

LANGUAGE SWITCHING AND CONSTITUENT STRUCTURE

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A Thesis

Presented to

The Faculty of the Department of Psychology

University of Houston

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In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

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By

Peggy E. Bradley

December, 1973

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## ABSTRACT

Four experiments were performed to investigate the functioning of constituents as perceptual units and the independence of the two languages used by bilinguals. Two groups of bilinguals, Korean-English and Spanish-English, and two modalities of presentation, visual and auditory, were used. Split-language sentences were presented to bilingual subjects. The point in the sentence at which the language transition occurred was varied. One group was asked to respond "true" or "false" to sentences in which the switch in language occurred between constituents. Another group was asked to respond to sentences in which the language switch occurred within one of the constituents. Longer response times resulted from sentences in which the language switch occurred within a constituent. Results supported the position that major constituents define units which function in perception of sentences and that, in decoding, the two languages used by bilinguals are functionally distinct.

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## CHAPTER I

### INTRODUCTION

During the last decade, psycholinguistics has become an established part of psychology. Integrating the theoretical and empirical tools of both linguistics and psychology, the psycholinguist directs study toward the structure, acquisition, and use of language. Defining language as a "set of sentences", a linguistic event, or sentence, is regarded as an end product of the operation of a system of complex rules (Chomsky, 1957; Chomsky, 1965). Concerned with postulating underlying structures and processes of the linguistic event, as well as with providing a formal description of this structure of language, the psycholinguist conceptualizes a grammar or theory of language to delineate this system of complex rules.

The model of linguistic description which has emerged suggests that fundamental to every language is a set of phrase structure rules which generate the deep structure of sentences; this deep structure specifies everything necessary for establishing the meaning of a sentence and, in addition, specifies the surface structure, or superficial structure, of a sentence. The surface structure of a

sentence is obtained by applying transformational rules, or rearrangement rules, to deep structures. Further, sentences are not merely strings of words, but structured strings of words consisting of hierarchies of units. These units, called constituents, are described in a constituent or phrase structure analysis, and they represent abstract, structured patterns which underlie the syntactical, morphological, and phonological components of a grammatical sentence.

To illustrate the idea of constituents, with which this investigation is concerned, consider the sentence "That the dancer was skilled was apparent from his performance." The constituent or phrase structure analysis partitions this sentence into the following units: that the dancer was skilled; the dancer was skilled; was skilled; was apparent from him performance; apparent from his performance; from his performance; his performance. This analysis is expressed by placing brackets around each constituent of the sentence in the following manner: (((that) ((the) (dancer) ((was) (skilled)))) ((was) ((apparent) ((from) ((his) (performance)))))) (Slobin, 1971).

Pursuing the idea of constituent structure beyond the level of formal description, the following question arises: do the units defined by constituent analysis correspond to the perceptual units into which sentences are articulated

by speakers and hearers? That is, are constituent, or phrase structure boundaries, reflected in the individual's perception of sentences?

In the same fashion that constituent analysis describes units whose members are more closely related to each other than to members of a different unit, investigators have suggested that different languages constitute different systems (Macnamara, 1967; Macnamara, Krauthammer, and Bolgar, 1968). Conceptualizing language as a coding system which provides names (codes) for classes of objects and concepts and which provides a set of rules for indicating relationships among the names (grammar), each language is thought to have its own grammar and set of codes. Thus, different languages are considered to constitute distinct, separate, and independent systems.

As with constituent structure, pursuing this idea beyond the level of description, the question arises whether different languages function as separate and independent systems for a bilingual speaker or hearer. In other words, is the described independence between two languages reflected in an individual's perception of sentences?

The present series of experiments was designed to investigate the functioning of constituents as perceptual units and the independence of languages used by bilinguals.



## CHAPTER II

### REVIEW OF RELATED RESEARCH

The idea that some sort of phrase-like units are of functional significance in perception and expression of language has been considered for some time. Goldman-Eisler (1958) and MacLay and Osgood (1959) observed hesitation patterns in spontaneous speech and demonstrated that discontinuities occurred with increased frequency at phrase boundaries and that repetitions typically involved minimal phrase units.

Ladefoged and Broadbent (1960) presented evidence that the unit of speech perception must be longer than a single speech sound. Subjects listened to English sentences and strings of digits, each of which had an extraneous sound (a click) superimposed over it. The task was to note the word during which the extraneous sound was perceived. Arguing that switching from processing verbal to processing non-verbal material (the click) might interfere with perception of a natural unit, they predicted that switching would take place at boundaries of units and suggested that magnitude of error in perception of a click was a measure of the size of perceptual units.

They found that location errors often displaced the

noise beyond the boundaries of the word in which it was positioned objectively. Further, all Ss tended to locate the noise prior to its objective position and errors were larger for sentences than for digit sequences. Thus, the experiments supported the hypothesis that the unit of speech perception does not correspond to the phoneme and is larger in sentences than in random sequences of words.

Kent (1963) presented three groups of subjects with one of three sets of superficially similar sentences which could be distinguished only in terms of bracketing and labeling. For example, consider the following sentences:

1. (they) ((are discussing) (books))
2. (they) ((are) (falling leaves))
3. (they) ((are) (parking meters)).

Sentence (1) was distinguished from (2) and (3) by the bracketing relationships. Sentences (2) and (3) were distinguished by the labeling within the last constituent.

Subjects were then presented with incomplete sentences and asked to judge the "best" completion from three possible choices. For example, They are \_\_\_\_\_ cups: (a) washing, (b) leaking, (c) drinking. For each group, over 75% of the subjects made choices resulting in sentences following the same structure as the set of sentences with which they were presented initially.

Garrett and Fodor (1968) commented that, although these results were to be expected in terms of learning set or expectancy set, the findings supported the notion that subjects were able to make judgments of structural similarity or difference among sentences in line with the manner in which psycholinguists formally describe constituent structure.

Considering the relationship between constituent structure and immediate recall, Miller (1963) required subjects to copy text and instructed them to refer to the text as infrequently as possible. With this task, subjects tended to use constituents as units to be copied. They consulted the text, wrote to a phrase boundary and then consulted the text again.

In a somewhat similar experiment, in terms of learning and immediate recall, Johnson (in Osgood, 1963) recorded errors made by subjects during a task of learning sentences of different grammatical types. Errors were most frequent at major phrase boundaries. Also, when a portion of a constituent was learned, the remainder of it tended to be learned independent of the content of other constituents in the sentence.

Boomer (1965) observed that linguistically determined juncture pauses were not reported by trained observers as hesitation pauses even though they were of longer duration

objectively than pauses reported as hesitations. Thus, Boomer suggested that trained observers responded to their knowledge of language structure rather than to the physical properties of acoustic signals.

Investigating the idea that formal phrase structure boundaries were similar to the psychological rules used for decoding and encoding language, Johnson (1965) conducted an experiment to determine the degree to which subjects used their knowledge of grammar to partition a sentence into subunits during a learning task. Subjects learned eight sentences as responses to digits in a paired-associate task; responses were scored for the conditional probability that the words in the sentences were incorrect, given that the preceding word was correct. The probabilities were assumed to measure the extent to which adjacent words were independent events during learning. If certain subunits were of functional importance, the conditional probability of an error, or transition error probability (TEP), would be expected to be high between functional subunits and low within subunits. The results indicated that the conditional probabilities were predictable from linguistic structure of the sentences. Thus, TEP's were not equal from word to word, but rose significantly at phrase structure boundaries. That is, error probabilities were larger between than within constituents,

suggesting that sentences were learned and remembered in terms of phrase length units.

Fodor and Bever (1965) suggested that the unit of speech perception corresponded to the constituent. They argued that extraneous noises superimposed over speech would tend to shift perceptually in a fashion that would minimize the number of constituents the noise was perceived as interrupting. They hypothesized that noise heard during speech should shift perceptually toward the boundaries of constituents of the sentences. Subjects were presented with recorded sentences, each containing a click at one of eight different positions. The task was to write each sentence after presentation and to indicate at what point the click was perceived to have occurred in the sentences. The hypothesis was supported for all sentences and click positions employed.

Considering the possibility that acoustic properties of sentences, such as pauses, might explain the perceptual shift of clicks, Fodor and Bever measured the energy drop at the major break and found no linear trend in number of responses confirming the hypothesis over the entire range from 100 percent energy drop (complete pause) to no energy drop. They concluded that constituent structure properties of sentences were independent of acoustics and explained the displacement of clicks better than did acoustic properties.

In another experiment designed to further rule out the possibility that clicks were shifted as a function of acoustic properties of sentences, Garrett, Bever, and Fodor (1966) superimposed clicks upon sentences in which identical acoustic signals were given different contexts. The results, obtained from a procedure similar to that used by Fodor and Bever (1965), demonstrated that the acoustic properties could not account for location of clicks. Exactly the same acoustic signal, an identical sentence fragment spliced into tapes carrying the different contexts, resulted in clicks being shifted to different places depending on constituent structure.

In these studies by Fodor and Bever (1965) and Garrett, et al. (1966), subjects were required to report location of the extraneous sound after first hearing and then writing sentences. Interpretations of these results have been criticized by the investigators themselves and by Fillenbaum (1971) on the basis that memory rather than perceptual factors might account for the subjective shift of click location.

Accordingly, Garrett and Fodor (1968) reported three studies designed to consider this type of criticism. However, the studies were explained briefly, referenced as unpublished papers, and not reported by Fillenbaum (1971) in his extensive review of the literature. Thus, their description here is

merely a paraphrase of that information presented by Garrett and Fodor. The contribution and validity of these studies should be weighed accordingly.

Garrett (1965) used the same stimulus materials employed by Garrett, et al. (1966) but did not require subjects to reproduce sentences. Subjects were required to provide an interpretation for each sentence with only the auditory signal as input and respond immediately with a click judgment. Results were comparable to results obtained by Garrett, et al. (1966). Similar results were obtained by Kirk, Lackner, and Bever (1965) in a study using a mild electric shock instead of an auditory click; subjects verbally reported their judgments of the shock location immediately following presentation of a sentence. Bever, Kirk, and Squire (1965) obtained similar results using a flash of light instead of a click.

Mehler and Carey (1967), in an effort to assess psychological reality of surface structure and base structure, hypothesized that subjects made use of both surface structure (constituent structure) and base structure (deep structure) in processing sentences. They attempted to establish a set for one or the other of two surface structures by presenting ten sentences of one type or the other against a background of white noise. A test sentence followed each group of ten sentences which contained either the same or a different

surface structure from that of the preceding sentences. Subjects were instructed to listen to each sentence and write it down in an interval before the next sentence. The same procedure was followed to assess influence of base structure.

Results indicated that the test sentence was perceived significantly less accurately when this sentence followed a series of sentences different from it in surface structure than when it followed a series of sentences with the same surface structure. Although changes in base structure also tended to disrupt perception, changes in surface structure had a stronger effect. Mehler and Carey concluded that both surface structure and base structure affected perception and that such findings were consonant with the view that sentence representations which are related abstractly to their physical realization play a role in speech perception.

Considering literature concerning independence of languages, Kolers (1966) suggested the possibility that bilinguals possess two language coding systems which were kept relatively separate. He suggested that requiring a bilingual to switch languages while processing a single message would impair performance. In a series of experiments, subjects were tested for comprehension, ability to read aloud, ability to make summaries, and ability to speak freely. Three forms of linguistic material were used, including unilingual, alternate



sentence, and mixed (passages presented with words appearing randomly in English or French). For the comprehension task, subjects performed with a similar degree of proficiency on comprehension check tests regardless of the linguistic form of a passage. Other tasks, however, resulted in poorer performance when alternate or mixed linguistic forms were used.

Suggesting that the absence of effect obtained on the comprehension task in Koler's (1966) study might be a function of measure of comprehension used, that is, that the test was not sensitive enough to demonstrate existing differences, Dalrymple-Alford and Aamiry (1967) reported a study designed to investigate further whether extraction of information was impaired by linguistically mixed material. Subjects were presented with two-word unilingual and mixed language signals designating which of six keys were to be pressed (two-word instructions to press keys, such as "right-red" or "left-blue"). Speed of correct response was not affected by whether the signal was mixed linguistically or unilingual. The investigators noted initially in this study that results obtained by Kolers (1966) on the comprehension task were somewhat surprising in view of reports that performance of bilinguals was impaired in other tasks, such as reading aloud and continuous verbal production, when switching between

languages was required. Dalrymple-Alford and Aamiry considered their own results similarly surprising and closed their article stating, "We are unable as yet to suggest a satisfactory explanation of this [the results] (p. 536)."

Macnamara, Krauthammer, and Bolgar (1968) presented bilingual subjects with lists of linguistically neutral stimuli (numbers) and asked them to name the numbers first in one language ( $L_1$ ), then in the other language ( $L_2$ ), and, finally, to alternate between languages (switching condition). Additionally, in order to consider the question of whether language switching was different from other forms of switching in which the response transition did not involve language, subjects were presented with the following tasks: (a) lists of number for which the required response was to add one to the number presented (for example, if 5 appeared, S was to say 6), and (b) lists of numbers (number-switching lists) for which the required response was either to name the number presented, or add one to it. For all conditions, the expected response was cued by a previously designated geometric design. Results of this experiment indicated that switching took a measurable amount of time, that switching time was reduced if the switch could be anticipated (when subjects were required to switch languages in a predictable fashion) and that language switching did not differ in any significant way from

number switching. That is, language switching did not differ from a unilingual form of response switching. Concerning this last result, the authors suggested that language switching of the type required in their study seemed to require no perceptual skills particular to bilingualism, but "rather a skill which is equally applicable to a large number of operations in which persons are asked to switch modes of response rapidly (p. 213)."

Investigating the theory that bilinguals are able to keep languages functionally distinct, Macnamara (1967) used Irish-English bilinguals whose task was to give spoken, continuous associations to stimulus words. Subjects were required to give responses unilingually, bilingually (with a language switch after every response), or, finally, with a translation of each response before the next response. Scores were lower for the language switch and translation conditions. Considering the results, Macnamara suggested that stronger links existed among lexical items within each language than between corresponding items across languages and that the results supported the theory that languages are functionally distinct systems based on limited associational networks among lexical items.

In an effort to give full consideration to the idea of strength of intra- and inter-language associative links,

Taylor (1971) agreed that language switching was an effective way to disrupt associations if words were, in fact, organized by languages, or, in other words, if stronger links existed among items within a language than between equivalent items across languages. However, he argued that since switching itself took an observable amount of time (Macnamara, et al., 1968), thus adding to the task load for subjects, the results reported by Macnamara (1967) were not necessarily a function of strong intra-language links. Accordingly, Taylor designed a study to separate the effects of organization disruptions caused by language switching from the effects of switching per se. He suggested that in a continuous word association task in which subjects were free to switch or not switch languages at will, subjects would be allowed to reveal their natural patterns of word organization and prediction that the subjects would switch languages when they had temporarily exhausted their supply of words in one language. In this situation, language switching would not be "disruptive" and fluency would not be impaired. In the implementation of this idea, English-French bilinguals were required to give continuous word associations under five conditions. In the first condition subjects were instructed to switch languages as they pleased. In the remaining conditions, instructions were to switch languages at designated

rates varying from no switching to continuous switching (after every response). Results indicated that instructions to switch frequently resulted in lower scores (fewer associations were produced). As predicted, the free switching condition resulted in performance comparable to a unilingual, or no-switching, condition.

To examine the relative strengths of intra- and inter-language associative links in a free switching condition, Taylor considered (a) the conditional probability of a response word from one language being followed by another word from the same language; (b) the probability of switching as a function of a certain unilingual run length; and (c) the relation between number of responses and number of switches. Examination of these factors supported the idea that intra-language associative links were stronger than inter-language links. The average switching probability for English was .27 (1.00 - .73, the conditional probability of an English word being followed by another English word), and for French was .32. The language switching probability was below .50 at all run lengths and for both languages. If frequent switches were required of subjects, word fluency was impaired. Further, since English was the dominant language for all subjects, one might expect stronger inter-language links to exist. In spite of this, intra-language links were stronger. Thus,

word organization patterns of bilinguals seemed to be similar in each of their two languages, even when they possessed unequal skills in the languages.

Macnamara and Kushnir (1971) considered the capacity of bilinguals to interpret linguistically mixed passages and reported four experiments in which times for processing unilingual and bilingual materials were compared. The first experiment required subjects to read continuous passages. The second and third required subjects to judge the truth or falsity of written sentences. The fourth required them to judge whether spoken sentences were true or false. Response times were shorter for subjects presented with unilingual rather than linguistically mixed passages in all experiments. Specifically, response times were ranked from shortest to longest in the following order: (a) material presented in the subjects' strong, or native, languages; (b) material presented unilingually in the subjects' weaker languages; (c) material containing one language switch; (d) material containing two language switches; and (e) material containing three language switches. Further, when a language switch was signaled by presenting each language in a different color, longer response times resulted compared with a task in which no signal was given. The investigators concluded that switching languages in input required a measurable amount of time

and that the input language switch was automatic since added cues resulted in longer, rather than shorter, response times. Also, input and output switches operated independently and bilinguals did not translate from their weaker to their stronger language except during initial stages of acquiring a language or when a particular problem was met. If such translation typically occurred, response times would be shorter for material with one switch than for unilingual material in the weaker language, because less material would have to be translated in the former case. Thus, the two languages of bilingual subjects existed as separate and somewhat independent systems rather than as parts of one over-all superlinguistic system.

Finally, the authors suggested that Dalrymple's (1967) failure to obtain results consistent with theirs might be attributed to the fact that the verbal task used (color naming) was relatively artificial. Macnamara and Kushnir employed full sentences and tasks closely related to typical language use, such as reading full paragraphs.

## CHAPTER III

### STATEMENT OF THE PROBLEM

The present series of experiments was designed to investigate further the functioning of constituents as perceptual units and the independence of the two languages used by bilinguals. If (a) constituents define units of language which must be perceived sequentially and (b) the two languages of a bilingual define separate systems both of which do not function fully at the same time, the systematic juxtaposition of constituent structure and language in a sentence should be expected to yield specific effects on perception of that sentence. The hypothesis of these experiments was that sentences in which the languages of presentation and the constituent structures were in phase would be perceived more readily than sentences in which languages and constituents were not in phase. Specifically, subjects should yield shorter response times when responding "true" or "false" to sentences in which the break between major constituents and a language switch occurred at the same point than when responding to sentences in which the break and the language switch occurred at different points. Sentences of the former type were



referred to as Main sentences. Sentences of the latter type were referred to as Off sentences. An example of a sentence used is:

(The number of persons who have taken up  
parachuting as a sport) (is definitely  
increasing.)

The brackets indicate the two major constituents of the sentence. The Main sentence, in English and Spanish, with the switch indicated by a line, was:

(The number of persons who have taken up  
parachuting as a sport) / (está definitivamente  
aumentando.)

The corresponding Off sentence was:

(The number of persons who have taken up /  
deporte del paracaídas) (esta definitivamente  
aumentando.)

In English and Korean, the Main sentence was:

(The number of persons who have taken up  
parachuting as a sport) / ( 단연코

증가하고 있다.)

The corresponding off sentence was:

(The number of persons who have taken up/ 낙하산  
강하를 하나의 스포트로서) (단연코  
증가하고 있다.)

All sentences used in these experiments contained parts in two different languages. If major constituents of sentences functioned as perceptual units, sentences which had one of these units disrupted by a language switch (Off sentences) should be more difficult to perceive and understand than sentences with intact major constituents separated by a language switch (Main sentences). On the other hand, if formally defined constituents had no relation to the perception and processing of verbal material, no difference in difficulty would be expected because a switch within a major constituent should be no more disturbing than a switch separating two constituents.

## CHAPTER IV

### METHOD AND PROCEDURE

#### Method

Four experiments were performed employing two groups of bilingual subjects, Korean-English and Spanish-English, and two modalities of presentation, visual and auditory. Split-language sentences were presented to subjects and the point in a sentence at which the language switch occurred was varied. One group (Main group) was asked to respond "true" or "false" to sentences (which referred to the content of a previously read passage) in which the change in language occurred between constituents. Another group (Off group) was asked to respond to sentences in which the language change occurred within one of the constituents.

Translations from English to Korean and English to Spanish were performed by persons qualified in both written and conversational forms of the respective languages. To further insure adequate translation, the translated materials were read by several other people knowledgeable in each language. The Korean phonetic alphabet was used for the Korean materials.

## Experiment I

### Korean-English Visual Experiment

Subjects. The subjects were twenty Korean-English (10/group) bilinguals whose native language was Korean. All learned English as a second language in an academic environment. The subjects were college graduates who received a year or more of their college or graduate school training in the United States.

Materials and Procedure. Korean and English versions of a brief selection concerning parachuting and eight linguistically mixed sentences referring to the content of the selection were used. The selection was adapted from a passage appearing in Better Reading Book 2 (Simpson, 1962, pp. 30-32) which contains selections from various literary sources and is designed for use in reading-skill improvement. Each selection is followed by a "Comprehension Check" test consisting of ten stem phrases with five possible completion phrases. One of the completion phrases is correct and the others are incorrect concerning the content of that selection. Eight of the ten Comprehension Check statements following the selection concerning parachuting were chosen to present to the subjects. Efforts were made to select those statements containing the most concrete concepts as well as the most familiar vocabulary. The parachuting selection was

typewritten in Korean and in English and placed in a folder for use by subjects. Sentences were photographed and presented to subjects in random order via a slide projector. Sentences were counterbalanced in the following manner. For each group, Main and Off, four sentences were true concerning content of the story and four were false. Four sentences began in English and switched to Korean and four began in Korean and switched to English. For the Main group, the language switch occurred at the major constituent boundary for each sentence. For the Off group, the language switch occurred at a point within a major constituent. For the Off group, four sentences contained switches occurring at points in the sentences prior to the major constituent boundary and four contained switches occurring after the major constituent boundary.

Before participating in the experiment, subjects were asked if they anticipated, or had ever experienced, difficulty reading at a distance. After the experiment, they were asked if any difficulty had been experienced in terms of viewing the slides easily. No problems were reported.

The following instructions were paraphrased to each subject:

Please read this story carefully in both  
languages and indicate when you are finished.

Upon completion of reading, subjects were given the

following instructions:

You will be presented with several sentences which concern the content of the story just read. Each sentence will be part in English and part in Korean. Read each one and indicate whether it is "true" or "false" by pressing one of the two buttons before you. "T" indicates "true" and "F" indicates "false." Make an effort to respond quickly and accurately.

Subjects read both Korean and English versions of the selection. Then, E presented each sentence to S by pressing a button which simultaneously operated the automatic shift on the slide projector and started a timer. As noted, the task was to read the sentence silently and judge it to be "true" or "false". Judgment was indicated by pressing one of two buttons labeled "T" or "F". Pressing either button stopped the timer and the response time (accurate to 1/100th of a second) for each sentence was recorded by the experimenter.

Average time per sentence was computed for each subject. A t test was computed to compare the average response times of the subjects in the two groups.

## Experiment II

### Spanish-English Visual Experiment

Subjects. Subjects were twenty Spanish-English bilinguals (10/group) who were extensively exposed to both languages before entering school. Further, subjects routinely made use of both languages for practical communication purposes. Subjects were undergraduate college students.

Materials and Procedure. Materials and procedure were the same as those for Experiment I with the exception that those portions presented in Korean for Experiment I were presented in Spanish for Experiment II.

## Experiment III

### Korean-English Auditory Experiment

Subjects. The same subjects were used as in Experiment I. However, subjects were assigned to groups independently for the two experiments.

Materials. A brief selection concerning the sinking of the ship Titanic and eight linguistically mixed sentences referring to content of the selection were used. Selection and sentences were adapted from Better Reading Book 2 (Simpson, 1962, pp. 50-52) in the same manner described for Experiment I. Selection and sentences were presented to subjects via a tape recording. Selection and sentences were recorded by a native speaker of English and a native speaker

of Korean. For the sentences, several recordings of each sentence were made in the following manner: the English speaker read the English portion of the sentence and the Korean speaker immediately began reading the Korean portion at the transition point. The sentence in which the transition was judged to sound most natural was chosen for use in the experiment. Construction of sentences followed the same design as that of Experiment I with the exception that sentences were not presented in random order. Specifically, for each group, Main and Off, four sentences were true concerning content of the selection and four were false. Four sentences began in English and switched to Korean and four began in Korean and switched to English. For the Main group, the language switch occurred at the major constituent boundary for each sentence. For the Off group, the language switch occurred at a point within one of the major constituents. For this group, four sentences contained switches occurring at a point in the sentence prior to the major constituent boundary and four contained switches occurring at a point after the major constituent boundary.

Procedure. Prior to participation and after participation, subjects were asked if they anticipated difficulty or experienced difficulty hearing the presented materials. No problems were reported.



Instructions similar to those noted for Experiment I were paraphrased to each subject, with the exception that the subject was asked to "listen to" rather than "read" the material.

Subjects listened to both English and Korean versions of the selection. Then E presented each sentence to S by pressing a button which activated the tape recorder. As the last word of each sentence was presented, a timer was automatically activated by a piece of conductive tape on the recording tape. The task was to listen to the sentence and judge it "true" or "false" on the basis of the selection just heard by pressing one of two buttons labeled "T" or "F". Pressing either button stopped the timer and E recorded the response time (accurate to 1/100th of a second) for each sentence.

Average time per sentence was obtained for each subject. A t test was computed to compare the average response times of the subjects in the two groups.

#### Experiment IV

##### Spanish-English Auditory Experiment

Subjects. The same subjects were used as in Experiment II. Once again, the assignment to groups was different for the two experiments.

Materials and Procedure. Materials and procedure were

the same as those used for Experiment III with the exception that those portions presented in Korean for Experiment III were presented in Spanish for Experiment IV. Selection and sentences were recorded on the tape recorder by a Spanish-English speaker who learned both languages before entering school. The speaker's accent was judged to be relatively accent-free in both languages.

## CHAPTER V

### RESULTS

While running subjects for Experiment I (Korean-English Visual Experiment), it was noted that subjects were responding incorrectly to sentence number three more often than to the remaining seven sentences. The error frequency for each sentence for the first eight subjects has been presented in Table 1. The response pattern on sentence number three was at a chance level, suggesting lack of attention to the sentence, difficulty reading the sentence, or difficulty understanding the sentence. It was removed from Experiment I for the remaining twelve subjects.

To confirm this observation, the procedure of presenting all eight sentences was repeated for the first eight subjects in Experiment II (Spanish-English Visual Experiment). Once again, sentence number three was incorrectly responded to with increased frequency when compared to the other sentences, and it was removed from Experiment II for the remaining twelve subjects. Frequency of errors for each sentence for the first eight subjects has been presented in Table 2.

In order to make the design of the auditory condition comparable to that of the visual condition, seven sentences,

rather than eight, were presented to subjects for Experiment III (Korean-English Auditory Experiment) and Experiment IV (Spanish-English Auditory Experiment). Observation of the response trend to these seven sentences used in Experiment III and Experiment IV revealed correct responding above a chance level for all sentences for the first eight subjects. Error frequency for each sentence for the first eight subjects has been presented in Table 3 and Table 4.

Results of the four experiments have been shown in Table 5. The means and standard deviations (in seconds) of the Main and Off groups and the  $t$  test of the difference between the two groups have been presented for each experiment.

Direction of difference between groups was consistent with the hypothesis in all four experiments. However, only the two visual experiments yielded differences large enough to achieve statistical significance.

The hypothesis of the experiments, that the Main condition would yield shorter reaction times than the Off condition, was directional, thus justifying use of one-tailed probabilities. Experiment I surpassed the .01 level of significance, Experiment II surpassed the .05 level of significance, and Experiments III and IV approached the .05 level of significance.

Failure of the auditory experiments to achieve significance was attributed to beginning the timer at the ends of sentences. On many occasions, subjects responded before the timer had started. For Experiment III, this occurred 13 times in the Main condition and 5 times in the Off condition. For Experiment IV, this occurred 5 times in the Main condition and 2 times in the Off condition. These times were arbitrarily set at zero in order to compute the  $t$  test. A binomial test of the frequencies of the zero reaction times (Siegel, 1956, pp. 36-42) ( $p = .048$  for Experiment III;  $p = .227$  for Experiment IV) demonstrated that these unmeasured response times occurred with reliably different frequencies in the Main and the Off conditions. This strongly suggests that significant  $t$  values would have been achieved if length of time that the response preceded the end of the sentence in these cases had been measured.

Table 1  
Error Frequencies for Eight Subjects  
Korean-English Visual Experiment

Sentence	Number of incorrect responses for the first eight subjects
1	0
2	1
3	4
4	0
5	0
6	1
7	1
8	2

Table 2

Error Frequencies for Eight Subjects  
Spanish-English Visual Experiment

Sentence	Number of incorrect responses for the first eight subjects
1	0
2	2
3	5
4	1
5	0
6	2
7	0
8	1

Table 3

Error Frequencies for Eight Subjects  
Korean-English Auditory Experiment

Sentence	Number of incorrect responses for the first eight subjects
1	1
2	1
3	2
4	1
5	0
6	1
7	1



Table 4

Error Frequencies for Eight Subjects  
Spanish-English Auditory Experiment

Sentence	Number of incorrect responses for the first eight subjects
1	0
2	1
3	1
4	2
5	1
6	1
7	3

Table 5

Means, Standard Deviations, and t Values  
of Response Times for All Groups

	Experiment I Korean-English Visual		Experiment II Spanish-English Visual		Experiment III Korean-English Auditory		Experiment IV Spanish-English Auditory	
	Main	Off	Main	Off	Main	Off	Main	Off
Mean (in seconds)	9.40	11.55	7.55	10.08	0.89	1.62	0.77	1.18
SD	1.53	1.71	1.77	2.50	0.91	1.07	0.26	0.68
t	2.83**		2.48*		1.56 NS		1.73 NS	

\*\*  $p < .01$

\*  $p < .05$

## CHAPTER VI

### DISCUSSION

#### Comments Regarding the Use of t

A t test considers group differences in relation to individual differences and t is defined as the ratio of a deviation to a standard error. The pooled estimate of the population standard deviation in the denominator of the fraction is an expression of measurement error and of individual differences existing prior to the experimental manipulation. The difference between group means in the numerator expresses group differences resulting from the experimental manipulation, individual differences, and measurement error. A significant t indicates that group differences are large compared to individual differences (and error). If individual differences are fully restricted by experimental control, subtle effects of an experimental manipulation can be demonstrated. If individual differences are allowed to retain their full ranges, significance indicates the existence of much more forceful effects.

Subtle and forceful effects have different uses and implications. Subtle effects are not likely to be intuitively obvious and may shed light on theoretical statements. Their

practical utility, however, rests on the utility of the theory as a whole. The effects themselves are likely to be too weak to be profitably used in isolation. The forceful effects, on the other hand, are gross enough for practical application and too crude for theoretical enlightenment. Although a number of individual differences were controlled in the present study, it was impossible to provide experimental controls for all variables. Thus, consideration must be given to the fact that, to the degree that individual differences were retained, the results lend information which is of theoretical, rather than practical, value.

In order to justify the use of the  $t$  distribution in problems involving differences between means, two assumptions are conventionally required, that the populations sampled are distributed normally and that the population variances are homogenous. All samples in the present study had response times which were positively skewed, suggesting violation of the normality assumption. Accordingly, several authors have considered the implications of violation of this assumption. Box (1953) showed that violations of the assumption of normality have slight effects on the probabilities of obtaining critical values in parametric tests. Hays (1963) suggested that violations are not of significant consequence when the distributions are unimodal and when samples of the same size

are used. The present study fulfills these criteria. Bradley (1964), in a much more extensive study, arrived at conclusions similar to those of Box. His primary reservation about the "robustness" of parametric statistics concerned cases in which different samples had drastically different distributions. This reservation does not apply to the present study; all samples had response times which were positively skewed. Further, Bartlett (1971) held that the slight effect of violations of normality was in the direction of yielding more conservative tests. Finally, in the present study, subject response time was stabilized by averaging times for each subject over seven sentences. Due to the central limit effect (Bradley, 1964), times should tend toward normality. Hence, the standard log transformation for positively skewed data (Bartlett, 1971) would be expected to overcompensate for the skewness remaining in the data. Considering the nature of the data obtained as well as the above comments regarding use of t tests in questions concerning differences between means, use of the t distribution for testing the hypothesis of the present experiments was considered appropriate and valid.

### General Discussion

Results of the present experiments were expected considering that, in general, the research literature has been

interpreted as confirming the functional role of constituent structure for the speaker-hearer. However, two criticisms have been directed toward empirical study in this area, and in the field of psycholinguistics generally, which deserve mention.

First, researchers in psycholinguistics have used the standard array of perceptual, cognitive, learning, and memory procedures in their experimental designs and the following question has accompanied much of this work: is study being directed toward the psychological or perceptual reality of some psycholinguistic construct or, rather, toward an assessment of how verbal material is remembered or learned? Fillenbaum (1971) noted that, although these were not independent issues, inferences should not be made directly in terms of errors or confusions on a memory task. Considering constituent structure, for example, the type of perceptual processing required in a rote memory task might be expected to differ significantly from the type required in a full comprehension task. Also, data of these types provide information both about the psycholinguistic construct under consideration and about memory and retrieval processes. Thus, determination of the relative contribution of the various components to results is difficult. Fillenbaum directed specific comment toward those studies in which the subjects' task was

to report the location of an extraneous noise superimposed over a sentence after hearing and writing down the sentence. Noting that results in these experiments were interpreted as supporting the perceptual effects of constituents, he argued that memory effects or delayed response strategies are equally valid interpretations. Although the "click" literature is generally considered cogent evidence for the functional significance of constituent structure in sentence perception (Osgood, 1968; Slobin, 1971), those investigators primarily involved with this type of research (cf. Chap. II) apparently have not been able to present a less contaminated experimental procedure to investigate or demonstrate the phenomenon. The brevity and lack of clarity with which Garrett and Fodor (1968) reported those studies proposed to handle the "memory" variable suggest that they were not significant improvements upon the procedures employed by Bever and Fodor (1965) and Garrett, et al. (1966).

The present experiments were subject to similar concerns since subjects' task was to respond to stimuli on the basis of material presented earlier in time. However, an attempt was made to avoid a rote memory task or a difficult comprehension task and to provide a task which would correspond closely to the type of language processing typically and frequently employed by persons in routine interaction

with others and the environment (in terms of semantic content--the language switch, of course, was atypical). The low frequency of incorrect responses observed suggested that this attempt was successful (see Tables 1, 2, 3, and 4 which are representative for all subjects). The selections and true-false statements presented apparently did not present subjects with a difficult memory or comprehension task, yet provided more contextual content than would have a rote task. If a major component of the task had involved memory or comprehension, this would have reflected itself in an increased frequency of incorrect responses.

The second criticism, directed more specifically toward constituent structure research, again concerns methodological difficulties in experimentally investigating the construct. Investigators typically assume that perceptual units tend to preserve their integrity by resisting interruptions (Fodor & Bever, 1965) and, accordingly, utilize a procedure of disrupting perceptual processing to investigate the issue. Ladeoged and Broadbent (1960) suggested that significant results might be artifactual when extraneous sounds were used to disrupt processing because of their artificial quality. In other words, inability to locate accurately a click superimposed over a word or sentence might result because clicks were mechanical sounds which did not normally form a meaningful part



of a speech sequence; thus, they were not processed in the same fashion as were meaningful sounds, even when subjects were instructed to attend to the click. Although this criticism is not of major concern since subjective shifts in click location have been systematic and consistent with that predicted from constituent structure analysis, the procedure remains indirect at best.

The present study employed a more direct method for investigating the perceptual significance of constituents. Presenting a subject with a sentence containing a language switch affected perceptual processing in a measurable way (Macnamara, et al., 1968; Macnamara & Kushnir, 1971) while at the same time allowing the perceptual process to remain in the same dimension--language.

Concerning independence of different languages, the literature consistently demonstrates that when verbal material of the type typically encountered in language use is presented to bilinguals, imposed language switching interferes with performance in terms of speed in input and fluency in output (cf. Chapter II). The present results were consistent with findings that language switching in input disrupts processing in a manner which requires a measurable amount of time. If this were not the case, that is, if language switching had no effect, no differences would have

occurred between the Main and Off groups.

The obtained results were interesting in several respects considering the particular groups of bilinguals used as subjects. First, the Spanish-English bilinguals corresponded to Weinrich's (1958) definition of coordinate bilinguals. That is, they were bilingual speakers who learned more than one language either during childhood acquisition or later mastery of a second language with a proficiency level comparable to that of the native language. In the present case, all subjects fell into the former category. The Korean-English bilinguals, on the other hand, corresponded to Weinrich's definition of subordinate bilinguals which requires nonnative acquisition of a second language. The proficiency level must be clearly functional, but not necessarily equal to the proficiency in the native language. Also, Spanish and English belong to the Indo-European family of languages and are inflectional in structure. Syntactic distinctions, such as gender, number, case, mood, tense, and so forth, are usually indicated by varying the form of a single word or word base (Robertson & Cassidy, 1954, p. 23). Korean is considered a branch of the Altaic family of languages and, thus, is considered agglutinative in structure. Formal affixes are attached to independent and invariable bases in such a way that base and affix are always distinct (Poppe, 1965, p. 43; Sunoo,

1959, p. 25). Further, Vetter and Howell (1971, p. 48) note that Korean and English possess more complex phonemic systems than does Spanish.

Considering the above factors, language switching was demonstrated to have similar effects for both coordinate and subordinate bilinguals. Level of proficiency and/or length of time spent using the languages had no differential effect on the results. In this sense, the results lend support to findings (Taylor, 1971) that equal proficiency levels in two languages does not facilitate inter-language associations. Further, recall that the languages of the two groups of bilinguals were simultaneously similar in some respects and different in others. Spanish and English are both Indo-European, but differ in degree of complexity of phonemic systems. Korean and English are Altaic and Indo-European respectively, yet possess comparably complex phonemic systems. This observation suggests that the positional effects of language switches were not artifacts of certain languages and that they were not obtained as a function of degree of similarity or dissimilarity between languages.

Finally, there is much interest in the area of psycholinguistics concerning the nature of language universals (Chomsky, 1965; Chomsky, 1968; Lenneberg, 1967; McNeil, 1970). If language is the manifestation of species-specific cognitive

properties which constrain variations among natural languages, significant universals of language should exist because of this common biological foundation. That is, characteristics or properties should exist which are shared by all languages. Accordingly, Greenberg (1963) has delineated a set of language universals which reflect aspects of constituent structure. On the basis of empirical evidence, a list of 45 language universals were presented including such features as manifest order of subject, object, and verb. The area of language universals is beyond the scope of this paper and, additionally, Chomsky (1965) notes that "insofar as attention is restricted to surface structure [in the study of universals] the most that can be expected is the discovery of statistical tendencies such as those presented by Greenberg (1963)." Implicit in this comment is the notion that universals as they relate to transformational rules are of more concern and importance. Nevertheless, it is interesting to note that Greenberg's universals were formulated from the investigation of 30 languages and that Korean was not included among them. The results of the present experiments using Korean-English bilingual subjects demonstrates that some aspects of surface structure (major constituents) function in Korean in the same manner in which they function in other languages.

## CHAPTER VII

### SUMMARY

The present set of experiments investigated functioning of constituents as perceptual units and independence of the two languages used by bilinguals. Split-language sentences were presented to bilingual subjects and the point in sentences at which the language transition occurred was systematically varied. The task was to judge the "truth" or "falsity" of the sentences. Longer response times resulted from sentences in which the language transition occurred within a constituent, supporting the hypothesis that sentences in which languages of presentation and constituents were in phase would be perceived more readily than sentences in which languages and constituents were not in phase.

The phenomenon was investigated in two modalities, visual and auditory. The hypothesized effect of switching languages at different places in sentences was clearly demonstrated by the visually presented material. The auditorially presented material failed to yield significant results. However, the direction of the differences was as hypothesized, suggesting that more refined methods of presenting the material would

show the effect of the position of a language switch to be no less real in the auditory modality than in the visual. Further, the phenomenon was demonstrated for two pairs of languages, suggesting that positional effects of language switches are general across pairs of languages.

The present results not only demonstrate the salience of constituent structure as it functions in perception of sentences, but also suggest support, although indirect, for perceptual significance of other constructs set forth in psycholinguistic theory. As noted earlier, a linguistic description of a sentence possesses three components: a phonological component which phonetically interprets strings of sounds; a semantic component which provides meaning for the speaker-hearer; and a syntactic component which is the source of structural descriptions of sentences. The syntactic component is of central import because the phonological and semantic systems operate on its output. The converse is not true. In the same fashion, constituents are of major import because certain features of the phonetic shape of the utterance depend on constituent structure and because constituent structure may provide clues to the speaker-hearer for recovery of deep structure. Because constituent structure is inextricably related to syntax, the functional importance of syntax in sentence perception was suggested by the present results. Further,

since surface structure reflects deep structure, the perceptual role of this construct was also implied.

Concerning the independence of the two languages used by bilinguals, the current results suggest possibilities for further research in the area of second language acquisition. If sentences are most easily decoded in units defined by constituents and, if intra-language associative links are stronger than inter-language links, regardless of degree of proficiency in either language (Macnamara, 1967; Taylor, 1971), further research consideration of these factors might well provide formulations concerning methods of foreign language instruction.

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