THE DISTRIBUTION OF SPEECH ERRORS IN PROSODIC PHRASES IN KOREAN

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ABSTRACT

In order to examine the distribution of errors in different phrases in the Korean prosodic hierarchy, 12 native Korean speakers were recorded while producing tongue twisters. The resulting errors were categorized and their location coded with respect to the prosodic structure of the utterances in which they occurred. Findings were that a disproportionate number of errors occurred in initial or early position of Accentual Phrases (AP) and towards the end of Intermediate Phrases (ip) and Intonation Phrases (IP). The findings are interpreted to suggest that the AP is a structural unit that enables the serially encoded of speech sounds, while the ip/IP is a functional planning unit in which meaningful chunks of speech are organized for output.

Keywords: speech error, Korean prosodic phrase, production and planning process

1. INTRODUCTION

A number of studies on sequential speech errors have found that word-initial segments are more likely to be transposed, anticipated, or perseverated than word-final segments (e.g. [3, 10]). Shattuck-Hufnagel [10] has suggested that the prevalence of errors in word-initial position is due to the fact that word- or foot-initial slot is unique in potentially sharing both phrase-level prominence and lexical stress. Dell, Juliano & Govindjee [3] and Frisch [4] have suggested that errors are especially likely in word-initial position because the initial segment of a word is less predictable than subsequent ones, and so more candidate phonemes are likely to compete for the position, creating a larger number of errors.

Few studies have investigated the distribution of speech errors in prosodic units larger than the word, but results from two studies on the distribution of errors within Intonation Phrases (IP) suggest that errors are more likely to occur towards the end of these units and the least number to occur in initial position [1, 2]. Choe & Redford [1] suggested that this pattern of error distribution could be explained if IPs serve as planning units rather than structural units. Specifically, the activation of these units would correspond to the implementation of speech planned there within. If this activation cascades forward to the structural prosodic units that enable the serial encoding of speech elements, and overall IP activation decays as units within the IP are executed, then units towards the end of an IP will be receiving less activation than units that occur earlier in the IP, which may impede sequencing operations.

Whether one accepts that initial errors are attributed to encoding processes and final errors to planning processes, the well-structured distribution of errors within the prosodic units confirms their psychological reality and suggests a probe for investigating the hierarchical prosodic structure of languages more generally. The current study focused on units intermediate between the lexical foot and the IP in an effort to determine their psychological reality.

The identity of supralexical prosodic units in English that are smaller than the IP is the subject of discussion and disagreement [11]. By contrast, the supralexical units in Korean are well defined for the Seoul dialect of Korean [5, 7, 8, 9].

Korean has several unique prosodic characteristics. The language is syllable-timed and so does not have lexical stress, tone, or pitch accent. Instead, Korean has 3 phrase-level prosodic units: the Accentual Phrase (AP), the Intermediate Phrase (ip), and the Intonation Phrase (IP). The AP in Korean is the smallest phrase-level unit. It is defined by one of two tone patterns, either LHLH or HHLH, depending on the AP-initial segment. An AP is defined completely by this tone sequence, having neither obligatory final lengthening nor other features of temporal boundary marking.

The next larger unit in Korean is the ip, which is the domain of focus and of phonetic downstep. It is marked by either a pitch reset on the ip-initial syllable or by a higher AP-final high tone in an ip-

final syllable. The final boundary of an ip is also not obligatorily marked with final lengthening.
The largest prosodic unit in Korean is the IP, which is marked off by one of nine boundary tones and by obligatory final lengthening. An IP can also be followed by a pause.

The current study focuses on the 3 phrase-level prosodic units in Korean to probe their psychological reality and to gain insights into their role in speech planning and production.

2. METHODS

2.1. Participants

12 native speakers of Korean participated in the study. All were native speakers of the Seoul dialect.

2.2. Stimuli

Participants repeated 26 Korean tongue twisters 6 times in one of 3 pre-determined randomized orders for a total 156 tongue twister productions per participant. The Korean tongue twisters used in the current study ranged between 1 and 3 of sentences and between 7 and 150 syllables.

2.3. Procedure

Each participant was seated in front of a computer monitor. The tongue twister stimuli were presented one by one on the monitor first in green and then in red. When each tongue twister was presented in red, participants were to read it silently and prepare to produce it. Once participants felt ready to produce the tongue twister, s/he pressed a button on the keyboard, turning the stimulus from red to green with a beep sound, which signaled to the participant that they should begin to speak. This procedure was used to minimize the possibility of reading errors and to maximize the likelihood that participants would produce well-planned speech.

Participants were also instructed to produce the sentences at a comfortable speaking rate and to not stop, hesitate, or self-correct even when they made errors. This instruction was meant to minimize the number of disfluent productions and to increase the number of errors.

Participants were given 10 practice trials to get familiar with the procedure and the constraints. The experimenter remained with the participant throughout the experiment to provide corrective feedback on speech rate and fluency. Participants' speech was digitally recorded for later analysis.

2.4. Coding speech errors and prosodic units

2.4.1. Speech errors

The author listened to the recordings and coded the occurrence of speech errors. A second native Korean speaker also independently listened to recordings and identified speech errors. Inter-coder reliability was 93.32%.

Speech errors were then categorized as errors of anticipation, perseveration, anticipation and perseveration, deletion, insertion, or lexical substitution. Errors identified as errors in sequencing (anticipation and/or perseveration) had a source from within the tongue twister. Of course, tongue twisters are special in that they provide multiple sources for sequencing errors. In this study, the source was identified following the criterion of nearness. Errors were categorized as anticipatory when the nearest source was subsequent to the error, and as perseveratory when the nearest source preceded the error. Errors were categorized as both anticipatory and perseveratory when the preceding and subsequent element provided the source and both were equally close to the error. Hesitation and disfluencies were also noted, but not counted as speech errors.

2.4.2. Prosodic units

Next, sentences that contained speech errors were prosodically transcribed to identify AP, ip, and IP boundaries. K-ToBI conventions were used to mark AP and IP boundaries [6], but since the K-ToBI criteria are less clear criteria for identifying ip boundaries, these boundaries were identified by pitch reset in the ip-initial syllable or by an especially high H tone in an ip-final syllable [7]. An example of a tongue twister is provided in (1) along with its canonical prosodification. Each lexical word is divided by a space.

(1) $[[$*jeogi issneun*$]_{AP}[$*malttug-i*$]_{AP}[$*mal mael*$]_{AP}[$*malttug-inya*$]_{AP}]_{IP}$ $[[$*mal mos mael*$]_{AP}$ $[$*malttug-inya*$]_{AP}]_{IP}$
Is the stack there the one to chain a horse or not?

2.4.3. Error position

Once errors had been identified and the sentences containing errors prosodified, error position was coded. Error position referenced unit length, defined by the total number of syllables in a certain unit. Error position was coded in terms of syllable position within the unit counting from left to right. Each error was coded for position independently from all other errors in the same unit.

3. RESULTS

3.1. Speech errors

The average error rate was 28.58% (11.54% to 44.23% across participants). A total of 791 speech errors were identified in 535 stimulus sentences. 171 sentences had more than one speech error. Of the 791 speech errors, 277 were categorized as errors of anticipation, 263 as errors of perseveration, 141 as errors of anticipation and perseveration, and 110 as deletion, insertion, or lexical substitution. Only errors of anticipation and/or perseveration are discussed further in this study because they are homogenous and because they represented the majority of errors (86.09%).

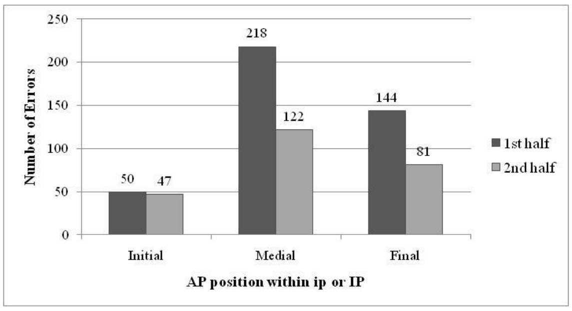
3.2. Prosodic units

A total of 484 tongue twisters contained sequencing errors and so were prosodified. All of the prosodified tongue twisters had one or more IPs, but only 31.20% of them had internal ip boundaries.[1] The prosodification of 484 tongue twisters yielded 607 APs with errors. 11.53% of these had more than one error.

3.3. Distribution of errors in prosodic units

The distribution of errors in APs was different from the distribution of errors in ips or in IPs. The interaction between error position in an AP and error position within an ip/IP is shown in Figure 1.

Figure 1: The number of errors is shown as a function of error position in the AP (1st or 2nd half) and as a function of AP position in an ip or IP (Initial, Medial, or Final).



Overall, 62.24% of errors occurred in the first half of APs and 61.17% of these occurred in the AP-initial syllable. As is evident from Figure 1, though, the overall number of errors in APs varied as a function of AP position within an ip or IP. 14.65% of the total errors occurred initial ip/IP position, 51.36% in medial ip/IP position, and 33.99% in ip/IP final position.

Figures 2 and 3 show a finer grain numeric breakdown of the errors in ips (Figure 2) and IPs (Figure 3). Since ips and IPs always had more syllables than APs, the units were divided into quarters and the errors within these quarters were counted.

Figures 2 and 3 show that more errors occurred towards the end of both ips and IPs: 64.65% of all errors were in the second half of ips, and 56.24% of all errors were in the second half of IPs. If an IP had internal ip boundaries, then errors were more evenly distributed than if the IP had no internal ip boundaries (see Figure 3).

Figure 2: The number of errors as a function of error position in ip.

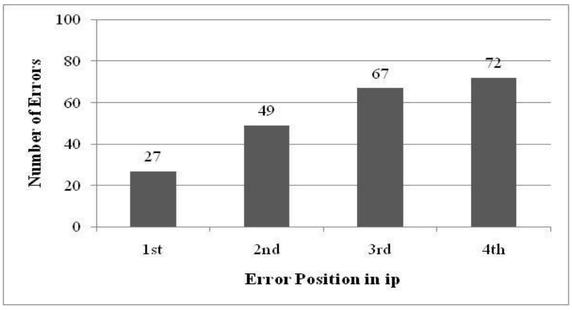
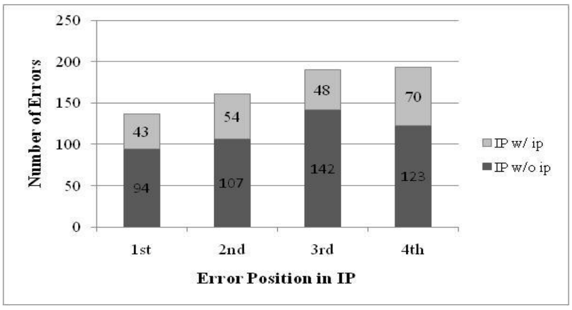


Figure 3: The number of errors as a function of error position in an IP with and without IP-internal ip boundaries.



4. DISCUSSION

The distribution of errors in Korean APs, ips, and IPs appears to be nonrandom. For several decades, nonrandom distributions of errors have been used to argue for the psychological reality of different linguistics units. Accordingly, the nonrandom distribution of errors in Korean prosodic phrases suggests their importance to planning and producing speech.

A central finding of this study was that the distribution of errors differed for APs and ips/IPs. Errors were more likely to occur in initial or early position in APs, but towards the end in ips and IPs. These results are interpreted to suggest that APs and ips/IPs have different roles in production.

The higher probability of AP-initial errors might be understood by extending Dell and colleagues' [3] model of word form encoding to the domain of AP. Specifically, the suggestion is that phonemes are serially encoded from the beginning to the end of AP. AP-initial position is especially error prone since the first element of an AP would be the least predictable element and so subject to the most competition between candidate elements.

On the other hand, and different from the initial error effect in English, many additional errors occurred after the first syllable in the AP, but before the second half of the unit. In effect, the AP showed an early error effect rather than an initial error effect. The early error effect might arise from the unique characteristics of Korean prosody at both the lexical and phrasal level. Spoken Korean must follow the AP-internal structure of phrasal tone (THLH) without any lexical-level prosodic specification such as stress or accent. The lack of a lexically-specified prominent syllable may provide fewer landmarks for accurate encoding, rendering the second syllable only slightly less predictable than the first. This idea extends Shattuck-Hufnagel's [10] view that prominences and prosody play a key role in the sequential coding of speech—a view that contrasts with Dell, et al.'s [3] lexicon-driven approach.

Interestingly, although Korean AP frequently larger than a word, some often corresponds with a 3-4 syllable word [8]. Thus, studying error patterns associated with Korean APs may provide a way to understand whether initial and/or early error effects are driven mainly by prosodic factors or mainly by lexical factors.

Unlike the pattern of error distribution in APs, the distribution of errors in ips/IPs suggested that these might be planning units. The notion of IPs/ips as planning units is further supported by the fact that pragmatic and discourse factors readily affect the size of these units. Thus, similar to IPs in English, errors may be more likely to occur towards the ends the ip/IP in Korean as activation decays during the implementation of the plan.

Although errors were more likely to occur towards the end of Korean ips/IPs than at the beginning of these units, the errors were nonetheless more evenly distributed than in English IPs. One explanation for this difference might be due to the rhythmic differences in the two languages. Since Korean is a syllable-timed language, each vocalic nucleus must be fully realized, unlike in English where unstressed vowels can be reduced to schwa. Fuller vowels mean more complete vowel specification, which may lead to more errors.

Another possible explanation for the difference in error patterns in English and Korean IPs is grammatical. Unlike English, IPs usually end with grammatical elements such as case-markers and affixes. Since the grammatical elements are much less likely to be errors, the number of IP-final errors in Korean can be smaller than in English.

5. ACKNOWLEDGEMENTS

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[1] The ip unit co-occurs with focus or complex syntactic phrases such as relative clause [7]. Because of the special nature of tongue twisters, focus-marking occurred frequently, which may account for why 31.20% IPs were determined to have internal ip boundaries even though ip boundaries are less obvious than AP or IP boundaries.