sequence *Chinese fan*, *Chinese* may be either an adjective or a noun, i.e. the sequence is [A+N] or [N+N]. This paper investigates whether the incidence of stress shift (e.g. Giegerich 1985) varies with the different structural analyses, and whether the (non-)occurrence of the process can cue the correct structural interpretation in comprehension.

A category-ambiguous (CA) sequence such as [1] *a French fan* may be interpreted as (a) a fan from France or (b) a fan of the French language. Structurally, (a) is commonly described as a syntactic phrase and (b) as a compound (Liberman & Prince 1977, Bauer 1983, Radford 1988). At first glance, the difference seems clear; however, as Matthews (1974) points out, the distinction between compounds and phrases in English is problematic. Relevant criteria may be drawn from various sources and these do not yield the same results. Radford (1988) correlates different syntactic categories with different stress patterns. Items such as *increase* carry primary stress on the second syllable when verbs and on the first syllable when nouns. Similarly, the two possible interpretations of *a French fan* are said to correlate with two different stress patterns found in phrases and compounds. The phrase has greater prominence on the second element, and the compound has greater prominence on the first. This corresponds to a difference in the syntactic category of *French*: when this word is an adjective in a phrase [2], then *fan* has greater relative prominence; if *French* is a noun in a compound [3], then it is more prominent than *fan*.

Selkirk (1984) suggests that the incidence of stress shift varies with respect to syntactic category and attributes this to the prominence relations at the supra-word level: when *fan* is more prominent, as in the phrase, then stress shift will apply to an immediately preceding stress shift item. This is of interest to speech comprehension. If stress is

shifted reliably in the phrasal interpretation, then this might signal that an accented word is likely to follow and a [A+N] interpretation might be cued early. Thus, CA sequences containing stress shift items [5] might contain an additional cue to syntactic category that non shifting CA sequences [4] do not have.

[4] *French fans are popular.*
[5] *Chinese fans are popular.*

In [4], the category ambiguity is likely to be resolved when listeners hear *fans*. If the information in [5] is processed as it is heard, then the relative stress pattern of *Chinese* may resolve the ambiguity earlier.

First, we need to determine how well the incidence of stress shift correlates with differences in syntactic category. Liberman and Prince (1977) state that relative prominence is defined on syntactic constituents and define prominence relations on each pair of sister nodes in a syntactic structure. According to the nuclear stress rule (a) and compound stress rule (b) the following should apply:

(a) if a sequence such as *Chinese fans* is a phrasal category, *fans* is strong;
(b) if a sequence such as *Chinese fans* is a compound, the second element is strong if it branches.

(b) means that sequences such as [6] *French entrance exams* and [7] *Chinese entrance exams* will not be distinguished in their phrasal and compound forms because the branching right element (*entrance exams*) will be strong. [7] will exhibit stress shift in both phrasal and compound interpretations, unless speakers produce stress clashes in order to map rhythmic patterns of stress shift items onto syntactic structure systematically. The next section examines the reliability of stress shift as a marker of syntactic category.

2. INCIDENCE

A production experiment has been carried out testing the incidence of stress shift in non-right-branching and right-branching CA sequences. We predict (i) that in non-right-branching sequences speakers produce phrasal stress patterns in [A+N] sequences and compound stress patterns in [N+N] sequences; and that stress shift applies in phrases, but not in compounds. Furthermore (ii) we expect phrasal stress patterns and stress shift in both [A+N] and [N+N] right-branching sequences.

Twelve native speakers of Southern British English read 24 sentences with the following category-ambiguous sequences:

- non-right-branching CA sequences with a non-stress shifting (-SI) first element, e.g. *French fans*
- non-right-branching CA sequence with a stress shifting (+SI) first element, e.g. *Chinese fans*
- right-branching sequences with a -SI CA first element, e.g. *French entrance exam*
- right-branching sequences with a +SI CA first element, e.g. *Chinese entrance exam*

The sentences were read with over 70% fillers in two sessions, approximately one week apart. A trained phonetician performed an auditory analysis of the data, assigning phrasal or compound stress patterns to each sentence. Table 1 below presents the percentage of phrasal stress patterns for *French fans* and *Chinese fans*. In the -SI sequence *French fans*, speakers produced only phrasal stress patterns for [A+N] and only compound stress patterns for [N+N] sequences. In the +SI sequence *Chinese fans*, the [A+N] sequence also always had phrasal stress, and a small number of [N+N] sequences showed phrasal stress. Each incidence of phrasal stress in the +SI items was accompanied by stress shift on Chinese. The results confirm hypothesis (i). A clear preference for the phrasal stress pattern emerged in sequences with branching second elements (Table 2). Again, phrasal stress on +SI items was accompanied by stress shift. This confirms our second hypothesis (ii).

Table 1. *Distribution (%) of phrasal stress patterns in CA sequences without (-SI) and with (+SI) stress shift items (French fans and Chinese fans respectively).*

	-SI	+SI
A+N	100	100
N+N	0	17

Table 2. *Distribution (%) of phrasal stress patterns in right-branching CA sequences without (-SI) and with (+SI) stress shift items (French entrance exams and Chinese entrance exams respectively).*

	-SI	+SI
A+N	100	75
N+N	100	100

3. COMPREHENSION

On the basis of the production data, we ask whether (i) listeners are sensitive to a phonological distinction between compounds and phrases, and (ii) stress shift provides additional information which facilitates syntactic category assignment. To address these questions, we carried out a comprehension experiment with non-right-branching test sequences only, since the production data suggests that right-branching sequences do not exhibit a correlation between stress shift and syntactic category.

In a cross-modal naming task, subjects heard sentence fragments ending with category-ambiguous -SI and +SI tokens. All -SI tokens had two syllables and late stress, thus matching +SI tokens in number of syllables but not stress shift. Examples of fragments with -SI and +SI tokens are given in [8a] and [8b] respectively.

[8a] *I'm trying to find reliable Malay*
[8b] *I'm trying to find reliable Chinese*

The subjects' task was to name a visual probe presented at the end of each sentence fragment. For the sentence pair in [8] the probe word was SERVANTS. This probe is appropriate if the preceding CA word (*Malay* or *Chinese*) is an adjective, but not when it is a noun. The sentence materials from which the fragments were taken were recorded with nuclear accent either on the CA word or on the following word, giving four context conditions as in Table 3. We predict that when a fragment is heard with nuclear stress on the CA word, this signals a [N+N] compound with prominence on the first element, as no further accented syllables should follow. In this case, the probe SERVANTS will be inappropriate. By contrast, if the CA item is prenuclear, it is likely to be interpreted as the first element of a phrase, and the probe will be appropriate.

Table 3. *Test conditions and average response times (in msec) in comprehension experiment.*

condition	structure	item type	accent	CA item	probe	average RT
A	N+N	-SI	+nucleus	Ma'**lay**	inappropriate	619.6
B	A+N	-SI	-nucleus	Ma'**lay**	appropriate	586.3
C	N+N	+SI	+nucleus	Chi'**nese**	inappropriate	638.6
D	A+N	+SI	-nucleus	'**Chi**nese	appropriate	538.3

Thus we predict (i) that for -SI and +SI items, the reaction time (RT) will be longer if the probe does not agree with a [N+N] interpretation (i.e. conditions A and C should be slower than B and D respectively) and (ii) that the difference in RT for appropriate and inappropriate probes will be larger for +SI items (i.e. the difference between C and D will be greater than that between A and B). The average reaction time data are given in the final column of Table 3, and confirm both these hypotheses. For both -SI and +SI items, subjects react significantly faster to probes in the A+N condition. Furthermore, the effect is stronger for the +SI item *Chinese* (where the difference between appropriate and inappropriate probes is 101 ms) than for the -SI item *Malay* (where it is 34ms). That these effects result from the interpretation of the CA item and the consequent integration of the probe word, and not from some other property of the context fragments, is made clear in corresponding control conditions where the same

fragments were followed by the probe word TEACHERS. This word is appropriate in all conditions (i.e. as the second element of a compound and as the head of a noun phrase modified by the CA word), and the response times did not differ across conditions A to D.

The pattern of results for SERVANTS would seem to confirm both hypothesis (i), that nuclear stress placement will determine the category interpretation of the CA item, and hypothesis (ii) that stress shift provides additional information which facilitates parsing. However, we found that stress shift does not cue syntactic category reliably for other category-ambiguous items such as *dark-blue* or *grown-up*. This is presumably attributable to morphological and semantic differences between such items and the nationality/language items. For example, *dark-blue* has two free morphemes, either of which may be contrastively stressed. This means that greater prominence on *blue* does not necessarily exclude the adjectival interpretation, and thus the following probe word may have been appropriate in all conditions.

4. DISCUSSION AND CONCLUSION

In Grabe & Warren (1993) we show that in connected speech the application of stress shift is highly likely, but can rarely be predicted with any degree of certainty for a particular sequence. The current production data suggest that stress shift occurs reliably in CA stress shift sequences with a branching right element. Furthermore, the data suggest that in non-right branching CA sequences the application of stress shift correlates with syntactic category. It would appear that category-ambiguous stress shift items allow us to predict the application or non-application of the process with a higher degree of certainty than our previously studied materials.

The comprehension data show that in CA sequences of the type *Malay servant*, listeners are sensitive to stress signalling a distinction between compounds and phrases, and that they are able to supplement this with stress shift information on CA items such as *Chinese* in *Chinese servant*. This suggests that the phonological information in stress shift sequences affects syntactic parsing as follows: the application of the process is likely to indicate that an accented item will follow - this cues a phrasal interpretation. Non-application suggests that the following item (if N) should be compounded. However, it appears that this applies only to sequences with nationality/language items such as *French* or *Chinese* followed by non-right branching items.

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