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**The perception of pre-switch cues by Spanish-English bilinguals**

**Mahecha, Nancy Ruiz, Ph.D.**

**City University of New York, 1990**

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THE PERCEPTION OF PRE-SWITCH CUES

BY SPANISH-ENGLISH BILINGUALS

by

NANCY RUIZ MAHECHA

A dissertation submitted to the Graduate Faculty in  
Speech and Hearing Sciences in partial fulfillment of  
the requirements for the degree of Doctor of  
Philosophy, The City University of New York.

1990

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2 May 1990

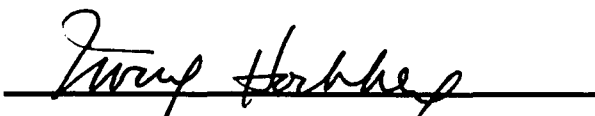
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## ABSTRACT

THE PERCEPTION OF PRE-SWITCH CUES  
BY SPANISH-ENGLISH BILINGUALS

By

Nancy Ruiz Mahecha

Adviser: Dr. Loraine K. Obler

The purpose of the present research was to determine whether bilingual adults are able to use code-switching cues preceding code-switches to predict the occurrences of code-switches. The potential code-switching cues explored in this study were: prolongation of the last sound before the switch; phonological anticipation (section immediately preceding the code-switch was accented with the phonology of the incoming language); audible hesitation (Spanish filler vowel preceded the code-switch into Spanish and vice versa); and pristine code-switch (no deliberate cue preceded the code-switch). The existence of phonological anticipation, formally introduced by this study, was confirmed spectrographically from naturalistic speech samples. Control unilingual sentences (no cues) were used.

Data were obtained from 54 Spanish-English bilingual adults classified according to degree of

language dominance, age of second language acquisition, and amount of exposure to code-switching. Each subject listened to three individual speakers presenting the first clauses of 90 semi-randomized compound sentences, which either contained pre-switch cues, foil pre-switch cues, or no cues (control sentences). The task was to guess whether the sentence would continue in the same language or switch. Both accuracy scores (responses to all sentences) and bias scores (responses to control sentences) were calculated.

The main results of this study indicated that: bilinguals were sensitive to pre-switch cues and similar in their ability to perceive them; some pre-switch cues were more effective than others, possibly related to saliency at the phonetic/phonological level; the perception of pre-switch cues by bilinguals was affected by which language was heard; and language-dominant bilinguals, and bilinguals who acquired their language before or after puberty exhibited a bias towards their unmarked, less fluent language.

The main conclusion of this study is that an adult Spanish-English bilingual is able to perceive pre-switch phonetic/phonological cues, seemingly in accord with context-specific and whole-language markedness effects, by activating a postulated bilingual monitor system. The proposed monitor in turn is free to use the pre-switch cues to predict incoming code-switches thereby facilitating on-line processing of mixed speech. This study complements previous research suggesting that bilinguals process code-switching cues that occur at or immediately following the code-switch boundary.

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I wish to thank each member of my committee. I have thoroughly enjoyed working with William Stewart. This dissertation would have been more difficult were it not for his warmth, his availability to answer my

questions at any time, his brilliant mind which never lost sight of the whole picture, and his sharp sense of humor. I also learned much from Bill during our unscheduled conversations on many academic subjects.

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Nancy Ruiz Mahecha

April 8, 1990

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## CHAPTER ONE

### INTRODUCTION

Some groups of bilinguals who share the same languages code-switch (alternate use of two or more languages). Code-switches seem to occur as a natural part of the bilingual's speech flow and do not appear to interfere with the comprehension of the messages being conveyed.

Much research has concentrated on analyzing production data in order to decipher the linguistic, sociolinguistic, and interactional aspects of code-switching. How code-switching is perceived has been markedly less studied.

Several theoretical psycholinguistic models have addressed how bilingual code-switching is executed to postulate how it is processed. The most frequently proposed models are: an input/output switch, a translation switch, no-switch, and a monitoring system. Not all of these models are mutually exclusive. Some

of them assume the bilingual has special abilities, over and above those of a monolingual; others do not. An input switch would automatically channel messages in either language to the correct linguistic decoder whereas an output switch, considered a voluntary process, would permit a bilingual to encode a message in one or the other language. A translation switch would permit the encoding of a message in one language after it has been decoded in the other language. A no-switch model would rely on systems already operating within a monolingual person. A monitoring system, on the other hand, would not involve any input/output switches, rather, it would be a continuous process scanning various levels of information to facilitate the decoding and encoding of code-switched messages by the bilingual person. At present, it is unclear what type of information a monitor model, or any of the other models for that matter, would require and whether the information, or at least part of it, can be found within the speech stream produced by the bilingual speaker.

Another issue which has not been addressed in past studies is whether language dominance (i.e., degree of proficiency with which a language is spoken) influences

the perception of code-switches. However, in terms of the production of code-switches, several researchers interested in code-switching among bilingual adults (e.g., Poplack, 1979), or among bilingual children (e.g., Zentella, 1981) have noted that the quantity of intra-sentential code-switches (i.e., switches within a sentence) increased as the speaker's degree of proficiency in the two languages increased, whereas more inter-sentential code-switches (i.e., switches between sentences) were used by speakers who were dominant in one of the languages. The latter type of code-switches would not require an integration of the knowledge of the two linguistic systems because a sentence in one language would simply follow a sentence in the other language. It has been shown (e.g., Poplack, 1979) that in order to produce intra-sentential code-switches the bilingual person must thoroughly know the two linguistic systems and know code-switching rules (e.g., equivalency rule). This in turn would allow the bilingual to produce code-switched sentences which do not violate any underlying linguistic rules when the two languages are integrated (e.g., by inserting the code-switches only at syntactically equivalent points).

It stands to reason then that just as differences in the productive code-switching abilities among bilinguals were found as a function of language dominance, so differences in the perception of code-switches may exist; these may or may not parallel the production differences. It is possible that "balanced" bilinguals (those who speak both languages with native-like fluency) easily perceive code-switches regardless of their direction (i.e., from language A to B or from B to A) whereas dominant bilinguals (those who speak one language better than the other) may better perceive code-switches if they move in a specified direction. This possibility is based on the assumption that for the dominant bilinguals, their native language may have an unmarked status, whereas, their second language may have a marked status. According to Stewart (1990, personal communication) the native language is unmarked since it "is not felt to be, or behaved toward as if it were, specifically a language that one switches into and out of, but merely talking." He also stated that "this is also how monolinguals feel about their first (and only) language." The second language, however, does feel like a specific language that one switches into and out of for dominant bilinguals who are not totally fluent in it.

One would then expect, based on this extension of the markedness theory to whole languages, that the dominant bilinguals would perceive better those code-switches which move from their unmarked, dominant language into their marked, weaker language.

The basic questions that triggered the present research are the following: is there information contained within the acoustic speech output that could be used to support the existence of a bilingual monitor?; can this information be used by a hypothetical bilingual monitor to identify and/or predict (anticipate) code-switches?; and does degree of language proficiency influence the manner in which code-switches are perceived and/or anticipated? Effects of age of second language acquisition and degree of exposure to code-switching on the perception of pre-switch cues were also explored to complement the main questions posed above.

In the literature review that follows it will become clear how these questions evolved. The review will present characteristic descriptions of code-switching and of the code-switching processing models

most frequently proposed (e.g., "switches," "monitor") followed by some research concerning transitional phenomena (e.g., hesitations) found in the speech output of monolingual and bilingual speakers. The few studies on the perception of code-switched speech (e.g., of gated stimuli) will be presented as consistent with the concept of some form of monitoring device. The possible influence of language proficiency (i.e., dominance) on production and processing of code-switches will be considered at that point. Age of acquisition of the second language, especially as it relates to the notion of a critical period, will be discussed. No studies to our knowledge have investigated the effects of different degrees of exposure to code-switching on the perception of code-switches. Studies tangentially relating to this area will be reviewed. Some basic ideas on markedness and its possible role, depending on language dominance or second language acquisition age, in the perception of code-switches will be presented. Finally, the main research question and hypotheses of this study on the perception of code-switching will be presented.

## CHAPTER TWO

### LITERATURE REVIEW

#### Relevant Descriptions of Code-Switching

There are several definitions of code-switching. One of the most accepted, however, is that code-switching is a complete shift from one language to another for a word, a phrase, or a sentence, and, contrary to borrowings, code-switches are not integrated phonetically and morphologically into the base language (Grosjean, 1988). Romaine (1989) stated that "code-switching is a mode of bilingual performance which allows the bilingual to display his full communicative competence" (p. 157).

Research thus far has concentrated on the productive aspects of code-switching, when and how it takes place. The main approaches to these questions have been linguistic and interactionist.

Linguistic (grammatical) approaches to code-switching have shown that code-switching is not

haphazard but rule-governed. Gumperz (1976) postulated universal syntactic constraints (e.g., no switch between subject pronoun and verb phrase). It has also been found that some constituents are switched more than others (Marlos and Zentella, 1978, Sankoff and Poplack, 1980), that bound morphemes cannot be separated from their stems, and that code-switched constructions obey equivalency rules whereby the grammar of each language is respected in the code-switch (Poplack, 1980).

Several code-switching constraints have also been found to operate within intra-sentential code-switches. Timm (1975) determined several "rules" of intra-sentential code-switching based on adult data. An example of a code-switching rule is that no switch is allowed between finite verbs and their infinitive complements (e.g., "they want a come"). It has been noted though that such adult-based rules are frequently violated by children who are in the process of acquiring two languages while also learning how to code-switch between them (Mahecha, 1986a). Romaine (1989) described how children will draw lexica from both languages while developing their grammars, and that this should not be considered to be deviations

from either language. Furthermore, she stated that in "situations of intense language contact it is possible for a third system to emerge which shows properties not found in either of the input languages" (p. 4).

McClure (1981), cited by Hamers and Blanc (1989), noted that younger Mexican American children code-mixed more than code-switched; whereas, they code-switched more than code-mixed after the age of 9 years to indicate their ethnic group membership and identity. Poplack (1983), cited by Hamers and Blanc (1989), has found that development of intra-sentential code-switching is a maturational social process requiring full development of syntactic rules for both languages. Romaine (1989) has noted, as Gumperz has (1976, cited by Romaine, 1989), that code-mixing or switching often does not occur in order to fill in lexical gaps. Zentella (1981) noted that switching often occurs with lexica that bilinguals know and use in both languages, basically as a form of style shifting.

Most of the above studies proposing code-switching linguistic constraints have been based on Spanish and English, languages that are syntactically similar. Data from studies of languages that are also in contact

yet are more syntactically divergent have contradicted some of the postulated code-switching constraints. For example, Berk-Seligson (1986) analyzed 3,771 code-switches between Spanish and Hebrew, two syntactically divergent languages, sampled naturalistically from Sephardic and Latin American Jews living in Israel. Findings revealed that most code-switches were from Spanish into Hebrew, that most of them were of intra-sentential type but usually using small constituent size, and that there were no differences in patterns of code-switching between balanced bilinguals or dominant bilinguals. These findings diverge from those found with Spanish and English (e.g., Poplack, 1980) which indicated a similar frequency in the direction of switching, that there was a similar number of inter- and intra-sentential code-switches but that large constituents were switched more, and that balanced bilinguals used more intra-sentential code-switches reflective of their greater bilingual ability. Berk-Seligson also analyzed code-switching errors (total of 186) and found that the equivalence constraint was often violated. She stated that this constraint was not universal and that "either it must be restricted to use in describing the code-switching of languages that are syntactically similar or else it must be modified,

to a weaker formulation" (p. 334). On the other hand, her subjects avoided violating the free morpheme constraint (i.e., that code-switching cannot occur after a bound morpheme) which was found to be a robust constraint even with these divergent languages.

Despite the differences being found between pairs of languages that are similar and those that are divergent, the important point is that the knowledge about the intricacies of code-switching has evolved significantly since Weinreich's concept of the ideal bilingual who switches from one language to the other according to "appropriate changes in the speech situation ... but not in an unchanged speech situation, and certainly not within a single sentence" (1953: 73).

An interactional approach to code-switching has demonstrated that bilinguals differentiate between situational and metaphorical code-switching (e.g., Blom and Gumperz, 1972). Situational switching occurs if there is a change in the situation (e.g., if a monolingual joins the group) whereas metaphorical code-switching, referred to some as stylistic, (e.g., McClure, 1977), is independent of the situation (e.g., used to emphasize, clarify, quote).

Auer (1984) stated that most researchers failed to explain the why of code-switching; because they did not take into account, as he does, the sequentiality of language choice. Auer's book outlines a comprehensive, coherent, and generative model for the interpretation of language alternation in order to resolve such questions as WHERE and WHY language alternation occurs, HOW it is accomplished, and WHAT it means (Mahecha, 1986b). For Auer, language alternation includes both code-switching and transfer. From his "real-time," naturalistic transcriptions Auer found that the meaning or function of a specific alternation resulted from the interaction between the context and the context-sensitive interpretative procedures: transfer vs. code-switching, and participant- vs. discourse-related language alternation. Four prototypical meanings resulted: discourse-related and participant-related code-switching, and discourse-related and participant-related transfer. These types serve different functions. Discourse-related code-switching can change the context of the interaction (e.g., to introduce a new topic); participant-related code-switching can indicate competency in a language (e.g., code-switch into most competent language); discourse-related

transfer may occur when someone quotes in another language; and participant-related transfer may occur when someone asks for a structure that she/he cannot access (e.g., what do you call...). Auer's approach does not "relegate language choice and alternation simply to the individual's style, or to outside social norms, but rather to the subtleties of the unfolding conversation" (Mahecha 1986b, p. 954).

The code-switching of bilingual Puerto Rican children, from El Barrio of New York, was studied by Zentella (1981) who found that three types of factors influenced code-switching: "on the spot" factors are those which we can observe (e.g., settings, speakers, listeners); "in the head" factors consist of social and linguistic knowledge in the head of the participants which influences their choice of language to communicate their intentions (e.g., "crutching" when the speaker cannot recall a word, "footing" when the speaker's role changes); and "out of the mouth" factors which are more linguistic in nature--that is, they are based on the structure of the languages and on the individual's knowledge of the languages. According to Zentella some of these factors used at any moment in the interaction are syntactic or phonological

constraints, influenced by the preceding language, and dependent on whether the speaker knows a particular word or expression in one of the languages only.

The influence of extralinguistic factors determining the use of code-switches was discussed by Timm (1975) who reviewed the work of Gumperz and Hernandez-Chavez (1969). Basically, it was found that in the speech of Mexican-American speakers code-switching occurred depending on the others' ethnic identity, age, sex, degree of solidarity or confidentiality. Timm corroborated the above with his own work. Gumperz (1982), cited by Romaine (1989), takes a discourse view which considers code-switching a discourse mode available to the bilingual person much the same way that different styles or dialects are available to the monolingual person. Also, the author stated that code-switching serves different discourse functions such as: to quote speech to use as interjections or sentence fillers, to qualify the message, to specify an addressee as the recipient of the message, and/or to mark personalization.

Hamers and Blanc (1989) present a further distinction of code-switching based on the bilingual's

competence in the languages. Specifically, they stated that code-switching may be either bilingual code-switching (resulting from the bilingual's competence with the languages), or incompetence code-switching (resulting from a limited functional competence in the second language). According to Gumperz (1982, cited by Hamers and Blanc, 1989) the incompetence code-switching differs from the bilingual type as it does not follow the same sociolinguistic and linguistic rules.

#### Code-Switching Processing Models

Thus far only the production data have been discussed. The question of why the bilingual processes code-switches with apparent ease is still unanswered, although, as stated in the introduction, several code-switching processing models have been proposed. Of these, the models postulating an input/output switch, a monitoring device, and a non-switch/non-monitor process will now be discussed.

#### Input/output switch models

Support for the concept of an input switch was presented by Kolers (1968) in his work on the

processing of mixed passages by French-English bilinguals. He found that no additional time was needed to read these passages silently and that comprehension was unaffected by the mixed mode. Reading aloud, however, required an average of 1/3 of a second per switch.

MacNamara and Kushnir (1971) studied similar French-English bilinguals on a variety of tasks (e.g., silent reading, true/false judgments on written and oral sentences). They used some of Kolers' sentences. They found that it took an average of about 1/5 of a second for the input switch - a time frame that they still considered to be automatic. The authors stated that the input-output switches operated sequentially and independently (e.g., one can listen in one language and answer in another). The output switch was considered not to be automatic but voluntary, because the language that a bilingual speaks is the one that s/he chooses (vs. having no choice as to what language is heard).

The notion of an input switch hypothesis was also tested by Guttentag, Marshall, Goodman, and Hauch (1984). They used the flanker-task paradigm in which

the target words were printed in one language, while the flanker words were printed in a different language. The subjects were French-English bilingual students and their task was to ignore the flanker words and process the target words (e.g., by responding to which semantic category they belonged in a two-way choice task). Results showed that response time was affected by the flanker words regardless of whether they were in the same or different language as compared to the language of the target word. The authors concluded that an "input switch," which should operate to process one language at a time, did not exist at the level of semantic processing of individual printed words. They also stated that "some form of input switch might operate at the higher level of the application of grammatical rules during language comprehension" (p. 188).

Wulfeck, Juarez, Bates, and Kilborn (1986), cited by Romaine (1989), compared healthy monolinguals and aphasic bilinguals. They found that bilinguals possessed a unitary system which operated in the same fashion for the two languages. They concluded that there was no evidence for an input switching mechanism for sentence processing. In addition, they found that

bilinguals exhibited more flexibility, in terms of strategies of processing, when compared to monolinguals in their respective languages. Romaine (1989), in her review of these studies, concluded that they supported the interactionist view of processing, and that the nature and extent of the interaction between the two languages will depend "on the speaker's proficiency in each, and on the relationship between the language-specific features which are available as cues for sentence processing" (p. 98).

Sridhar and Sridhar (1980) also favored an interactionist view to explain the process of code-mixing. These authors observed Kannada-English bilingual speech and concluded that the process of code-mixing, defined by them as the use of linguistic units of one language in a sentence from another language, was like an assembly line whereby individual components/constituents are put together separately and then inserted into the appropriate slots in the syntactic frame of the base language being spoken. They concluded that there is a comparison stage late in the process of production of code-mixing and that code-mixing required both systems to be on simultaneously "rendering unlikely any strong version of the language

'switch' hypothesis" (p. 413). They stated that the right approach is not an independence model nor a merged system model, rather, an interactionist one where systems overlap.

#### Monitor view

The concept of a "monitor," rather than an on/off switch mechanism or an interactionist view, was proposed by Obler and Albert (1978). They studied Hebrew-English bilinguals (balanced or dominant in one of the languages) using a Stroop test paradigm. In this task subjects are shown printed color labels (e.g., red, blue) which are printed in different ink colors (e.g., black, white). The subject's task is to name the color of the ink used.

A modified version of the Stroop test was used by Obler and Albert to test the interaction between the two languages. In this version, the task was to name the color of the ink in the other language. In order to do this accurately subjects would have to ignore the color label presented to them in the base language. Interference was found whether they were requested to label the ink colors in the same or different

languages. In the same language condition, subjects would tend to read the word, whereas, in the different language condition subjects would tend to translate the written color label into the other language, rather than naming the color of the ink in the other language. These data supported the idea that output was a more controlled process, that is, that once a subject is set to speak a certain language s/he will continue in the same language. Given that interference was found between these two very different orthographies, Opler and Albert concluded that the language stimuli of the input had been processed at a semantic level. They proposed a bilingual monitor system which participated in understanding the input received. In their words:

The monitor would scan incoming data for cues (emphasis mine) that one or the other language was being spoken, and then channel the matching element towards lexical items in that language ... Although the matching element might be primed to check items from a specific language first, it would always be prepared to process items in the other language, and might even attempt to process both languages concurrently. In essence then, one would not have an on-off input switch, but rather a flexible, continuously operating monitor system, sensitive to changes in the linguistic and non-linguistic environment. (p. 160)

Other studies using the Stroop paradigm did not address the issue of whether a monitoring system

existed within the bilingual person. Rather, most were concerned with the degree of interference between the two lexicons in order to infer their underlying organization (see for example Preston and Lambert, 1969; Hamers and Lambert, 1972).

The results of Chan, Chau, and Hoosain (1983) also are consistent with the idea of a monitoring device. They asked Chinese-English bilinguals to perform several tasks. Among them, they had to read a passage which contained spontaneous code-switches between the two languages and the unilingual Chinese version. The authors found no difference between the reading speed for the passage with natural switches and the unilingual Chinese passage. This led them to conclude that there is no evidence for an input or output switch in natural code-switching. They propose instead a processing system that would interact with "a unified cognitive mechanism like that of a 'monitor system'" (p. 413).

#### No difference view

The most extreme non-switch, non-monitor position is presented by Paradis (1980). He argued strongly

against any form of input/output switches, or any form of monitoring device. He claimed that characteristics of any two languages are sufficient to maintain them separate naturally without the requirement of any form of switch or monitoring mechanism. He claimed that there is no need for any system to keep two different languages apart, because their systems are completely unlinked and that "acoustic stimuli are directed towards their semantic target in accordance with their nature, whether there are two languages or only one" (p. 504).

Paradis (1980) stated that the same mechanism used to access or process a word in English (e.g., window) is also used to access or process a word in French (e.g., fenêtre). He further claimed that whatever processes a bilingual used to change languages in a bilingual context are similar to the ones that a monolingual used to change, for example, registers within a monolingual context. Paradis (1980) stated that the delays obtained in studies testing the hypothesis of an input switch could be explained as the expected result of the subjects' orienting to a new task. Although he did not present any hard data to back up his claims, he did point out some weaknesses in

the methodology of response time studies which supported the input switch view. For example, in some studies additional processing time was found with mixed sentences. These sentences, however, frequently violated code-switching rules which could have confused the subjects and caused them to take additional processing time (see for example, Kolers, 1968 and MacNamara and Kushnir, 1971). In dismissing the concept of a monitoring mechanism and proposing instead that whatever cerebral mechanisms are at work in any unilingual speaker-hearer are also at work within the bilingual subject Paradis (1980) stated:

Sentences are understood directly in one language or in the other, without any need for a particular switch mechanism, just as different sentences in the same language are directly understood ... The "switch mechanism" turns out to be simply the network of connections that link the phonemic decoding to the corresponding meanings, via various levels of analysis (morphological, syntactic) when required to derive the meaning of a sentence. (p. 504)

However, as Obler and Albert (1978) pointed out, Paradis' views do not explain the frequent occurrence, described by Taylor (1976), of a bilingual failing to comprehend a language that she/he knows until several seconds of speech have elapsed, because she/he did not expect to hear that language at that moment. It is

proposed here that this is difficult to explain unless some form of "monitoring" operation was set to expect the other language(s), thus temporarily impairing comprehension when an unexpected language was used.

#### Potential Information Used by Monitoring Process

Based on the review of the literature it is unclear whether a definite monitoring system is in place. Although several researchers propose the existence of the monitor, they are not definite as to what specific types of information it would use in order to process code-switches. The authors of this study propose that a monitoring system within the bilingual person is the most likely mechanism to be used by the bilingual to anticipate code-switches. We also postulate that this hypothetical monitoring system, which is most likely composed of several concurrent processes at different levels of processing, is able to use information contained within the speech stream to facilitate the processing of code-switches. It is proposed here that the bilingual person has extended the use of certain transitional phenomena (e.g., filled pauses) from the monolingual context into the bilingual context to cue upcoming code-switches.

In addition, it is proposed here, based on my own observations and those of others, that a certain anticipatory behavior particular only to the bilingual context sometimes occurs whereby the speech immediately preceding the code-switch is influenced by the phonology of the language of the code-switch (i.e., an "accent"). This condition we have termed phonological anticipation and spectrographic evidence for its existence is provided in the methods chapter.

A similar anticipatory behavior most likely exists in the speech of monolinguals just before style shifting. That is, characteristics of a low register may infiltrate high register style immediately preceding the shift from high to low register or vice versa (Stewart, 1988, personal communication). Although bilingual phonological anticipation had not been formally documented per se, there has been work done on other forms of transitional phenomena found in the speech of monolinguals and bilinguals. We will first turn to the research done on monolingual speech before discussing some cross-linguistic research.

### Pausal Phenomena within Monolingual Speech

There are much data supporting the fact that speech is not a totally fluent, continuous process. Pausological research was initially directed to the speech of monolinguals and only recently has it turned its attention to the speech output by bilingual speakers (to be discussed later). The work of Goldman-Eisler (1961 a,b,c) laid the foundations for the science of studying hesitation phenomena (i.e., pausology) contained within the speech stream. Goldman-Eisler (1961a) asked English speakers to describe non-captioned cartoon stories and then formulate the meaning, point, or moral of the story. A comparison of the use of silent hesitations (i.e., an arrest of external vocal activity) and vocal hesitation (i.e., filled with sounds such as "ah," "hm," "er") was made. Results indicated that silent hesitations reflected cognitive activity such as selection, abstraction or planning in speech while vocal hesitations, such as pauses filled with vowel sounds, seemed to reflect emotional attitudes. Silent hesitations increased in length as the difficulty of the cognitive task increased. The authors also distinguished between the

task of description (fewer hesitations) and of summarizing the meaning (more hesitations). Filled pauses, on the other hand, were insensitive to the cognitive processes underlying these different verbal productions.

Goldman-Eisler (1961a) also found that there were great individual differences in the ratio of the frequency of filled pauses to the duration of unfilled pauses which, according to her, reflected differences in the silence that individuals can tolerate without breaking it with a filled pause. She concluded that:

Under conditions requiring processes of abstraction and generalisation those who hesitated longer in silence, who also produced more concise statements and words which were less predictable, produced fewer filled pauses per second of unfilled pause time, while the less hesitant subjects who produced the more long-winded summaries and more predictable words produced filled pauses at shorter intervals of silence...those who consistently achieved superior (more concise) stylistic and less probable linguistic formulations are consistently inclined towards delay of action and tolerance of silence, whilst the inferior stylistic achievement (long-winded statement) of greater predictability is linked to greater verbal as well as vocal activity and to intolerance of silence. (p. 26)

In a later study Goldman-Eisler (1961b) found that the lengths of individual pauses are distributed differently for different persons depending on the

speech situations encountered (e.g., describing cartoon sequences vs. speech during a psychiatric session). She categorized those pauses lasting less than 250 msec as "articulatory pauses" and those of greater length as "hesitation pauses."

Boomer and Dittman (1962) measured the thresholds for pause discrimination and found that they were lower for hesitation pauses (200 msec to 500 msec) than for clausal juncture pauses (500 msec to 1000 msec). The results were interpreted by the authors as reflecting the fact that hesitation pauses can occur unexpectedly within a clause and are syntactically irregular as compared to juncture pauses which have a definite syntactic function and always occur between clauses. Of interest to us is that the values obtained for discrimination of hesitation pauses are close to the length established by Goldman-Eisler (i.e., 250 msec) as the minimum time required for an output disfluency to be classified as a hesitation pause.

The continuity of speech under different conditions (describing and formulating before and after practice) was also of interest to Goldman-Eisler (1961c) who found that those speakers inclined towards

delay of action and tolerance of silence (as discussed before) also achieved greater continuity in their utterances after learning. She found that an initial delay in producing speech accompanying verbal planning "at a high level of cognitive activity ... pays off in the ultimate efficiency of the process of reproduction" (p. 231).

The work of Jaffe and Feldstein (1970) described in detail how conversations can now be analyzed, through sophisticated computer systems, to study their rhythms carefully. According to the authors, the speaker who utters the first sound initiates the conversation and gains possession of the floor until she/he loses the floor through a speaker switch. Earlier work, done by Gerstman, Feldstein, and Jaffe (1967), investigated whether silence and syntax acted as cues to speaker switching in spontaneous dialogue. Results indicated that speaker switching occurred about nine times more often after words followed by a silence than after words not followed by a silence, and about 21 times more often after syntactic boundaries than after nonboundaries. The authors concluded that the syntactic boundary is a stronger determinant of speaker switching, because it contained more information (e.g.,

intonation contour). However, when both cues (i.e., boundary and silence) occurred simultaneously it made switching 42 times more probable than the occurrence of either one alone. Hence, the combination of both cues was more effective than either one alone. The authors stated that, at least in reference to silence, these behaviors could indeed serve as "determinants" or "cues" to speaker switching. They also noted that the probability of a speaker switch increased as the duration of the silence was prolonged.

#### Cross-Linguistic Studies on Pausal Phenomena

Some cross-linguistic aspects of pausal phenomena have also been studied. The pausological research at Saint Louis University was summarized by Kowal and O'Connell (1980). Developmental shifts in the use of pauses were found in their German, English, and Spanish populations. They found that "up to adulthood, speech rate increases and the frequency and length of silent pauses decrease accordingly as age or educational level increase" (p. 63). Further, they found that the decrease in the use of silent pauses was a better indicator of increased speech skills than the duration

of silent pauses. The authors associated length of silent pauses with the cognitive aspects of processing and the frequency with the "linguistic execution of semantic planning" (p. 63).

In addition, Kowal and O'Connell found similarities in temporal phenomena across German, English, and Spanish, and when their results were compared to other studies they concluded that it is possible that speech rate (within a range) is another language universal. The authors did find a difference in the use of hesitation phenomena between Spanish speakers and American subjects. The Spanish subjects used more silent and vocal hesitations than American subjects except for vowel filler pauses which were more frequent with the American subjects. The reason for this was attributed to the fact that many Spanish words end in unaccented vowels which would not invite the use of a vowel filler. The output of a five-year old Spanish-English bilingual girl was analyzed and it was found that she used filled vowel pauses in English but replaced them with "este" (a parenthetical remark) in Spanish.

A comparative study of French (first language) and English (second language) was done by Deschamps (1980).

His subjects were adults studying oral English (second or fourth semester) in Paris. The task was to describe orally a series of cartoons. Deschamps found that when describing the cartoons in the second language (L2) the speech rate decreased (from 153 syllables per minute to 102). Contrary to expectations this decrease was not due to lengthening the duration of the silent pauses in English as an additional hesitation procedure (indeed they were slightly shorter). Instead, results indicated that the decrease in rate was due to the increase in the number of pauses, mostly within the sentence, when speaking in English. For example, filled pauses increased by 10% from French to English. The author concluded that French students describing in English will tend to reproduce in their L2 the organization of hesitation processes of their own native language, with "an inevitable slow-down of speech rate and an increase of all types of hesitation phenomena due to a lack of fluency" (p. 262).

Similar findings were obtained by Raupach (1980) with his French and German undergraduate students. Subjects were asked to describe a non-captioned cartoon in their native language (German or French) which was to be followed immediately by a description of the same

cartoon in their second language (French or German). Results showed that native German subjects spoke faster than the French subjects; that the use of drawls (i.e., the nonphonemic lengthening of syllables) was much higher in the French group; that pauses occurred more often and shifted within the sentence in the L2 performance (thus causing loss of fluency); and that most speakers maintained the pause profile of their first language in their L2 performance.

Dechert (1980) compared the retelling in English of a story ("The War of the Ghosts") by a German undergraduate student before and after his three-month long visit to the United States. Dechert found that his subject had become less hesitant and more fluent but that interferences and fossilizations remained unchanged. The impression of fluency, however, was caused by the subject's use of more pauses and prolongations to aid him in overcoming his internal planning problems.

The research reviewed thus far has indicated that pausal phenomena are similar across similar languages. One can at this point postulate that just as there are possible "cues" within monolingual speech to indicate,

for example, speaker switch or topic switch so could there also be "cues" within bilingual speech to indicate a switch between languages. That is, it could be that the pausal phenomena found in monolingual speech, when used in the bilingual situation, as discussed above, could serve to cue the language switch at the code-switching boundary.

It should be noted here that most of the pausal phenomena, related to changes in type of underlying processing, described for the monolingual subjects and foreign language students occurred at sentence boundaries, or when shifting from one speaker to another. This study will also explore phenomena (cues) at boundary points but as an indication of a switch or no switch between the two languages of the bilingual person.

#### Transitional Phenomena preceding Code-Switching

Some researchers have noted speech disfluencies at the boundaries of code-switches. Specifically, Poplack and Sankoff (1988), cited by Romaine (1989), have noted that flagged switches need not follow any syntactic

constraints as they are preceded by pauses, hesitation phenomena, repetition and metalinguistic commentary. All of these phenomena draw attention to the switch boundary interrupting the smooth production of the switch. Einar Haugen (1950) observed Norwegian-American code-switching and suggested that code-switches were always preceded by a pause. Other studies showed that this was not the case for all bilinguals. Marlos and Zentella (1978) found that the population they studied, four Puerto Rican adolescents in Philadelphia, paused 55 percent of the time before they switched. Zentella (1981) coded editing phenomena which included all pauses, filled pauses, and stutters preceding the code-switching of Puerto Rican children. She found the following percentages: 56.8% were silent pauses (e.g., Es cerca de allí. You take the bus. Trans.: It is near there. ...); 0.9% were filled pauses in the language that followed (e.g., for the things that we got um, fiáo. Trans. ...um on credit); 1.2% were stutters (e.g., entonces vino la la la parrot. Trans. then came the the the ...); and 40.6% did not contain any pauses (e.g., I could put it on cuando me pongo el chiquito. Trans. ... when I put on the small one). Zentella concluded:

The presence or absence of pause preceding a code-switch is a function of the pause that normally precedes specific syntactic constituents, i.e., children who switched the highest percentages of full sentences also had the highest percentage of pauses; those who switched object nouns and noun phrases tended to incorporate them in the sentence fluently, in the same way that object nouns and noun phrases are embedded in a sentence in either English or Spanish. This was true even when the object nouns were crutches i.e., unknown to the speaker of the other language, and explains why there were fewer pauses before unknown constituents than before known constituents, i.e., a good number of the noun crutches may be on their way to becoming adapted loans and, as a result, the switchers did not pause for them. If most of the code-switching had been for crutching, as the community believed, we should have encountered a greater number of pauses/hesitations in the data. (pp. 315-316)

Although Auer (1984) did not analyze any editing phenomena, some of his examples contained boundary phenomena before the code-switching event. These included silent pause, prolongation of the sound (usually a vowel) preceding the code-switch (e.g., piú: schneller), and non-linguistic stimuli such as laughter (e.g., before the code-switch into the other language to talk about an embarrassing topic).

Grosjean (1982) mentioned that some authors (e.g., Hasselmo, 1970) have noticed phenomena occurring at the phonological level. Hasselmo noticed that switches are

not always clean but "ragged." He raised the question of how to classify these "ragged" code-switches which have a strong accent from the base language. For example, ragged switches would be produced by a Portuguese speaker who speaks English with a strong Portuguese accent. When this person brings into the base language (i.e., Portuguese) an English word, it is unclear whether it was a switch or a borrowing, because of the strong accent on the guest word. As Grosjean (1982) asks "should the word be classified as a switch even though phonetically it sounds like a borrowing?" (p. 309). This would be an interesting avenue of future research.

Although there is concern about the phonology of the "ragged" switches, not much research has investigated phonological phenomena often surrounding the code-switch boundary. Specifically, Auer (1984) and others do not mention what we have termed phonological anticipation before a code-switch, or what others have labeled phonological interference after a code-switch. Grosjean and Soares (1986), to be discussed in the next section, have documented phonological interference by noticing the influence of the base language on the language that follows a

switch. Based on William Stewart's observations (1987, personal communication), we noted phonological anticipations where the phonology of the language to be switched into begins to affect the base language at the point immediately preceding the actual code-switch. That is, the base language just before the switch has an "accent" caused by the phonology of the language of the code-switch due to anticipatory interference.

In contrast to other pausal phenomena, which can occur either within a monolingual or bilingual context, phonological anticipations would occur mainly within a bilingual context. In certain contexts monolinguals may use another language, for example, when using a borrowed word or expression (e.g., *taco*, *pizza*, *c'est la vie!*). These borrowings, however, have become such a part of the monolingual's vocabulary that their use is not considered to be equivalent to the code-switches used by bilinguals who are more fluent in the respective languages. In fact, these borrowings are frequently integrated into the phonology of the monolingual's language whereas in a code-switch, the phonologies of the two languages are distinct.

### Perception of Code-Switching

Assuming then that some form of a bilingual monitor does operate, the question still remains concerning what type of information this hypothetical monitor would use in order to perceive code-switching accurately. The research done by Altenberg and H. Cairns (1983), on the effects of phonotactic constraints on lexical processing by English-German bilinguals and monolinguals, indicated that bilinguals had two sets of phonotactic constraints and that these were simultaneously available to them during processing. Their results can be taken as support for some type of monitoring system that is perceiving these phonotactic cues.

Some specific research on the perception of code-switches has been conducted by Grosjean and Soares (1986), psycholinguists who are seeking to clarify the processes involved in the on-line processing of languages by bilinguals. They are interested in how bilinguals produce, perceive, and comprehend their languages when they are using them separately, that is, in a monolingual mode, and when they are using them

together, that is, in a bilingual mixed mode. Their subjects were French-English and Portuguese-English bilinguals. The authors share Obler and Albert's (1978) view of a hypothetical monitoring device which aids the bilingual in determining which language is being spoken at a particular point in time. They theorize that this device is flexible, very rapid, and that it automatically directs information obtained from the analysis of the acoustic signal (emphasis mine) to the higher level processors of the appropriate language. According to the authors the monitoring device:

Uses all the information it can to indicate as quickly as possible which language is being spoken: prosodic information (fundamental frequency, duration, rate, amplitude, stress pattern, etc.), segmental information (phoneme and syllable characteristics), syntactic and semantic rules, knowledge of the speaker and of the topic, pragmatic factors, as well as the constraints imposed on code-switching and borrowing by the two languages in question ... The language monitoring device does not itself process the language input; it leaves that to the processors of the two languages which share a number of basic cognitive and language processing operations but which also have language specific operations and strategies. These processors are, of course, in constant interaction when processing bilingual speech.  
(p. 149)

The authors then assumed there is a monitor and addressed questions about the amount of information it needed to identify the language, how early it could

make a language decision and how categorical this decision was. Spectrographic analyses of monolingual sentences and their code-switched versions (where one word was code-switched at the end) revealed that assimilation effects of the base language (i.e., the one preceding the code-switch) could be found at the beginnings (and sometimes the ends) of code-switched elements. For example, when switching from French into English the beginning of the code-switched word maintained some acoustic characteristics of French but resembled the English target word once its beginning had been produced. Also, the authors found that the prosodic pattern of the preceding base language is used in the code-switched segments. Hence, code-switches do not involve a complete switch into the other language, although they are so perceived. Based on these findings, Grosjean and Soares (1986) proceeded to explore the perception of code-switches.

To study the perception of code-switches Grosjean and Soares (1986) used a gating paradigm, as used in an earlier word recognition study (Grosjean, 1980). In a gating paradigm the target is presented incrementally by short blocks. In this 1986 study, the blocks were

of 30 milliseconds (msec.) each. The task was a language identification one (i.e., subject had to state whether French or English was heard) using excised real words and nonsense words to determine how soon and how well bilinguals can perceive a change of language. Targets were presented either in isolation or were preceded by a carrier phrase which was either in the same or in a different language as the stimulus word. The influence of sounds and sound sequences specific to just one of the languages (e.g., a cluster), and the effect of the preceding carrier phrase were analyzed. The results indicated that words containing language-specific sounds or sound sequences were identified sooner than those containing sounds found in both languages. Also, the listener's base language expectation, compounded by the fact that the beginning of the code-switched word resembled the preceding base language, due to assimilation effects, delayed identification of the code-switched words. The base language, however, also served as a contrast at the boundary (shift point) to items that contained typical sounds of the other language.

Grosjean and Soares (1986) were also interested in the language categorization process. They used both an

identification and a discrimination task to determine if perception was categorical from one language to the next. For the identification task, they used a synthesized continuum of twelve stimuli going from the French /re/ to the English /re/. The first stimulus was all in French and the remaining ones were made progressively more like English by progressively replacing the French /re/ for the English /re/ in 20 msec increments. Thus, the first stimulus was all French (463 msec), the second one began with 20 msec English followed by 443 msec French and so on until the last stimulus which contained 220 msec of English /re/ followed by 243 of French /re/. French-English bilinguals were asked to circle whether they heard English /re/ or French /re/ and results indicated that there was a sharp division between them. Specifically, the first six stimuli of the continuum were identified as French after which there was an abrupt shift to English (at the point when the laryngeal French frication disappears) with the seventh stimulus (despite the fact that it still contained 343 msec of French).

The authors obtained converging evidence for the perceptual break described above with their discrimination task. For this, the authors used a

standard ABX task where the subjects had to match the stimulus X with either A or B. As expected, from the labelling results, subjects discriminated poorly between stimuli within a perceptual category but very well between stimuli that fell on opposite sides of the category boundary. The authors thus confirmed that perception was categorical and stated that their results were consistent with the hypothesis that bilinguals categorize the speech input as belonging to one language or the other. They also pointed out that their results did not indicate at what point in the speech perception process language categorization took place (i.e., prior to, along with, or after phoneme/syllable identification).

Grosjean (1988), in his most recent research on the recognition of code-switches and borrowings, found that characteristics particular to only one of the languages (e.g., phonotactic configuration, word type) aided the word identification process. He concluded that phonotactic cues particular only to one of the languages will activate the lexicon that contains words with these cues. This in turn, will affect the isolation and recognition points of words. On the other hand, words with a homophone in the other

language were difficult to identify unless semantic information was provided after the last gate of the word. Sometimes the subjects were so identified in their "base language garden path" that the word was never identified correctly. Grosjean also stated that due to assimilation processes, described in Grosjean and Soares (1986), a subject listening to a base language expects "the next item to be in the base language, unless 'warned' otherwise" (p. 256). Again, the latter work by Grosjean would also support the idea of some form of monitoring that tunes into such factors as the phonetics of the language.

An interesting issue is whether language dominance will render a bilingual person more or less efficient in processing the cues specific to each language described, for example, by Grosjean (1988) and Grosjean and Soares (1986). We shall now turn to this topic.

#### Effects of Language Dominance on Performance

The effects of language dominance on processing of the bilingual's two languages have been studied through various paradigms such as the lexical decision one. Lexical access and word recognition of code-switches

and borrowings by bilinguals have also been studied by Soares and Grosjean (1984). They studied the lexical access of base language words and code-switched words via the Phoneme Triggered Lexical Decision Task, a paradigm borrowed from Blank (1980). The subjects, English-Portuguese bilinguals, listened to sentences and were asked to listen for a word or a non-word which began with a pre-specified phoneme. Once the target stimulus was found the subjects had to indicate as fast as they could, whether the item was a real word or not. Results showed that balanced bilinguals, as compared to English- or Portuguese-dominant bilinguals, took longer responding to non-words in a monolingual speech mode (only one language used) and in accessing code-switched words in the bilingual speech mode (two languages used) as compared to accessing base language words in the monolingual speech mode. The authors concluded that the other language is activated even in monolingual contexts and that with code-switched words there is a delay caused by an initial search of the base language. However, based on their further research on code-switch boundary effects (Grosjean and Soares, 1986), the authors concluded that the longer processing times were apparently caused by delays related to the decision as to which lexicon to search. Regardless of the various

interpretations, findings indicated that degree of language proficiency of a bilingual person may cause delays in processing mixed speech. It appears that a balanced bilingual would take longer than a dominant one, because of decision delays and/or searching the base language first.

In terms of production, some authors have observed differences in code-switching abilities depending on the degree of language proficiency. Specifically, Poplack (1980) noted that the type of code-switching became more intra-sentential (i.e., within a sentence, more sophisticated) as the degree of bilingualism increased whereas those bilinguals who were dominant in either English or Spanish tended to produce inter-sentential code-switching (i.e., between sentences, less sophisticated). Hence, it appears that the bilingual must know both languages well in order to code-switch intra-sententially and not violate code-switching rules (e.g., equivalency rule). Also, a developmental shift in production skills, from the use of inter-sentential to intra-sentential, was reported for a Spanish-English bilingual girl as her competency in her second language (English) increased, and as she became more proficient in her second language (Mahecha, 1986a).

Further support for differences in performance among bilinguals due to differences in language dominance can be found in Albert and Obler's 1978 book titled The Bilingual Brain: Neuropsychological and Neurolinguistic Aspects of Bilingualism. The authors summarized studies that indicated that performance of the balanced bilingual is quantitatively different from the dominant bilingual in certain respects (i.e., the balanced bilingual has increased abilities in certain skills) whereas other studies supported the idea that the balanced bilingual is qualitatively different from the dominant bilingual in other respects (i.e., has different processing strategies). Some of the results of these studies were: word identification and reading aloud was less skilled in the non-fluent language (MacNamara, 1970); sentence completion skills were not mastered by dominant bilinguals (Forster and Clyne, 1968); and semantic categorization skills in both languages increased as the proficiency in the second language increased (Champagnol, 1973). Albert and Obler concluded that:

The balanced bilingual has control of the processing strategies that a monolingual has for the respective languages, and perhaps also of superordinate strategies. The non-fluent bilingual does not have control of all these strategies and, as a result, will perform with decreased efficiency on a number of tasks in the second language. (p. 203)

Research cited by Hamers and Blanc (1989) indicates that balanced bilinguals benefited more from a language switch, in a semantic recall task, than did dominant bilinguals (Goggin and Wickins, 1971). Hamers and Blanc (1989) stated that this did not imply necessarily a separate semantic system within the balanced bilingual but "might just reflect separate phonological representations" (p. 101). These authors also referred to the work by Berkovits, Abarbanel and Sitman (1984) which found that English- and Hebrew-dominant bilinguals performed better in a sentence-recognition task of mixed-language passages when the input was in their non-dominant language. Better retention in the weak language was judged to be better, because processing had to be more controlled and less automatic. Another possibility, based on the special use of the notion of markedness proposed in this research, was that the weaker language was better retained as it is the most "marked."

Based on the research, it would thus appear that balanced bilinguals should process the pre-switch cues better than do dominant bilinguals, especially if they do indeed have separate phonological representations as

proposed by Hamers and Blanc (1989). Another question of interest, especially if no group differences were found with different language dominance bilingual groups, is whether age of second language (L2) acquisition affected the processing of the pre-switch cues. This question is related to the L2 acquisition research, and the notion of a critical period. We turn to this section now.

#### Age of Second Language Acquisition

The effects of the age of second language acquisition has also been researched as affecting the degree of fluency that a bilingual achieves in her/his second language. This area is of interest here since age of acquisition may be a factor in the perception of the pre-switch cues presented in this study. The most common argument proposes a "critical period" after which it is unusual for a person to achieve native-like fluency in the second language. A brief review of this issue follows.

### Critical period for second language acquisition

The issues surrounding the notion of a critical period for second language learning have been succinctly summarized by Genesee (1988), in the book edited by Beebe (1988). As Genesee discusses, the notion of a critical period came initially from biology and was popularized in the "imprinting" studies by ethologists. Genesee further discusses how Penfield and Roberts (1959) brought the notion to the field of language learning. According to these authors, the brain lost its plasticity around puberty after which it was difficult to learn a language, either a first or a second. Lenneberg (1967), developed this notion further based on hemispheric specialization of function, and concluded that the critical period for first language learning occurred between the ages of two years and puberty. Lenneberg stated that after this critical age, learning was difficult due to completion of lateralization processes. He based his argument on the fact that children with brain damage before the age of twelve could relearn language, a difficult task for individuals suffering brain damage after the age of 12 years. Krashen (1973) reanalyzed

Lenneberg's data and found that the critical period occurred at an earlier age (at about five years of age). Krashen also stated that this period was not related, as frequently noted, to the processes of lateralization which have been shown to be already established in infants (see for example, Kinsbourne, 1972; Molfese and Molfese, 1979, 1980). According to Yorio (1980), there are processes of automatization which make it difficult for an adult to acquire a native-like accent. He quoted H. A. Whitaker's (1971) work describing how certain muscles learn to act together in such activities as ballet, gymnastics, piano playing; for which motor routines have become programmed in the brain. The automatizations required for these activities are best acquired if commenced before puberty. Yorio states that this may account for adult second language learners who are able to distinguish and produce individual sounds correctly, but cannot do so in longer sequences.

Based on the notion of the critical period hypothesis, age of second language acquisition is attributed to influence the degree of fluency achieved, especially within the phonological system, by a second language learner (see for example, Seliger, Krashen,

and Ladefoged, 1975; McLaughlin, 1982, 1984; Scovel, 1969). There is some controversy as to the exact cut-off age for fluent second language learning (see for example, Seliger, 1978), however, it is generally agreed that best second language learning occurs prior to puberty, before the age of nine years (e.g., Seliger, Krashen, and Ladefoged, 1975). For the acquisition of syntax fluency, an age of fifteen years has been proposed (e.g., Patkowski, 1980). Genesee (1988) stated that the finding that more pre-pubertal, than post-pubertal, learners achieve higher and more native-like levels of proficiency in the second language may reflect inaccuracies in the collection of data with the post-pubertal learners and/or may be due to other factors. He stated that the existing evidence on second language acquisition indicates that older subjects learn more efficiently, at least in the initial stages, and that they can achieve native-like proficiency at all levels (phonology, syntax, and comprehension) in the target language.

Long (1988) discussed instructed interlanguage development. He stated that several studies indicated that subjects receiving formal instruction focusing on the marked elements of the second language ultimately

achieved a higher level of competency than naturalistic learners. Albert and Obler (1978) quote Slobin's study (1968), which asked university students to pair sets of antonyms in languages foreign to them with their English equivalents. Results of interest here were that subjects who had studied a foreign language more than three years performed better than subjects who had studied for less than four years. Albert and Obler concluded that there seems to be a relationship between experience in the study of a foreign language and the ability to perceive universals of phonetic symbolism. They further stated that "such a skill may be considered a device of compounding at some phonological analytic level" (p. 77).

Exceptions to the critical age hypothesis were discussed by Seliger (1981) who found that certain individuals learned a language with native fluency as adults and others failed to learn it native-like even though they were exposed to it as children. He attributed differences to poor environmental factors for the children and to flexible, child-like brains in the adults. It is interesting to note that some fluent polyglots feel more fluent in one language than another despite the fact that both were acquired before

puberty. Specifically, Stewart (1989, personal communication) stated that he feels much more at ease with Portuguese, which was acquired at about the age of three years, as compared to Spanish, which was acquired a few years later at the age of six years. This comment is interesting as he is judged to be fluent in both by several linguists in the field.

Seliger (1982) also reviewed the support for the role of the right, usually minor, hemisphere in second language learning and concluded that although many right-hemispheric processes could be involved in second language learning, as in the initial stages of processing, more empirical studies were needed. Although a thorough presentation of the many lateralization studies is beyond the scope of this study, it has been claimed that the minor hemisphere is more involved: if the L2 is learned informally (e.g., Gordon, 1980; Vaid, 1983); if the L2 is learned after the age of 6 years (e.g., Sussman, Franklin, and Simon, 1982); and in the initial learning stages (e.g., Obler, Zatorre, Galloway, and Vaid, 1982). In addition to exploring the effects of language dominance, and age of second language acquisition, the present research explored whether the amount of exposure to code-

switching influenced the bilingual's ability to perceive code-switches. Not much research has explored this area as discussed below.

#### Exposure to Different Amounts of Code-Switching

The possibility exists that bilinguals exposed to many code-switches are better at perceiving them than those exposed to few code-switches. Most research, however, has been done on the production of code-switching. Romaine (1989) has noted that different attitudes towards bilingualism and the influence of the attitudes on the speaker's identity "may also play a part in determining the amount and type of code-switching found in any given case" (p. 153). Poplack (1985), cited by Romaine (1989), found that Puerto Ricans in New York City evaluate bilingualism positively. She found that 97 percent of the code-switches between Spanish and English were produced smoothly, whereas, bilinguals in the Ottawa-Hull communities of Canada, which she also studied, preceded most switches with some form of "flagging" (e.g., repetition, hesitation, intonational highlighting, explicit metalinguistic commentary, etc.). Poplack and

Sankoff (1988, cited by Romaine, 1989) attributed the differences in the code-switching styles between these bilingual communities to the different discourse functions that code-switching served within each community.

Not much research has been done in the area of perception of code-switching. Other tasks, requiring switching abilities, have been reported. Specifically, switching facility was compared between compound bilinguals and coordinate French-English bilinguals by Lambert, Havelka, and Crosby (1958) who found no differences between the groups in a translation of words task. Although these results are difficult to interpret, and although there is much controversy concerning whether a compound or coordinate bilingual exists (see for example Albert and Obler, 1978 for a discussion on this topic), it does indicate that ability to switch between languages is not related to underlying storage organization. However, it still may be influenced by the amount of switching that the bilingual is exposed to. No other studies, to our knowledge, have explored the influence of exposure to code-switching on the perception of pre-switch cues.

### Markedness Across Languages

One can postulate at this point that, at least for the ability to anticipate code-switching, performance by bilingual subjects may be influenced by the degree of markedness of the specific pre-switch cues and/or languages used. These are special views of markedness used for this study, however, there are many traditional views on what constitutes markedness. Several of these views from the leading scholars in this field have been summarized in a book called Markedness, edited by Eckman, Moravcsik, and Wirth (1986). Most of the papers quoted in this section are found in this book.

Moravcsik and Wirth (1986) provided an overview on markedness. They explained how what is familiar and common to us is unmarked. In terms of language structure these authors quoted Greenberg (1966) as assigning the designations "marked" and "unmarked" to structures that are opposed in their syntagmatic structure and/or paradigmatic complexity and/or distribution. Syntagmatic complexity has to do with the amount of structure that a linguistic object has

(see Comrie, 1986; C. Cairns, 1986; and Odlin, 1986 for differing views on this issue). Paradigmatic complexity has to do with the number of subdistinctions available within a particular category (see C. Cairns, 1986 and Odlin, 1986 for discussions). Distribution usually refers to cross-linguistic distribution with the claim that unmarked terms occur more frequently across languages than marked ones (see for example Harbert, 1986; Chao, 1986; Menn, 1986; Shaumyan, 1986; Gundel, Houlihan, and Sanders, 1986).

Based on the above criteria then, an item that is more widely distributed and/or simpler is the "unmarked" member whereas the opposite is the "marked" member. For example, in many languages such as English the singular form is unmarked at the morphological level (e.g., house) as compared to the plural form (e.g., houses). Markedness can also occur at the acoustic level. In many languages the voiceless stops are phonologically unmarked (e.g., /p/) as compared to their voiced cognates (e.g., /b/) which are produced by adding the feature of voicing (obtained through vocal fold vibrations), thus making the voiced stops more complex. Long (1988, note 5) explains how the voiced stop is marked, because languages exist which use only voiceless stops.

Not all interpretations of markedness are linguistic. Rutherford (1982) states that markedness is related to psycholinguistic complexity in addition to sentential complexity. Several researchers discussed other psychological interpretations of markedness relating to, for example, the immediacy of interpretation (Chao, 1986), availability to the child (Solan, 1986), learnability issues (White, 1986), and iconicity (Lapointe, 1986). Lapointe's view for example is quite interesting as it involves whole grammars. He presents the view that grammars are less marked if simple forms are paired with simple meanings and complex forms with complex meanings. He believes that markedness relations follow from acquisition. C. Cairns (1986) states that markedness assignments vary depending on whether one is considering production or perception.

Markedness can also be related to the age at which the second language is acquired. For example, "accents" can be considered to be "marked" in the sense that they are "salient" by not being native-like. Some researchers propose that accents result from the creation of a different phonological system. For

example, Flege (1981) stated that accents are not tied to any neurological reorganizations, but rather result from an intermediate phonology resulting from the comparison, by adults, of two phonological systems. One could say that if such is the case, then adults are comparing their marked and unmarked phonological systems. Snow and Hoefnagel-Hohle (1978), in one of her imitation of Dutch studies, found that the older subjects were better at this task. Later in life, however, the younger subjects were more proficient in the second language. Again, these results can be interpreted according to the extension of the notion of markedness used in this study. That is, older subjects with greater language experience reacted to the foreign language as more "marked" thereby obtaining greater contrasts and approximations, whereas younger subjects, being less experienced, may not have perceived the contrasts as well. For the younger children with not much experience, there may not have been much difference between their language and the foreign one (both perhaps seemed "unmarked").

In their overview Moravcsik and Wirth (1986) commented on the wide variety of definitions of markedness. They also stated that besides having

markedness with particular pairs of phenomena one can have markedness for larger sets "such as entire phonologies of languages or their entire grammars" (p. 5). This view differs from Lapointe's view previously presented in that whole languages are being considered without reference to the semantic level. As noted before, the view of whole language markedness is adopted in the present research. We maintain that there exists a more general form of markedness of native versus foreign. This could relate to a single pair of languages or a variety of language combinations in a linguistically talented polyglot (e.g., who could have several native languages contrasting with several foreign languages). This view would agree with Comrie's (1986) encompassing view that markedness in language is explained by markedness in the real world. He concluded that linguistic markedness was not only a pure language property or an accidental property of human beings, "but rather that it may be explainable in large measure in terms of human interaction with other humans and with the world around them" (p. 104).

In addition, we postulate a less encompassing form of markedness related to specific juxtapositions of elements of both languages that would "stand out," be

"salient," so to speak. Specifically, the use of a code-switched word beginning with a phonotactic configuration particular to the language of the word would be "salient" against the base language. Although in a sense that word with the special phonotactics is "marked," against the preceding base language, the term "marked" and "unmarked" in this study will be reserved when referring to whole languages. For example, English would be the "marked" language for the Spanish-dominant bilingual and vice versa. We are not claiming at any stage of our research that the two forms of markedness proposed here are necessarily interrelated or that they are connected to all of the other uses of markedness according to markedness principles. We are only postulating that some form of markedness, either of whole languages or specific to contexts, plays a role in the perception and interpretation of pre-switch cues. This leads us into the review of some of the present models of perception of bilingual speech.

#### Review of the Present Models of Perception of Bilingual Speech

Research in the field of bilingual speech perception, some of which has been reviewed and

discussed (e.g., Grosjean, 1988; Grosjean and Soares, 1986; Altenberg and H. Cairns, 1983), has indicated that bilinguals tune into the phonotactics of words. Also, it was noted that when the membership of the guest word is unclear, for example a borrowing which is integrated morphologically and phonologically within the base language, it causes confusion leading the subjects on a "base language path." That is, the subjects insist that they are hearing a word belonging to the base language because they are unaware that a change in language has occurred. In some instances these ambiguous stimuli were never identified even with the provision of all of the remaining parts of the sentence.

Grosjean (1988) proposes that an interactive activation model, such as McClelland and Elman's (1986) TRACE model based on monolinguals, can also be used to explain the processes underlying the perception of bilingual speech. According to this model there are processing units organized into three levels (features, phonemes, and words) which are interconnected. The activation and inhibition within one level will affect processing at the other levels. Grosjean adapts the TRACE model for bilinguals by stating that the

bilinguals have two separate language networks which are both independent and interconnected in one area.

Although an extensive discussion of same or separate storage is beyond the scope of this review, it should be mentioned that results vary from one study to the next. In fact, an interesting study succinctly illustrating the pitfalls in the various tasks is presented by Durgunoglu and Roediger (1987). To summarize, these authors found that Spanish-English bilinguals exhibited language specificity with the task of word completion, whereas, with the task of free recall they exhibited language independence. In addition, both types of processing were observed with a yes/no recognition memory task. Hence, the authors stated that they agreed with the conclusion reached by Glucksberg (1984) that the question of whether bilinguals have a "common, language-independent, conceptual representation for the words in the two languages, or separate, language-specific representations is indeterminate" (p. 388).

Despite the above controversy, the view held by Grosjean (1988) agrees with the one proposed by Paradis (1985) which states that both languages share a common

area, but are also separate due to their language-specific differences. Hence, bilinguals have neural connections for each language and also have a larger set where elements of either language can be drawn at any time. Naval (1986) proposes the existence of "seed concepts," in many languages based on the results of his study of English-Hindi bilingual adult subjects. Naval basically stated that some words are common to both languages resulting from factors overriding language differences (e.g., knowledge of a word such as "water" is essential to survival in either language). These "seed" words would be, according to Naval, stored together within a single store. Non-seed concepts, on the other hand, would be stored separately. An example illustrating Naval's ideas as it refers to Spanish and English would be the storage of the same referent "fish" (English) and "pez" (Spanish) in one store while "pescado" (meaning a dead fish) would be stored separately, as English does not make this distinction. Green (1986) has attempted to model bilingual speech production and perception by proposing three stages of a language system: selected, active, and dormant. The selected state is used to control speech output, the active state plays a role in on-going processing, whereas in the dormant state the language is in long-

term memory but does not affect processing. Green (1986) further stated, in attempting to explain some behaviors by aphasic persons, that if a language could not be used spontaneously it did not mean that it was inactive, but rather that it was unable to suppress sufficiently the activation of the other system.

Grosjean (1988) proposes that in a monolingual context the bilingual person activates the language used while the other is at a resting activation level. He states that in the bilingual speech mode the base language is activated more strongly (hence base language effects), units interact and activate each other based on their similarity, phonotactics or lexicon specific to one language will increase the activation within that language, and words that are similar in both languages will slow down the recognition process (e.g., with homophones). Grosjean states that the above model basically "does away with the switch or monitor mechanism" (p. 271) since the delays in processing of mixed speech could be due to numerous factors. According to Grosjean (1988) the proponents of a language switch or monitor:

Do not address pertinent questions such as: Is the switch/monitor an essential part of language processing or does it "fall out" of the processing? If the former, at what stage does it come in - during the acoustic to phonetic mapping of the speech sounds or after this mapping? The data and the model we have presented do not prove the absence of a language switch or monitor, they simply show that the processing system can do without it, and that language decisions (e.g., was that word English or French?) can simply emerge from the process ... the challenge ... will remain, for many years to come, to understand how processing in mixed language takes place so rapidly and so efficiently, despite, as we have seen, many intricate underlying operations (pp. 271-2).

#### Predictions about Perception of Code-Switches

Based on the studies reviewed about the performance of bilinguals, classified according to language dominance or age of second language acquisition, on a variety of tasks, and based on our proposed notion of cross-language markedness and markedness with specific "salient" contexts, one could predict that a dominant bilingual, or a late language learner, would be less efficient in processing code-switches than a balanced bilingual, or an early language learner. This prediction was also supported by results obtained with a pilot study preceding this research.

A summary of the pilot study is provided in the next chapter. Results of the pilot study indicated that balanced bilinguals perceived more code-switches, regardless of the direction of the switch, whereas, the Spanish-dominant bilinguals performed better when the switch moved from their unmarked, native language (i.e., Spanish) into their marked, more foreign language (i.e., English). Results also indicated that early language learners (those who acquired their second language before the age of 6 years) perceived significantly more pre-switch cues than late language learners (those who acquired their second language after the age of 14 years). Effects of the degree of the exposure to code-switching were not explored in the pilot. This author, however, based on the review and the pilot data, predicted that balanced bilinguals, early second language learners, and bilinguals exposed to a significant amount of code-switching should perceive the pre-switch cues significantly better than the opposite populations.

### Summary of Code-Switching: Relevant Factors

This review has provided a sketch of the knowledge available about the dynamics of code-switching. It is evident that code-switching is a rule-governed behavior varying according to factors internal and external to the bilingual participants in order to accomplish different communicative functions. Code-switches may be preceded by such factors as silent/filled pauses, repetitions, sound prolongations, and certain non-linguistic behaviors (e.g., laughter). Similar boundary/transitional phenomena (e.g., pauses) can be found within monolingual speech which are frequently used to indicate a switch between speakers, among other things. One expects that boundary/transitional/shift phenomena serve a variety of functions for bilinguals as they do for monolinguals (e.g., to also indicate a speaker or topic switch). However, in this study we are postulating that phenomena found in monolingual speech have also been employed in the bilingual situation to indicate a change of languages (i.e., code-switching). This study further postulates that a bilingual monitor may exist and that these boundary/transitional phenomena may function as

acoustic pre-switch "cues" which are perceived by the proposed bilingual monitor to better anticipate and process code-switches.

Some traditional views on markedness have been briefly reviewed. The notion of markedness has been extended in this study to include the situation where the native unmarked language is contrasted against the foreign marked language by the bilingual person. Based on this extension of markedness to a more gestalt level, predictions are made here about the performance of bilinguals of different language dominance. Specifically, it is proposed that dominant bilinguals should perceive code-switches into their marked language better than those moving into their unmarked language. In addition, the notion of markedness is extended in this study to indicate that specific contrasts are "salient" due, for example, to phonotactic configurations of one language contrasting with the preceding base language.

Let us suggest an operational definition of the proposed bilingual monitor at this time. The bilingual monitor would be a "device" (a "black box") which attends to the output of a bilingual speaker in order

to identify cues as to which language is being used or is about to be used. According to Stewart (1987, personal communication), like other such devices or "black boxes" in psycholinguistic theory, for example the Language Acquisition Device, the faculty may be the result of more general psycholinguistic mechanisms that are dedicated, through learning, to a specialized function. Stewart draws the parallel with the faculty of speed monitoring, for example. In order to monitor the speed of one's car, and the speed of other cars, many mechanisms are engaged (e.g., kinesthetic cues, visual cues), indicating that the faculty of speed monitoring is composed of several factors. Also, this faculty is a process of learning, and the more one drives a car the better one should become at monitoring the speed of one's car and of other vehicles. The learning process involved in monitoring bilingual, mixed speech (such as with code-switching), we maintain, should be reflected in different performances by bilinguals differing in their language dominance, in their age of second language acquisition, and in their degree of exposure to code-switching.

According to Stewart (1989, personal communication) we cannot measure how efficient the

proposed monitor is, because at this time we do not know exactly if it indeed exists and what it is made of. We do not know what the norm is, what it is in neurological terms as we know for other structures (e.g., muscles). We propose that it is some type of composite of mechanisms, but that it cannot be described by itself. However, we can tell how efficient people are in using this hypothetical monitor. So although this study does not address how efficient the proposed monitor in itself is, a topic for future research, it does address how efficient different bilinguals are in using it. This study also does not address whether bilinguals deliberately produce the pre-switch signals, and whether these cues enhance comprehension. These questions are also topics for future research.

The purpose of this study is to explore cues placed at the boundaries of code-switches to determine their effect on the anticipation of code-switches. If significant effects are found in the perception of pre-switch cues it could mean that the subjects are interpreting them as code-switching cues. This in turn would be consistent with the notion that some form of bilingual monitor may be attending to these pre-switch

cues. In addition, this study addressed whether different types of bilingualism, as determined by language dominance, age of second language acquisition, and exposure to code-switching, differentially affected the ability to perceive/interpret these pre-switch cues.

## CHAPTER THREE

## RESEARCH RATIONALE, PILOT STUDY, AND PLAN

As a habitual Spanish-English code-switcher, I wondered how bilinguals understood each other with ease when they unpredictably switched between both languages. What was it that prevented this switching behavior from interfering with effective communication? Were monitoring mechanisms being utilized by the bilinguals to allow them to continue easily with the conversation despite having to process many language switches? Were some bilinguals better than others in their ability to process switches? The main purpose for this research was to obtain more information relating to these questions.

As the review of the literature indicated, most studies have concentrated on the linguistic, sociolinguistic, and interactionist factors preceding the production of code-switches. Speech production phenomena, sometimes noted in these studies, were not, however, given much perceptual function. Production

studies, however, confirmed that many phenomena found in monolingual contexts, such as pauses, hesitations, laughter, fillers, drawls, were also present in the bilingual context. No mention, however, was made in any study about whether any of these pausal phenomena could be used by a proposed bilingual monitor. Hence, although several researchers support the idea of some form of monitoring device they did not identify what the bilingual person could actually be monitoring.

The few perceptual studies that have been done have concentrated on the phenomena within the speech stream at the code-switch boundary or immediately following it. Although these studies with bilinguals revealed much fascinating data as to the on-line identification of words, they could not readily explain why many subjects frequently failed to identify the language of the word correctly even when hearing the whole sentence.

The fact that subjects at times failed to correctly predict the language switch in these perceptual studies pointed to the possibility that perhaps it was in the area before the switch that perceptually relevant speech phenomena existed. These

phenomena, before the actual code-switch, could cue the bilingual speaker's proposed monitor that a possible switch into the other language could occur. Armed with this knowledge a bilingual person was on "alert" that words from the other language could appear suddenly. The pragmatic advantage of monitoring information while in one language set would be to prevent information loss if a switch occurred into the other language.

No studies to date, to our knowledge, have systematically investigated the existence, perception, and relevance of speech phenomena preceding the code-switch. That is, no studies thus far have determined if pre-switch speech phenomena are acting as code-switching cues and whether bilinguals with different degrees of fluency in their languages vary in their ability to advantageously process these pre-switch cues. Informal, unsystematic observations indicated that these pre-switch cues existed, and that they could be processed by some form of monitor to insure continued communication between bilinguals who code-switched. In order to explore these ideas a pilot study was conducted. A brief summary of this study is presented below.

### Pilot Study

In order to obtain more evidence on the reality of pre-switch cues a pilot study was conducted with balanced bilinguals (N=5), Spanish-dominant bilinguals (N=4), and monolingual English-speaking controls (N=6). The subjects' task was the same as in the main study, that is, to predict whether the sentence heard continued in the same language or switched to the other language, however, in this preliminary study the subjects listened to two speakers instead of three. One of the speakers learned Spanish as his first language, and the other speaker, a polyglot, learned English as his first language. Subjects were tested twice, a week apart, to determine whether any learning effects occurred (test-retest repeatability). Percent correct scores were collapsed across the two speakers, and were calculated for the unilingual control sentences (N=12/condition), and for the experimental conditions of pristine code-switches which contained no deliberate cues (N=6 in each direction), prolongation cues (N=6 in each direction), consisting of extending the sound immediately preceding the code-switch, and phonological anticipation cues (N=6 in each direction) consisting of speaking the section immediately

preceding the code-switch with an accent of the phonology of the incoming language.

In addition, the same Spanish and English experimental sentences were selected for each speaker and transferred onto separate cassette tapes. To determine whether there existed confusion about the speakers' dialects and accents, which could confound results across speakers, a total of 10 English-speaking monolinguals judged the dialect and accent of both speakers in English, and 10 Spanish-speaking monolinguals judged the dialect and accent of both speakers in Spanish. Judges were asked to listen to the tape and judge whether the speaker was a native speaker of the language heard. If the judge's answer was negative, he also was asked to select the speaker's native language out of a list of five, and to judge his degree of accent in the language heard. In addition, each subject had to make a judgment on the speaker's approximate age, his highest degree of education, and his country of birth.

Additional factors probed in the pilot, as possibly influencing the perception of pre-switch cues, were subjects' attitude towards code-switching, and the

age of second language acquisition. Although it was of interest, the effect on performance depending on the degree of exposure to code-switching was not analyzed as the majority of pilot subjects were exposed daily to a maximum amount of code-switching.

A modified  $t$ -test on the difference between total proportional scores (i.e., speaker and direction effects collapsed), using  $z$  values with infinite degrees of freedom, was used to assess within- and between-group performance. Significance at the .05 level in this preliminary study was taken as  $z = 1.96$  or better.

Test-retest repeatability was high in this preliminary study, indicating non-significant learning effects ( $p > .2$ ;  $z < 1.96$ ) when the performances of all bilinguals were compared across the two sessions on three conditions: pristine code-switches ( $z = .32$ ), phonological anticipations ( $z = 1.19$ ), and prolongations ( $z = .97$ ).

The influence of attitude on the perception of phonological anticipations was measured by comparing those bilinguals with a positive attitude towards code-

switching with those having a negative attitude. The information on attitude was obtained through personal communication with the bilinguals. Results were non-significant when scores from both bilingual groups were collapsed ( $z = 1.78, p = .1$ ), and also when analyzing attitude within the Spanish-dominant bilingual group ( $z = .007, p > .2$ ).

Speaker dialect and accent of the two speakers used for this pilot study had minimal effects on performance. Specifically, qualitative analyses of dialect using mostly monolingual judges indicated that there was no confusion about dialect and accent with the speaker who learned Spanish as his first language. All judges stated that due to the perception of a slight accent he was non-native in English, and correctly identified his first language as Spanish. With the polyglot speaker, whose first language was English, most (4 out of 5) judged his Spanish to be non-native but several (3 out of 5) judged his English to also be non-native. Those who stated that his Spanish was non-native identified this speaker's first language as being either Italian, Portuguese, or English. Those who stated that his English was non-native stated that his first language was Spanish. It

is interesting that judges identified languages in which this polyglot speaker is fluent. Also, as mentioned above, both speakers had an opposite pattern of language acquisition. That is, the polyglot speaker acquired English first and then Spanish, whereas, with the Spanish-dominant speaker the opposite is true. The polyglot speaker also acquired Portuguese a few years before acquiring Spanish.

Subjects' perceptual judgments on sentences containing the pre-switch cues of prolongation and phonological anticipations, and on pristine code-switches which contained no deliberate cues before the code-switches, were compared for both speakers quantitatively through a modified  $t$ -test (significance at .05 level obtained if  $z$  value was 1.96 or greater). Results indicated non-significant effects for all bilinguals on the perception of phonological anticipations ( $z = 1.78, p > .05$ ), and pristine code-switches ( $z = 1.43, p > .1$ ). Perception of the prolongations was significantly better with the polyglot speaker when they indicated a switch from Spanish to English ( $z = 3.49, p < .01$ ) but not when they indicated a switch from English into Spanish ( $z = .98, p > .2$ ). Balanced bilinguals were not affected by

the slight speaker accents when perceiving phonological anticipations ( $z = .63, p > .2$ ). However, the Spanish-dominant bilinguals perceived the phonological anticipations significantly better with the Spanish-dominant speaker when the switches went from Spanish into English ( $z = 2.03, p < .05$ ) but no such effects were obtained when the switch went from English into Spanish ( $z = 1.87, p > .05$ ). Direction effects within each speaker were analyzed for the condition most critical in bilingual contexts, that is, phonological anticipations. It was found that for all bilinguals there were non-significant effects when listening to the polyglot speaker switch in either direction ( $z = .81, p > .2$ ), or when listening to the Spanish-dominant speaker ( $z = 1.88, p > .05$ ). In general, the effects of speaker accents were considered to be minimal in this pilot, considering the small populations being tested.

Another factor briefly explored in the pilot was the effect of age of second language acquisition. A comparison was made of the accuracy of perception of phonological anticipations between those subjects acquiring their second language before the age of 6 years ( $N = 4$ ) and those subjects acquiring their second

language after the age of 14 years (N = 3). Subjects acquiring their second language between the ages of 6 and 14 years were not considered (N=2). Results were highly significant ( $z = 3.47$ ,  $p < .001$ ) caused by the better performance of the early acquisition group (79% correct) as compared to the late acquisition group (42% correct). These results are also related to degree of fluency as most (3/4) of the subjects acquiring their second language early were balanced bilinguals whereas all subjects acquiring their second language late were Spanish-dominant. Although this was a perceptual study, results were consistent with the findings by Seliger, Krashen, and Ladefoged's (1975) interview study which reported no accent in the second language of adults if they acquired it before the age of nine years and vice versa.

The main purpose of the pilot, however, was to explore the responses to the pre-switch cues by monolinguals and bilinguals (balanced and Spanish-dominant). It was of interest to us whether some cues were better perceived than others, and whether there were any group differences depending on language dominance (that is, from no knowledge of the second language whether it be Spanish or English, as with

monolinguals, to competency with both languages, as with balanced bilinguals). Hence, responses to the unilingual control sentences, and pre-switch cues within each group and between different groups were analyzed using the modified t-test on the difference between total proportional values (i.e., speaker and direction effects collapsed).

Within-group comparisons. Performance by each of the bilingual groups on the unilingual control sentences, pristine code-switches, phonological anticipations, and prolongations were analyzed. Performance with each of the conditions was compared with performance on their respective control sentences. In addition, the performance with the phonological anticipations was compared to the performance with the prolongation cues and pristine code-switches. Results indicated that bilingual subjects were sensitive to pre-switch cues. Specifically, when compared to the scores obtained with the unilingual control sentences, highly significant differences were obtained with the phonological anticipations ( $z = 7.77, p < .001$ ), and the prolongations ( $z = 5.52, p < .001$ ), and significant results with the pristine code-switches ( $z = 2.02, p < .05$ ). In addition, bilingual subjects perceived

the phonological anticipations significantly better than the pristine code-switches ( $z = 7.24, p < .001$ ) and the prolongation cues ( $z = 3.09, p < .01$ ). Results were similar for the individual bilingual groups except for the comparison between the pristine code-switches and their control sentences. This comparison was non-significant for the Spanish-dominant group ( $z = .89, p > .05$ ) but almost significant for the balanced bilinguals ( $z = 1.91, p > .05$ ).

Performance within the monolingual group was similar to the bilingual groups except that the difference between the perception of phonological anticipations and pristine code-switches approached significance ( $z = 1.92, p > .05$ ). There was also a highly significant difference ( $z = 5.9, p < .001$ ) between the perception of prolongations and phonological anticipations. This difference, however, contrary to the bilinguals, was caused by a better perception of the prolongations instead of the phonological anticipations. Another interesting finding was that for the monolinguals, but not for the individual bilingual groups, there was a significant difference ( $z = 5.4, p < .001$ ) between the performance on the unilingual control sentences (11 % accuracy) and

on the pristine code-switched sentences (53 % accuracy). This better performance by the monolinguals on the pristine sentences may have been due to the presence of inadvertent pre-switch cues. It was proposed that monolingual subjects did not process cues particular to the bilingual context, such as phonological anticipations, to the same depth as the bilinguals since there would be no pragmatic advantage in doing so as monolinguals only know one language. Furthermore, it was proposed that this resulted in the monolinguals' perceptual system being freer to tune into subtle inadvertent cues before the code-switches in the pristine code-switched sentences.

Between-group comparisons. After finding the expected non-significant ( $p > .2$ ) differences between all groups when perceiving the lack of pre-switch cues in the control sentences, all bilinguals and monolinguals, and balanced bilinguals and Spanish-dominant bilinguals were compared on their performance with the pristine code-switched sentences, phonological anticipation cues, and prolongation cues. The comparisons between all bilinguals pooled and monolinguals were highly significant ( $p < .001$ ) for all conditions. The monolinguals performed better (53%

correct) as compared to the bilinguals (20% correct) on the perception of pristine code-switches ( $\underline{z} = 4.84$ ). They also performed better (85% correct) than the bilinguals (45% correct) on their perception of the prolongations ( $\underline{z} = 5.55$ ). The bilinguals performed better (64% correct) than the monolinguals (37% correct) on the perception of phonological anticipations ( $\underline{z} = 3.7$ ). Hence, there was no doubt that bilinguals were better than monolinguals in perceiving pre-switch cues particular to the bilingual context, such as phonological anticipations, whereas monolinguals were better with those ambiguous pre-switch cues (that could belong to either context) such as prolongations, and with those switches requiring attention to possible subtle inadvertent cues, such as pristine code-switches.

To determine if differences existed in the ability to perceive these pre-switch cues based on language dominance, the two bilingual groups were compared on their performance with the conditions of phonological anticipation and prolongation. Results indicated that the balanced bilinguals perceived the phonological anticipations significantly better (77% correct) than the Spanish-dominant bilinguals (53% correct) which was

highly significant ( $z = 2.75, p < .01$ ). The balanced bilinguals also performed better (55% correct) than the Spanish-dominant bilinguals (35% correct) on the perception of prolongations ( $z = 2.20, p < .05$ ). These results seemed to indicate that prolongations are ambiguous cues for bilingual listeners as they may use them in monolingual or bilingual contexts, whereas, there is less confusion with the phonological anticipations, which may be particular only to the bilingual context. It was also noted in this pilot that balanced bilinguals perceived phonological anticipations regardless of their direction whereas Spanish-dominant bilinguals tended to perceive better those phonological anticipations going into their marked language (i.e., English). This result seemed to indicate that language markedness, possibly tied to language dominance, influenced the accuracy with which pre-switch cues were perceived. Hence, based on information drawn from other studies, observational data, and results from this preliminary research, the following research questions and specific questions were proposed for this study.

### General Research Questions

The overall general research question of this study is: Are bilinguals sensitive to boundary/transitional code-switching cues that may precede and signal the code-switches into the other language? The term "sensitive" in this study is defined as being attentive to phenomena which signal an impending code-switch.

A second general question of this study is whether bilinguals are more sensitive to certain pre-switch cues as compared to others. Specifically, transitional cues such as prolongations and hesitations, which occur both within a monolingual and bilingual context, frequently occur due to reasons not associated with code-switching (e.g., word-finding difficulties, speaker turns). This could render them less effective pre-switch cues than those which usually occur only within the bilingual context for example, phonological anticipations.

A third general question of this study is whether language dominance (i.e., balanced, Spanish-dominant,

English-dominant) influences the bilingual's sensitivity to these boundary pre-switch cues. If no differences are found, this question will also be explored with bilinguals classified according to their age of second language acquisition, and degree of exposure to code-switching.

### Specific Research Questions

Thus, after the existence of pre-switch cues prior to the switch is verified, the following specific questions of this study will be explored.

1) Are bilinguals sensitive to cues preceding the code-switch?

2) Are some pre-switch cues more effective than others? and,

3) Does the subject's type of bilingualism (balanced, Spanish-dominant, English-dominant) affect: a) the ability to detect the pre-switch cues, b) the relative effectiveness of the different pre-switch cues, and, c) the sensitivity to the direction of the code-switch?

In addition we will ask,

4) Does the direction of the code-switch affect differentially the performance within the different conditions?, and

5) Does the type of pre-switch cue affect the response of a bilingual (of any dominance type) to the direction of code-switching?

In the event of no group differences based on language dominance, all of the above questions will be asked of bilingual subjects classified according to age of second language acquisition, and to degree of exposure to code-switching.

## CHAPTER FOUR

## METHODOLOGY

Documentation of Phonological Anticipation

Although it was not the focus of this study to document the use of phonological anticipation within the bilingual communities, its existence is confirmed here, inasmuch as it has not been documented, to our knowledge, thus far in the literature. Evidence for the existence of phonological anticipation was observed informally mainly by William Stewart (1987, personal communication), a polyglot linguist (English-Portuguese-Spanish-French-Creole languages-etc.) with expertise in the area of bilingualism. Other linguists (1987, personal communications) have also noted this phenomenon such as Edward Bendix (German-English-Slavic languages polyglot), Fatiha Nakloufi (French-Arabic-English trilingual), and Kris Johnson (Norwegian-English bilingual). In order to obtain verification of this phenomenon particular to the bilingual context, a Spanish-English balanced bilingual speaker, originally from Venezuela, South America, who uses phonological

anticipation naturally within his speech was tape-recorded during two lengthy conversations in a quiet, naturalistic environment. He was also asked to read the same set of sentences used for the speakers of this study. The speaker was told that he was a subject of a study investigating bilingual code-switching. He was not, however, informed that he produced phonological anticipations in order not to bias his natural code-switching patterns.

The author listened to this speaker's productions of the control sentences and experimental sentences to determine if he used the same types of consonants for both languages (e.g., aspirated stops) or whether he distinguished between them. This speaker had distinct phonologies for both languages. For example, voiceless stops were aspirated in English and unaspirated in Spanish. An interesting phenomenon noted was that this speaker exaggerated at times the voicing of /z/ in English. He only devoiced this sound in anticipation of code-switches into Spanish. The [z] was also produced by this speaker on a few occasions in Spanish which does not usually have this sound in its phonology. According to Stewart (1989, personal communication) some dialects of Spanish do have the [z] in their phonology. Specifically, Stewart stated that:

There is a "band" (perhaps better called a dialect area) inside Colombia and extending into Venezuela where word-final /s/ is voiced to [z] before another word beginning with a voiced consonant or a vowel: los tiempos [los tyempos] but los monos [loz monos] and (unusually in Spanish, except for this dialect area) los ojos [loz oxos].

This speaker spend his first four years of life in an inland town before his family moved to the coast (Caracas). Since he continued to live within his family, all of whom were from the inland, this could have increased his tendency to use [z] in Spanish rather than assuming totally the coastal /s/.

Regardless of the reasons for the exaggeration of the voicing of the /z/ in English and the inappropriate use of [z] at times in Spanish, this speaker produced naturally many phonological anticipations involving vowel sounds and consonants before switching into the other language. Spectrograms of some of this speaker's code-switching boundaries, illustrating phonological anticipations, are found reproduced in Figures 4.1, 4.2, and 4.3. These figures illustrate clearly how the phonology of the incoming language influences the base language being used at that moment. Figure 4.1 is taken from a sentence that the subject read. This

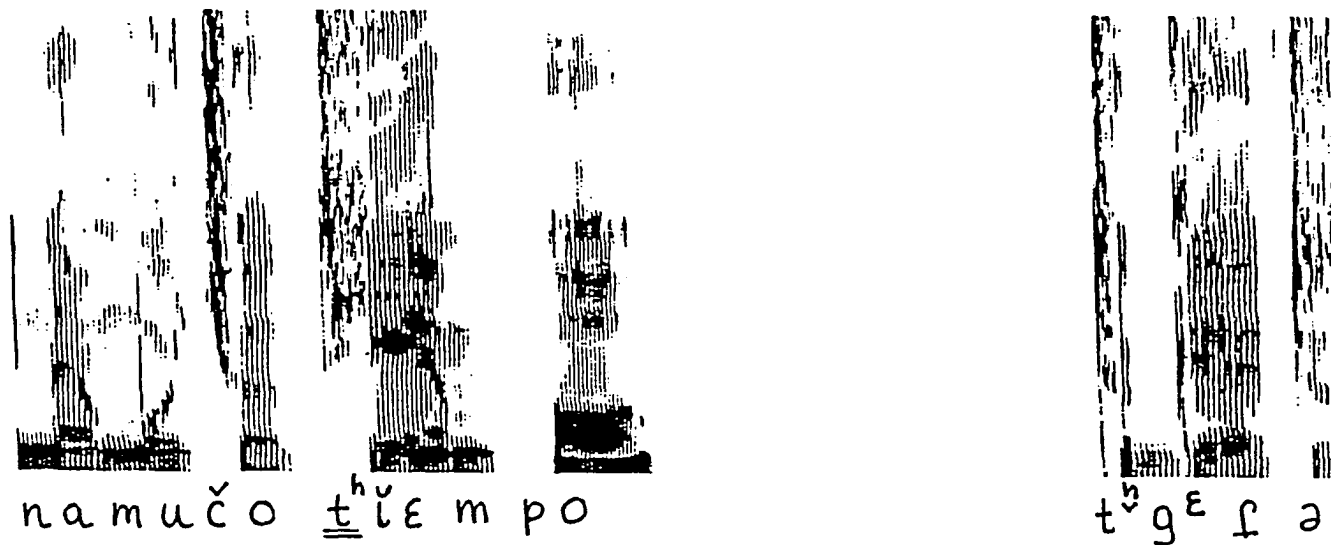


Fig. 4.1: Spectrogram illustrating phonological anticipation during reading on word preceding the code-switch boundary. Sentence is: "...na mucho tiempo to get to" from: "uno camina mucho tiempo to get to school" (translation: one walks a long time ...). Phonological anticipation occurs on underlined aspirated /t/ in tiempo which immediately precedes the code-switch boundary.

sentence contained a silent pause between the initial Spanish base language and the code-switched clause into English. The complete sentence was: En el campo uno camina mucho tiempo (silent pause) to get to school (translation: In the country one walks a long time ...). As indicated by the spectrogram, the /t/ in tiempo is aspirated in anticipation of the switch into English despite there being a silent pause in between.

Figure 4.2 presents a similar effect. This example is from the speaker's natural conversation while he was having lunch. The sentence is: Yo tenía clashes ... (Translation: I had ...). As indicated by the spectrogram, the /t/ in tenía is not an unaspirated Spanish /t/. Instead, because of anticipation of the incoming English language, the speaker used an allophone of [t], specifically, the English flap. Also, the final [z] is devoiced, contrary to his tendency to exaggerate the voicing of this phoneme as discussed above, due to another code-switch, into Spanish, that followed the segment analyzed here. Hence, this subject, who is considered to be quite "balanced" by this author and other fluent bilinguals, naturally anticipated in and out of either language by changing a variety of vowels and/or consonants in the word immediately preceding the code-switch.

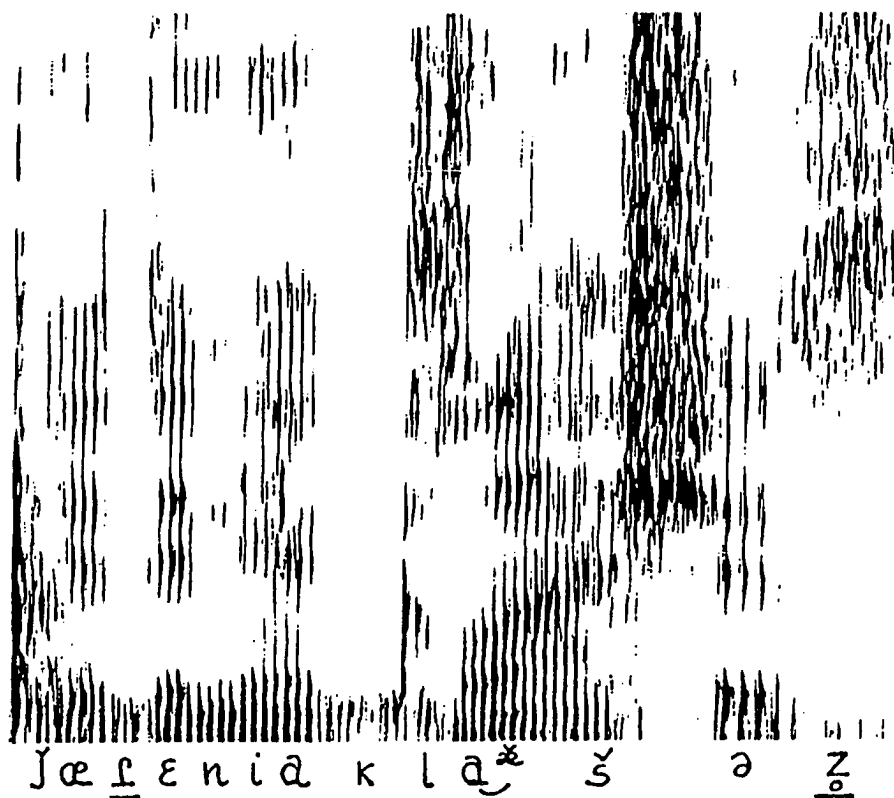


Fig. 4.2: Spectrogram illustrating phonological anticipation during conversation on word preceding the code-switch boundary. Sentence is: "yo tenía clashes" (translation: I had ...). Phonological anticipation can be seen on underlined flapped allophone of /t/ in tenía. Also, final /z/ is devoiced.

The above two examples illustrate phonological anticipations on the word preceding the code-switch. Hence, because of this, many skeptics may claim that such effects are only co-articulatory in nature rather than representing any internal planning schema on the part of the subject. Figure 4.3, however, suggests otherwise. This spectrogram illustrates that phonological anticipations do not only occur immediately preceding the switch but also may occur earlier within the speech stream with base language words in between. The sentence, also from natural lunch-time conversation, is: *Y que tenía garlic* (And that it had ...). It can be seen that the [k] in que is affricated, most probably reflecting an attempt to approximate the English aspiration, rather than being unaspirated as found within this subject's Spanish. The que is followed by the Spanish word tenía which belongs more to Spanish phonology despite some possible weak aspiration on the /t/. Finally, the English word garlic is uttered with a semi-fricative retroflex American /r/. What is of relevance here though is the strong affrication on the [k] of que despite being separated from the English code-switch by a whole word. Hence, this appears to be evidence that these

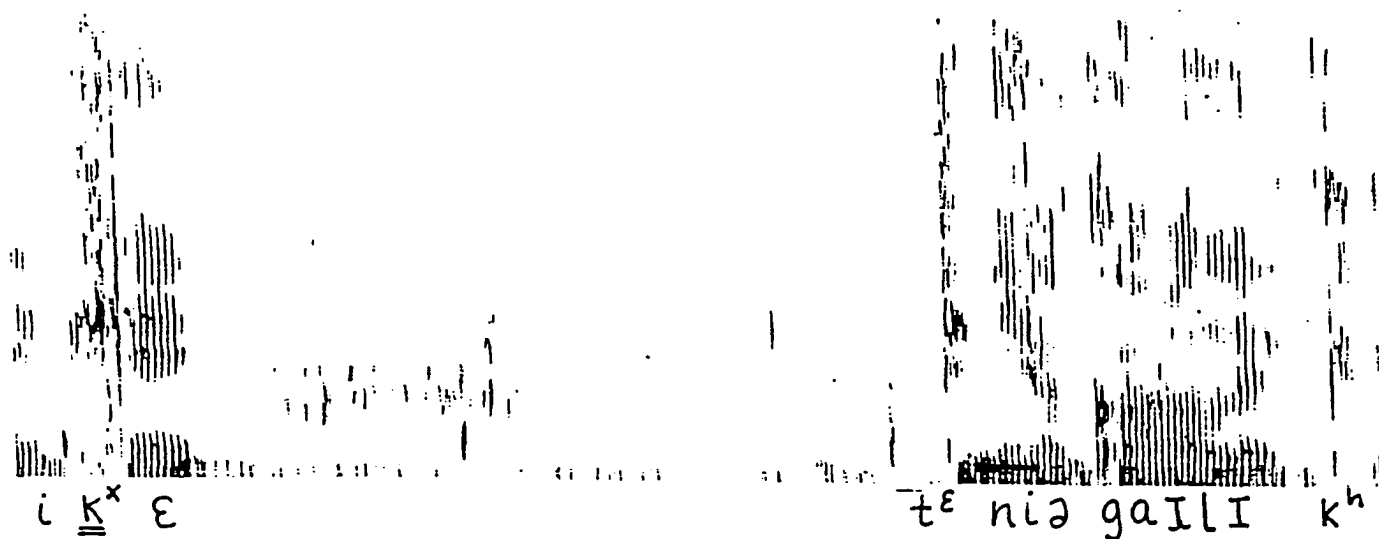


Fig. 4.3: Spectrogram illustrating phonological anticipation during conversation on word removed from the code-switch boundary. Sentence is: "y que tenía garlic" (translation: and that it had ...). Phonological anticipation can be seen on underlined affricated /k/ in que which is not immediately preceding the code-switch boundary.

phonological anticipations may be the result of planning processes, most likely at an automatic, not totally conscious level, rather than just the effects of co-articulatory events. According to Stewart (1989, personal communication) the phonological anticipation illustrated here is "detached" which in his words is of great importance. To quote:

The reason "detached" switched signals (i.e., way before the code-switch boundary, with an interlude of the first language in between) are theoretically so important is that, separated as they are from the code-switch boundary, they can no longer singly be the automatic effect of co-articulation or motor processing, but must instead be truly conventionalized signals - ones which, no longer purely automatic reflexes of the language being switched into, can be used at virtually any point before the switch itself.

Phonological anticipation in other research. It should be mentioned here that previous research by Grosjean and Soares (1986), concentrating on the factors occurring after the code-switch, has also shown that phonological anticipations are occurring even though they do not discuss these phenomena in their data. According to Stewart (1988, personal communication) a close scrutiny of the spectrograms presented in their 1986 study of mixed sentences containing the nonsense French word [daque], and the

English nonsense word [dack], indicates that effects indeed do occur before the code-switch, rather than at or after the switch as Grosjean and Soares (1986) propose. Specifically, a comparison between the mixed sentences I saw the [daque] and J'ai vu le [dack] and their monolingual, non-switched versions (I saw the dack and J'ai vu le daque) reveals a downward formant shift of the schwa vowel in both the and le before the English [dack] but an upward shift of this vowel in both the and le before the French [daque]. These shifts appear to result from an assimilation to alveolar English [d] versus dental French [d]. This suggests that the present phonological effects can occur before the switch, thus, contradicting the authors' belief that such effects occur at or after the code-switch boundary.

#### Construction of Stimuli Tapes

Sentence types. Sentences with three clauses, ranging from 9 to 15 words in length, were generated by the experimenter. A three-clause sentence was chosen as it is not so long to fatigue a listener yet it is long enough to permit the appropriate inclusion of the

cues. With a shorter sentence the phonological anticipation condition might have led the listener to consider the whole sentence as being accented. Hence, sufficient words preceded the pre-switch cue to insure that the pre-switch cue would not be the main part of the sentence. The following sentence types were chosen:

- infinitival e.g., "the other day I went there to get a newspaper,"
- prepositional e.g., "the city kids were excited to see so many animals on the farm," and
- temporal e.g., " the group of tourists went out to eat after visiting the museum."

The condition of prolongation of the sound before the code-switch when switching from English to Spanish contained two infinitival and one temporal sentences. All other conditions contained one infinitival, one prepositional, and one temporal sentence in each direction of code-switching.

These sentence types were chosen, because the code-switch can only occur before the beginning of the clause and not after (e.g., the dedicated doctor gave

the shots/to all the children) as compared to relative sentences, originally considered, where the code-switch can occur before or after the relative clause (e.g., "the girl closed the window because/it was very cold" or "the girl closed the window/because it was very cold"). Although adverbial sentences were considered they were eliminated as they were difficult to generate and did not sound as natural as the three types of sentences used.

Vocabulary. Common vocabulary words were selected in both languages. To test the level of the vocabulary used in Spanish these sentences were read by a 17.6-year old Spanish monolingual for comprehension. She had a high-school degree, worked as a cashier, and only had nine months of exposure to English. Results indicated that she understood all of the Spanish vocabulary readily. This subject also read the English sentences and results indicated that even with her limited English she only missed three words (scratches, shots, and climbed). Her understanding of the English sentences was confirmed by asking her to translate random English control sentences containing grammatical constructions not used in Spanish (e.g., "my daughter's class goes to the movies/at the end of the year").

To test the level of vocabulary of the English sentences, a subject of similar education and economic status as the Spanish judge was chosen. The judge of the English sentences was a 21.6-year old High-School graduate who also worked as a cashier in the same place as the Spanish monolingual. She had no difficulties understanding any of the English vocabulary. Since the experimenter knew that this judge also comprehended much Spanish but spoke it very poorly she was asked, again as a strong test of the vocabulary used, to read the Spanish sentences. She only missed a total of seven words (invirtió, bondadoso, teñirse, liviano, ladra, tésis, leves). Hence, the results of the judgment tasks by these non-sophisticated subjects confirmed that the vocabulary used for each language was very basic.

Pool of sentences. A total of 58 pairs of unilingual three-clause sentences was created. Each pair consisted of a sentence in English and its Spanish translation. The basic criterion used in the construction of these unilingual sentences was that the last clause could be eliminated without affecting the syntax of the first two clauses. That is, a

syntactically complete sentence had to remain after the third clause was eliminated. For example, the elimination of the third clause on the farm did not affect the comprehension of the first two clauses "the city kids were excited to see so many animals." There were approximately 19 sentence pairs under each of the three sentence types (i.e., infinitival, prepositional, and temporal).

Selection of sentences. A polyglot linguist (William Stewart) and this balanced Spanish-English bilingual author judged each sentence as to its appropriateness by speaking each one with and without a code-switch. There was high inter-judge agreement (beyond 90%) over which sentences sounded natural when switched and which did not. For example, the sentence "the music teacher was very happy when the choir sang well" was rejected, because the first two clauses were not totally semantically independent of the third. Hence, it did not sound natural to break it up since being happy was too closely related to the way the choir sang. Sentences that were frequently switched by bilinguals were avoided (e.g., containing tag phrases such as you know) as were sentences that sounded awkward when switched. Also eliminated were sentences

that contained topic specific words (e.g., "tenure"), that contained words high in emotional content (e.g., "neurosurgery"), or that sounded unnatural when the direction of the switch was reversed. In summary, we chose neutral sentences that contained a variety of general topics known to unsophisticated populations and that could be switched in either direction or just as easily left in one language.

For the construction of the experiment tape a total of 90 sentences was selected. Six sentences served as practice sentences and 42 pairs as the sentences for the experiment tape. Specifically, for each experimental condition a total of six unilingual sentences was modified: three were code-switched from English to Spanish and three were code-switched from Spanish to English. As stated before, with the exception of the prolongation condition, code-switching from English to Spanish (for which two infinitival sentences and one temporal sentence were used) all experimental conditions contained one example of each sentence type (i.e., prepositional, temporal, and infinitival). In addition a total of 42 unilingual control sentences was used. A description of the conditions, practice sentences, and control sentences is found below.

Description of experimental conditions used and constraints. A total of six experimental code-switched sentences (three in each direction) was constructed for each of the conditions following certain constraints as described below:

- Pristine code-switch. Characterized by a code-switch without the presence of a cue e.g., "the city kids were excited to see so many animals/en la finca." In this condition a vowel-vowel boundary at the switch was avoided. A consonant-consonant, vowel-consonant, or consonant-vowel was accepted and an attempt was made to have examples of these phonetic constraints within each set of three pristine code-switches (code-switching from English to Spanish and vice versa).

- Prolongation. Characterized by a prolongation [::] of the sound immediately preceding the code-switch e.g., "when she goes on a trip she takes medicine [::]/para no marearse." Although this example ended with a nasal consonant, all other prolongations ended with vowels. A variety of vowels was chosen as prolongation cues within each set of three sentences in either direction.

- Silent pause. Characterized by a silent pause [P] immediately preceding the code-switch e.g., "the new students attended an orientation [P]/ por la tarde." The same constraints at the code-switch boundary as described for pristine code-switches were applied here and different combinations were included within each set (i.e., consonant-vowel, vowel-consonant, consonant-consonant).

- Spanish hesitation form. Characterized by the presence of a Spanish hesitation form [ɛ ] before the code-switch into Spanish e.g., "the dedicated doctor gave the shots [ɛ ]/ a todos los niños." Words that began with the [ɛ ] sound or with another vowel were avoided after this cue. Also, no words ending with the [ɛ ] sound were placed before the [ɛ ] cue in order to prevent it from sounding like a prolongation cue.

- English hesitation form. Characterized by the presence of an English hesitation form [ʌ ] before the code-switch into English e.g., "muchos sordos hablan con las manos [ʌ ]/ to communicate their thoughts." Constraints in this condition were to avoid words that began with the [ʌ ] or any other vowel sound after the

cue or before it in order to prevent it from sounding like a prolongation cue.

- Incorrect English hesitation form. Characterized by the presence of an English hesitation form [ʌ] before the code-switch into Spanish e.g., "the president of the company has a nice view [ʌ] /desde su oficina." The same constraints specified for the English hesitation form applied here.

- Incorrect Spanish hesitation form. Characterized by the presence of a Spanish hesitation form [ɛ] before the code-switch into English e.g., "mi hermana tiene un profesor viejo [ɛ] / with a great sense of humor." The same constraints specified for the Spanish hesitation form applied here.

- Throat clearing non-verbal cue. Characterized by clearing of the throat immediately preceding the code-switch e.g., "that young scientist works in his lab [clear throat] / hasta muy tarde." No constraints applied here.

- Phonological Anticipation. Characterized by producing the one to two words (a total of two to four

syllables) preceding the code-switch with an accent. Longer strings of words were not accented in order to prevent the impression that the whole sentence was accented and to make this cue as subtle as it is in real life situations. Examples of sentences used are (accented words are underlined): "the other day I went there/ para conseguir un periódico," "el guardia' revisó las cerraduras/ while the prisoners slept." Words chosen for this condition were carefully selected to contain either consonants or vowels which were consistently accented when produced by a non-native speaker. Words were chosen which contained consonants which could indicate an accent in both Spanish and English. These were: /r/, /r/ blends, /b/, /g/, and /d/. We also selected the following vowels for their ability to indicate accent: /e/, /I/, /o/, /a/, /i/, and /u/. The specific words accented from Spanish to English were cerraduras, nervioso, and abogado, and from English to Spanish the following were used: went there, oral exams, and drink coffee.

Practice sentences. The practice sentences consisted of the following: a complete English sentence, a complete Spanish sentence, an English [P] Spanish sentence, a Spanish [::] English sentence, an

English [ξ] Spanish sentence, and a Spanish [^] English sentence. These sentences were not reused within the remainder of the tape.

Control sentences. In addition to the six experimental sentences for each condition described above, a control sentence was constructed for each experimental sentence. The control sentence consisted of the sentence without the code-switch and without any cues thus, "the other day I went there/ para conseguir un periódico" would have as its control "the other day I went there to buy a newspaper." All control sentences were carefully listened to by this author, and other sophisticated judges, to determine if any inadvertent pre-switch cues had been produced by the speakers. To the ear, no obvious pre-switch cues were apparent.

#### Recording of the Sentences

Speakers. Three adult males served as speakers. Two of them are linguists and one is a Speech-language pathologist. The linguists had opposite language acquisition histories. Specifically, one learned

Spanish as a second language and the other learned English as a second language. The third speaker is a fluent Spanish-English bilingual who learned English as a second language. All learned their second language during childhood, and are considered to be fluent bilinguals by sophisticated listeners (e.g., linguists).

Recording. The complete sentences were recorded on analog, reel-to-reel tape in the order of the experimental conditions listed above. A set of experimental sentences was recorded followed by its set of corresponding control sentences. The speaker had in front of him the typed version of the sentences, with the cues specified if they were experimental sentences, and no cues if they were control sentences. Sentences were numbered one through ninety. Preceding the recording of the sentences each condition was reviewed with the speaker and its production was practiced several times until the speaker produced it naturally. The speaker was advised to repeat any sentence as many times as he wished during the actual recording if he felt that he had not produced it as intended. The procedure for recording each sentence was as follows: the speaker announced the number of the sentence, read

it silently, and then produced it with a conversational intonation and delivery. Those control sentences with inadvertently produced pre-switch cues, or those experimental code-switched sentences that were judged by the examiner and the speaker not to sound natural, or not to be equivalent to the other sentences (e.g., volume or rate were changed), were recorded again at the end of the same recording session.

Monitoring of recording onto reel-to-reel. The set-up of the instrumentation used for the recording of the uncut sentences onto reel-to-reel tapes is illustrated in Figure 4.4. One reel-to-reel professional quality recording tape was used for each speaker. The speaker sat in a sound-proof booth and the experimenter sat outside the booth and monitored his productions through the earphones. The speaker spoke the sentences into a microphone which was placed about a foot away from his mouth and slightly below it. The recording level was adjusted by the experimenter for peak indications between -5 to +3 dB on a VU meter. Productions by the speaker were pre-amplified before being recorded onto tape. The output was monitored through earphones by the experimenter. If a speaker was observed to produce a whole condition incorrectly

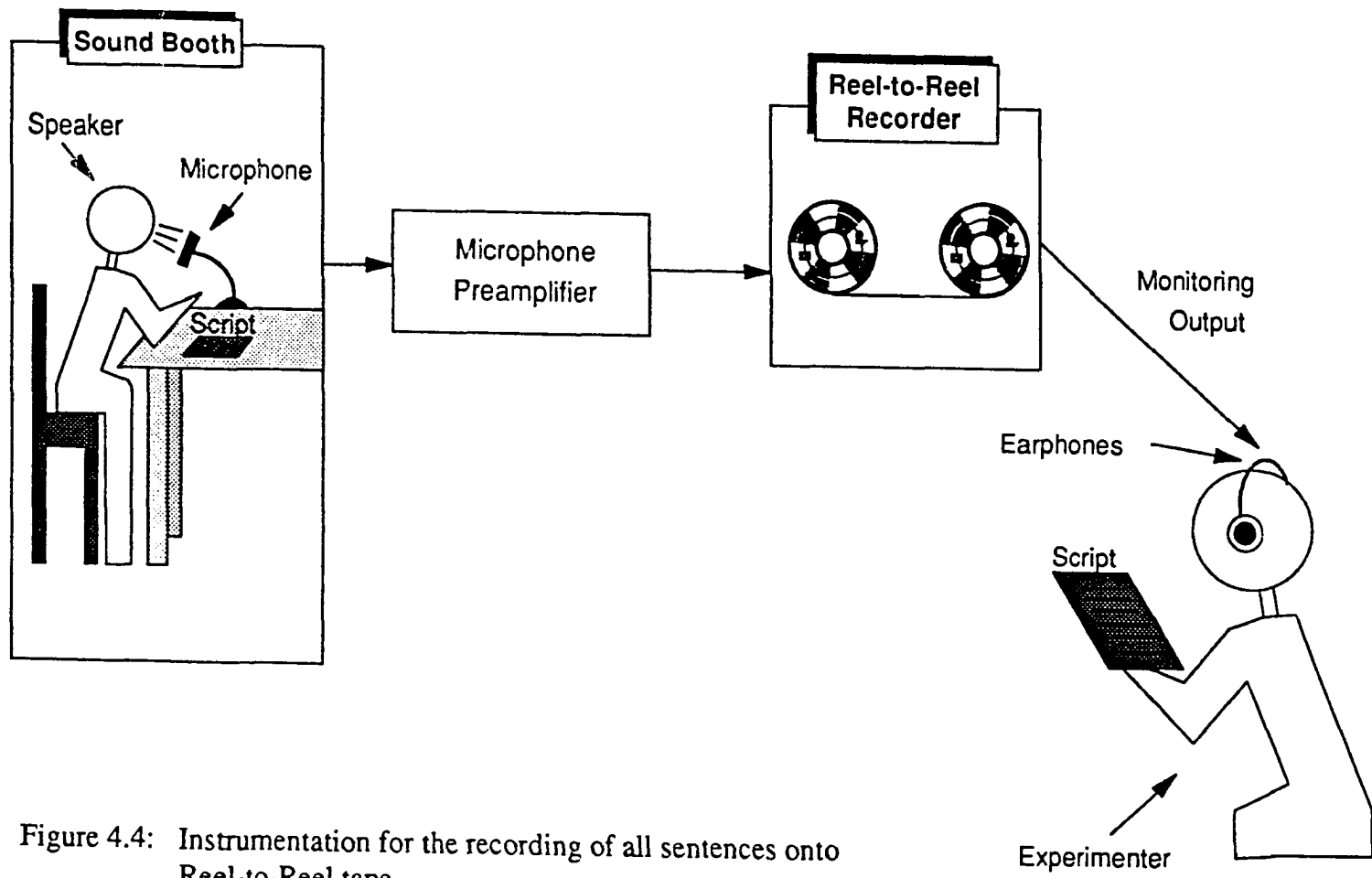


Figure 4.4: Instrumentation for the recording of all sentences onto Reel-to-Reel tape.

he was stopped, reinstructed, and asked to repeat the production of the stimulus. Speakers were corrected on such things as: changes in volume from one sentence to the next, leaving a silent pause before pristine code-switches, prolonging a sound too much or too little, having a downward intonation at the end of a clause preceding the silent pause, producing a schwa vowel form (instead of [ɛ] or [ʌ]), and exaggerating the clearing of the throat.

It was interesting to note that speakers experienced the most difficulty during the production of pristine code-switches. Specifically, they tended to insert cues during their production. Some difficulty was also encountered with the improper hesitation cues since frequently the speakers would spontaneously produce the correct ones. All speakers usually produced sentences containing phonological anticipations correctly on their first try. Only a few phonological anticipations had to be redone due to a slight decrease in rate and/or a slight exaggeration of the accent during their production. The whole recording session took approximately one hour per speaker.

## Transferring Sentences from Reel-to-Reel onto Cassette

Selection of sentences and transfer onto cassette tape. Prior to copying the recorded sentences onto cassette tape for digital processing, they were reviewed by the experimenter. Where there were multiple productions of the same sentence, the experimenter and/or the experimenter and speaker, selected the one that sounded the most natural. The transfer from reel-to-reel to cassette was accomplished by the use of a Tascam 122 recorder. The cassette copies were made on a Nakamichi recorder whose recording level was adjusted for maximum dynamic range. That is, the adjustment was made such that the signal level indication on the recorder's VU meter peaked between 0 and +2 dB. This level assures a signal-to-noise ratio of at least 45 dB for standard quality magnetic tape.

## Recording of Experimental Sentences

Semi-randomization of sentences. As it has been shown in various studies from a variety of fields that a blocked form of presentation may be detrimental to

performance (e.g., Dempster, 1978), a semi-random order of presentation was chosen. A randomization computer program was used for the practice sentences (randomization of sentences 1-6) and for the experimental sentences (randomization of sentences 7-90). The results of the randomized order were modified to satisfy the following criteria: at least two unrelated sentences were placed in between an experimental sentence and its control sentence or vice versa, and at least one sentence was placed in between sentences from the same condition. Based on these criteria, a total of 12 sentences out of 84 was rearranged to satisfy the semi-random design.

Recording of numbers to announce experimental sentences. The numbers 1 through 90 were recorded by the experimenter on a Marantz cassette-recorder in a sound-proof booth. Numbers were spoken into an Electrovoice model 635 dynamic microphone placed in a stand about a foot from and slightly below her mouth. All numbers were announced in both Spanish and English. The order of languages was alternated so as to not bias the context towards either language. Specifically, all odd numbers were announced first in English and then in Spanish with a pause [P] in between (e.g., number one

[P] número uno) and all even numbers were announced first in Spanish and then in English (e.g., número dos [P] number two). The speaker attempted to produce all numbers in an energetic fashion, with the stress slightly emphasized, and attempted to prevent too much of a downward fall at the end of each number. Those numbers that sounded different from the rest were recorded again until equivalent productions were obtained.

Recording sentences into the computer. The recorded sentences were reproduced on a Marantz model PMD 430 tape recorder. The recorder output was amplified and connected to the computer interface unit (see Figure 4.5). This unit contained the low-pass filters needed to prevent aliasing and imaging distortion of the A/D (analog-to-digital) or D/A (digital-to-analog) converted signals. To preserve the energy and spectrum of fricative sounds, filters with high-frequency cut-off frequencies of 10,000 Hertz were used which dictated sampling at 20,000 Hertz. The interface output was connected to a digital input/output board in the computer, where it was sampled at a rate of 20,000 samples per second, and converted to binary number form for input to the computer for editing and segmentation (Figure 4.6a).

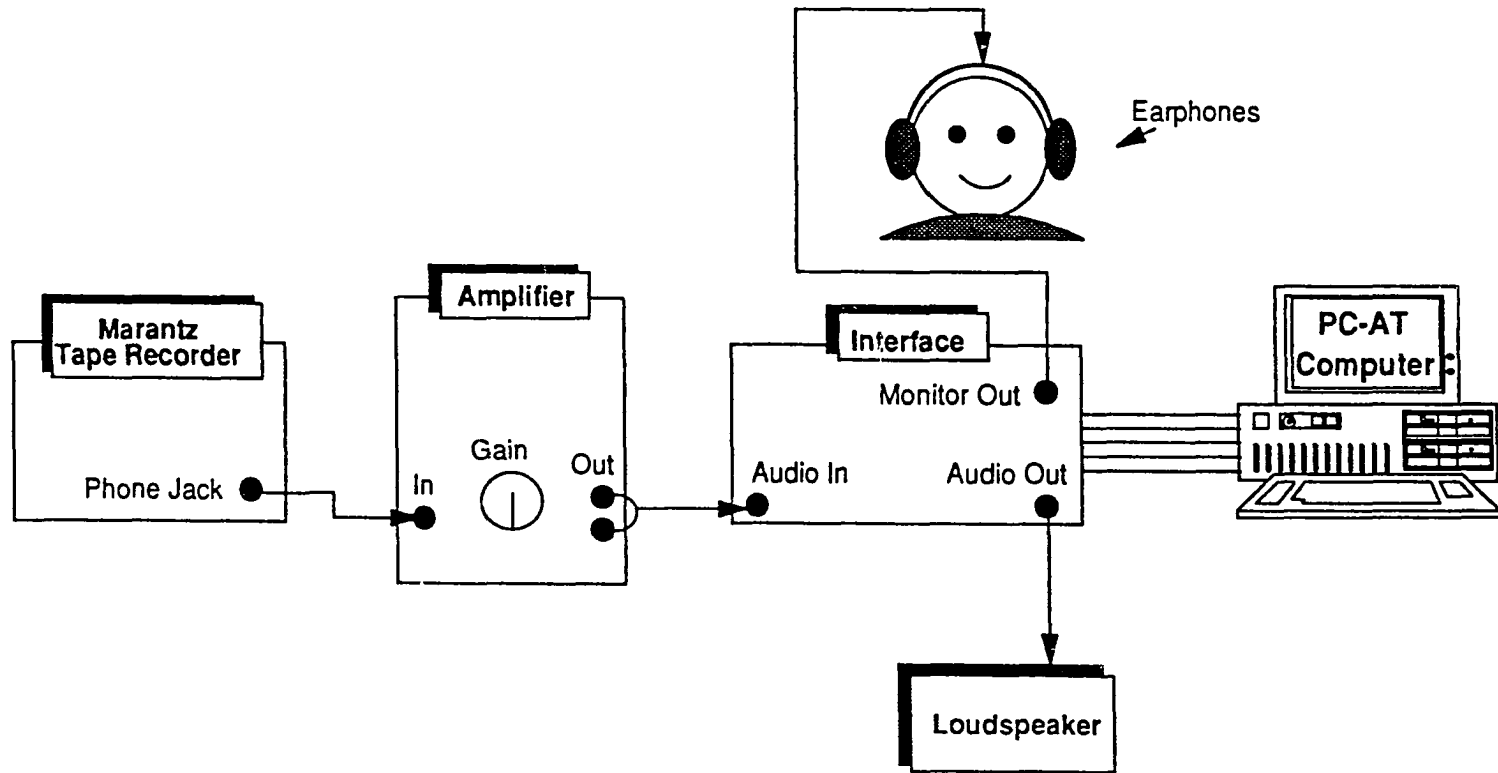


Figure 4.5: Instrumentation to record sentences from tape recorder into computer.

During the reproduction of sentences stored in the computer the binary samples were converted to analog form by the digital input/output board. The regenerated analog signals were passed through the anti-imaging filter in the interface unit, which conditioned the signals for monitoring and for recording (Figure 4.6b).

Segmenting the sentences. A time-waveform editing program was used to delete the phrase that announced the sequence number of each sentence and also to delete the last clause from each sentence. First, the time waveform of each sentence was presented on a video display screen. Two cursors were used to mark the section of the displayed sentence that was to be cut out of the waveform. One cursor was placed just after the number announcement. A second one was placed just before the code-switch and at a point where the speech intensity was low, to avoid the introduction of perceptible transient clicks. Deletion of the number was usually simple since most of the time the speaker remembered to leave a pause between the number and the sentence. Only a few sentences were problematic in that the number was close to the first word of the

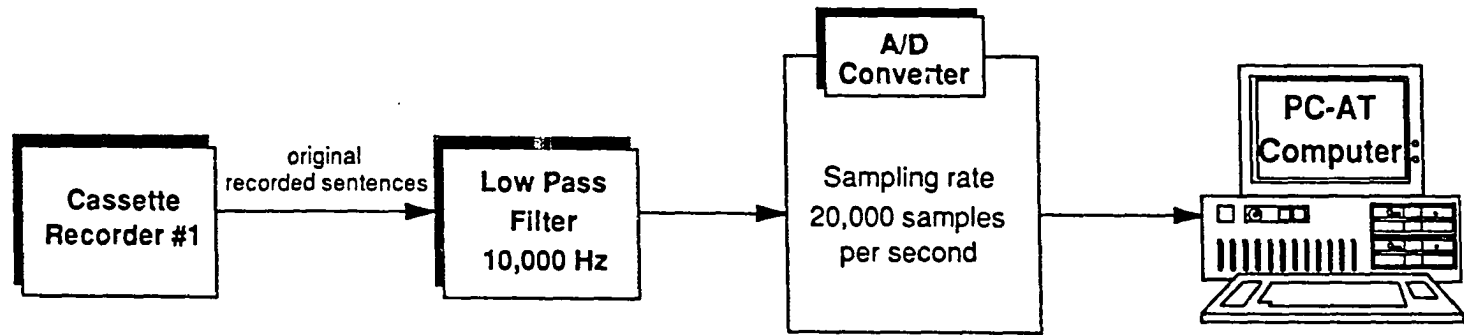


Figure 4.6a: Instrumentation used for input of analog signals to the computer.

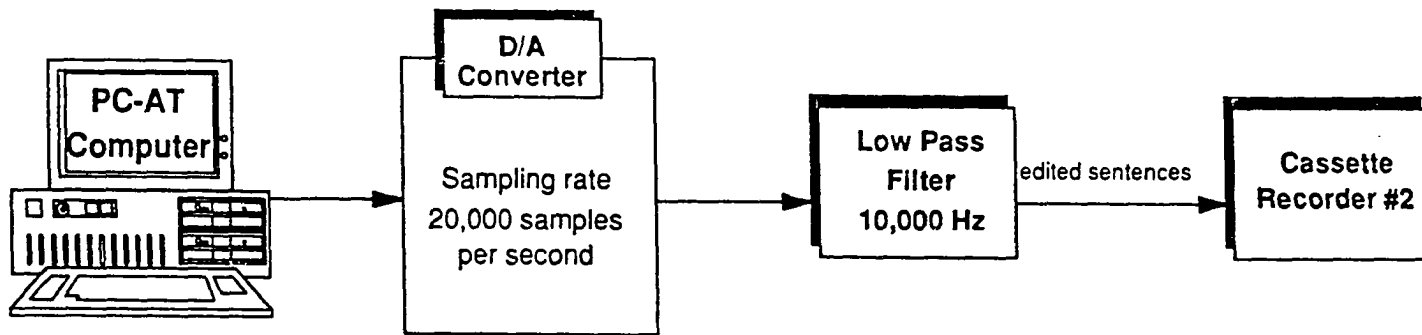


Figure 4.6b: Instrumentation used for output of edited waveforms to the tape recorder.

sentence, which produced a slight noise at the beginning of the sentence. For these cases, a program was used that suppressed the noise at the beginning of the sentence.

For some of the conditions, for example, clearing of the throat, prolongation, hesitation forms, and silent pauses, it was relatively easy to place the second cursor just after the code switch cue. The cut was made in each of the above as close to the end of the cue as possible (i.e., as close to the end of the pause, etc.). Other splices were more difficult, such as pristine code-switches, control sentences, and some of the phonological anticipation sentences. This was because the speakers, in order to sound natural and not produce pauses before the switches, frequently spoke rapidly, which resulted in increased co-articulation effects. At times a cut had to be made to minimize such effects. For example, the words carta en in the control sentence "antes de ayer fué que escribí una carta/ en la oficina" were produced as "carte/en" by two of the three speakers. In this case the e at the end of carte was shortened to make it more like an a (as in the target "carta"). The difference is almost imperceptible unless the listener is cued to this

factor, or is a very sophisticated listener. Editing was also difficult when two allophones of the same consonant were conjoined (e.g., "ciudad/ durante"), and when a continuant flowed into a glide (e.g., "coffee/ when"). In these situations a special technique was used whereby one expanded the waveform (to individual glotal vibrations if necessary) and made the cut at the transition point between the two sounds (e.g., just before the first glide waveform). In all cases the cut was made at a point such that the first sound of the spliced off section was not perceptible.

Recording of the experiment tapes. Once all the sentences were excised, they were reproduced, reconverted to analog form and recorded onto an audio-cassette. The order in which the sentences were recorded was determined by use of a table in which numbers from 1 to 90 appeared in semi-random order as described before. The main instrumentation used for the recording of the experiment tapes is illustrated in Figure 4.7.

The specific recording procedure was as follows. First, playback was initiated on cassette recorder number 1 and the next sequence number recorded on

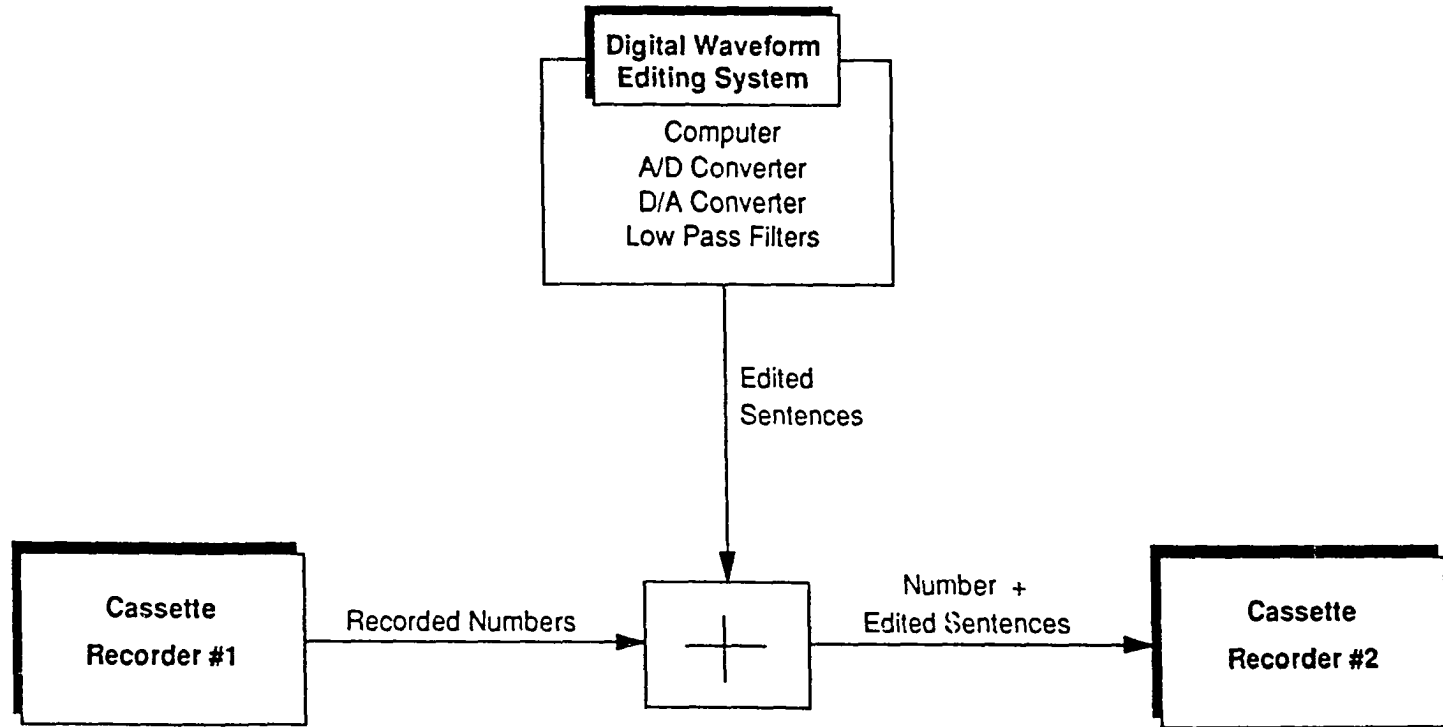


Figure 4.7: Setup for production of experiment recordings.

cassette 1 was reproduced and copied onto the experiment tape, cassette number 2. Immediately after that, cassette recorder number 1 was paused and then the selected sentence was called up from the computer and recorded onto the experiment tape. At the conclusion of the sentence the recording of the experiment tape was paused, and the identification of the next sentence to be called up was entered into the computer. Then the procedure was repeated.

The inter-stimulus interval on the experiment tape was about six seconds. This time was judged as long enough to allow subjects sufficient time to respond yet short enough so that their responses would be quick, and as intuitive as possible. Out of the total of 90 sentences of the first tape constructed three were slightly lower in volume (two control sentences and one prolongation moving from Spanish into English). However, according to an experienced listener (Mark Weiss) the quality and intelligibility of these sentences were not affected. No difficulties were encountered with the other two experiment tapes.

To summarize, each experiment tape contained six initial practice sentences (randomized 1 through 6)

followed by 42 experimental sentences (half of these switching in one direction and the other half switching in the other direction), and 42 control sentences. A randomization program (7-90) was used to mix the experimental and control sentences. The tape was reorganized where needed in order to minimize the possibility of the listener readily discovering patterns. A listener could discover a pattern if, for example, all experimental conditions were presented in a block form or if an experimental sentence was always followed by its unilingual control sentence. Such sequences were not used in this experiment. The list of the 90 sentences in each of the three experiment tapes is found in Appendix A.

### Subjects

A total of 54 Spanish-English bilingual adults from the tri-state metropolitan area (New York, New Jersey, Connecticut), with no reported hearing, vision, or emotional problems, participated in this study. The majority of the subjects was recruited from the colleges within the City University of New York. A few were recruited from Boricua College, a bilingual

college in New York City, and through private referrals.

Screening to determine bilingual group placement

All subjects were screened, to determine eligibility, over the phone or in person. They were asked their age, education, primary dialect of Spanish, age at which they learned each language, knowledge of other languages, and language dominance (i.e., whether they were balanced bilinguals, English-dominant bilinguals, or Spanish-dominant bilinguals). The latter was determined by asking the subject to self-rate her/his comprehension and speaking abilities for each language using a five-point scale (fair, average, good, very good, and excellent). The English screening form can be found in Appendix B and the Spanish screening form can be found in Appendix C. Subjects self-rated themselves on the scale which was clarified for them, if needed. We felt justified in using self-rating scales as they have been found to highly correlate with proficiency tests (Fishman and Cooper, 1969). Also, Grosjean (1982), in his discussion of measurements of dominance, reported that "self-ratings have repeatedly been reported to be highly related to

independent assessments of language skills (by exterior judges) and to more direct tests of language proficiency" (p. 233). Romaine (1989), criticized self-rating scales and demonstrated how greater reading and writing abilities in one language, resulting from illiteracy in the other fluent language, will result in a score indicating a degree of imbalance. Furthermore, she stated that the result(s) "does not tell us anything about the nature of the imbalance" (p. 15). These possibly confounding factors were prevented in this dissertation by only rating the degree of fluency in speaking and comprehension.

Criteria for placement within the balanced bilingual group were as follows: individual ratings in each language within each modality (comprehension and production) had to receive a minimum score of 3 (i.e., good), and the difference between the language averages (comprehension rating plus production rating in each language divided by two) had to be a value of 1 or less.

Criteria for placement within the dominant groups were as follows: individual ratings in each language within each modality (comprehension and production) had

to be at least a 2 (i.e., average), and the difference between the language averages in English and Spanish had to be a value greater than 1 and equal to or less than 3. For example; we found for one subject a Spanish average of 4.5 (average of 4 + 5), an English average of 2.5 (average of 2 + 3), and a Difference of 2.0 (4.5 - 2.5). Therefore, this subject was rated as Spanish-dominant. The screening information was supplemented with informal interviews, and a questionnaire administered at the end of the testing session. The following additional factors for each type of bilingual group were controlled.

Age, education, and additional selection criteria

Additional subject selection criteria were as follows. Age had to be between 17 and 59 years. The age was the reported age regardless of whether a birthday was near. Hence, for example an age of 20.8 years was recorded as 20 years.

Education had to include a minimum of a high-school degree or equivalent (G.E.D.). A high-school degree or equivalent was given 12 years of education,

and a total of 13, 14, 15, and 16 years were given for the respective college undergraduate years. Two additional years were allotted for studies at the Masters level (years 17, 18), and three additional years beyond the Masters level for the doctoral level (years 19, 20, 21).

Another factor noted was the knowledge of other languages, and the age at which the languages were acquired. Subjects selected had minimal or no exposure to a third language. Also, based on the results obtained in the pilot study, described above, and previous research on the critical period, all dominant bilinguals had acquired their second language after nine years of age and the balanced bilinguals either before nine years of age ( $N = 8$ ), or before 13 years of age ( $N=14$ ). Only four balanced bilinguals acquired their second language after 13 years of age. In terms of dialect of Spanish, speakers from the Americas and the Islands (Cuba, Puerto Rico, and Dominican Republic) were accepted. All subjects were part of bilingual communities from the tri-state metropolitan area (New York, New Jersey, and Connecticut). Subjects from Spain, on the advice of Stewart (1987, personal communication) were not used as they usually were not

part of the bilingual, code-switching latin communities of the tri-state area. Also, Spaniards frequently had different language acquisition histories (e.g., English learned in the classroom). Hence, for the purpose of maintaining the homogeneity of the populations these subjects were rejected.

It was informally noted during the screening that the balanced bilinguals usually had slight or no accents in their languages and used both languages singly, or code-switched between them while socializing. In contrast, the dominant groups usually had a noticeable accent in their non-dominant language, did not use it as frequently, and did not code-switch much between them while socializing.

#### Subjects in this study

A total of 18 subjects within each bilingual group were selected to participate. All subjects were remunerated at a rate of \$5/hour for their participation. Individual subject information in terms of sex, age, and years of education is found in Appendix D (Balanced bilinguals), Appendix E (Spanish-dominant bilinguals), and Appendix F (English-dominant

bilinguals). As indicated by the tables, all three groups were closely matched on these factors.

The sex distribution was the same for each group: 11 females and 7 males.

The range of ages in years for the balanced group was 19 to 36; for the Spanish-dominant group it was 19 to 45; and for the English-dominant group it was 18 to 39. The mean ages in years respectively for these groups were similar: 26.6, 26.1, and 23.6.

The range of years of education and mean values for each bilingual group were also similar as follows: Balanced bilinguals--range of 12 to 21 with a mean of 15.3 years; Spanish-dominant bilinguals--range of 12 to 19 with a mean of 14.9 years; and English-dominant bilinguals--range of 12 to 18 with a mean of 14.6 years.

### Procedures

Order of tape presentation was randomized across subject groups. Since each group had 18 subjects, and

there were a total of three experimental tapes (1, 2, and 3), a maximum of three subjects/order was assigned in order to cover the six arrangements of tape presentation for each group (i.e., 1-2-3, 2-1-3, 2-3-1, 1-3-2, 3-2-1, and 3-1-2).

Subjects were tested by this "balanced" Spanish-English bilingual author in a quiet classroom singly, in pairs, or in groups of three. A pair or group consisted of subjects from the same bilingual group or from a dominant group and the balanced group. Members of opposite dominant groups were not tested together to maintain the same language of communication for all.

Instrumentation used and seating arrangements for the group setting are illustrated in Figure 4.8. Tapes were played on a high-quality tape recorder (Marantz) and transmitted to the subjects via high-fidelity earphones. Subjects were instructed beforehand as to how to adjust the volume of the incoming speech to a comfortable level.

Instructions were presented in English written form for the English-dominant subjects (Appendix G), or in Spanish for the Spanish-dominant subjects (Appendix

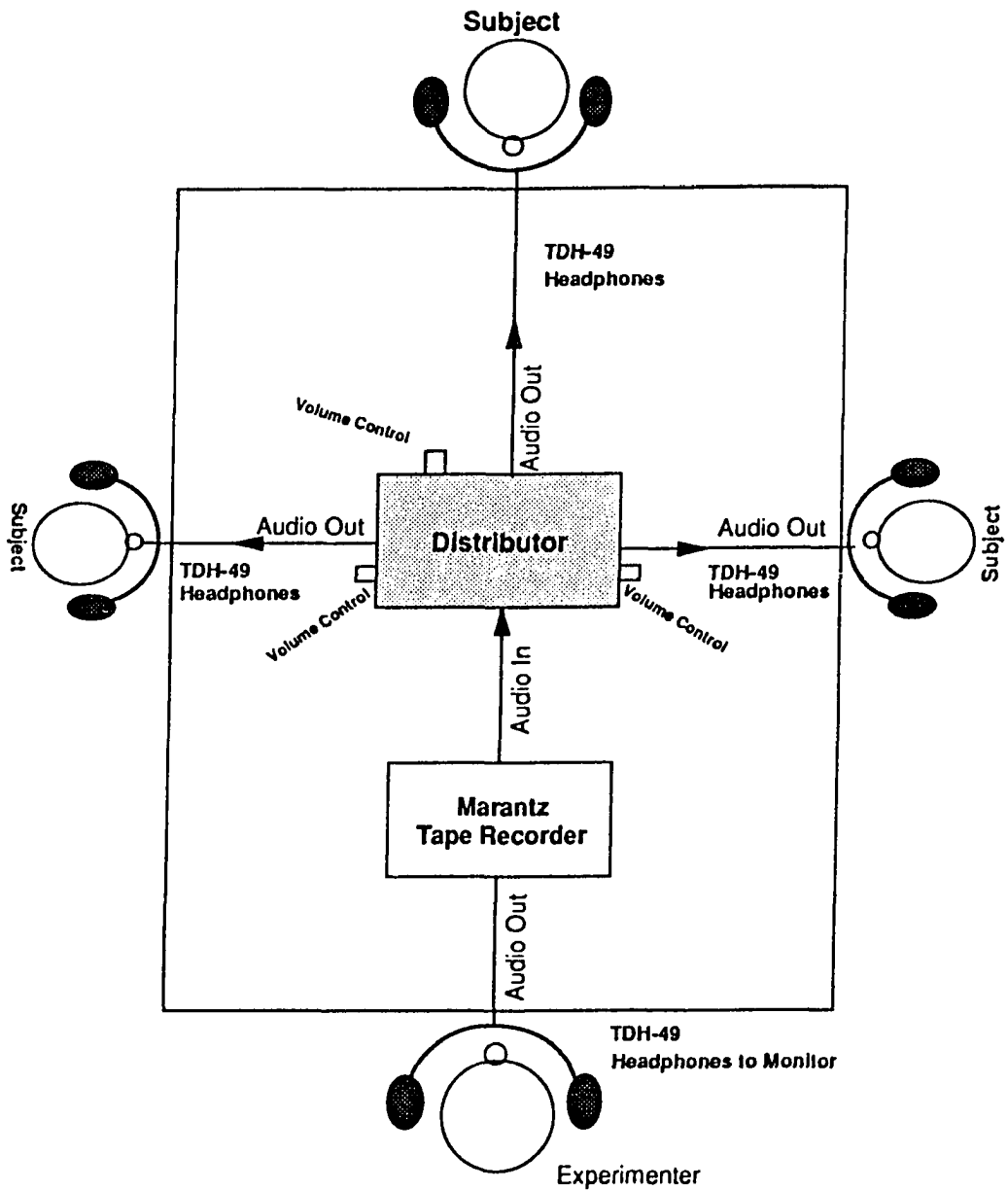


Figure 4.8: Instrumentation for testing subjects.

H). Balanced bilingual subjects were free to choose either version. Written instructions emphasized that subjects were to concentrate on their own work quietly without influencing others. They were instructed not to make verbal comments about their reactions to the task. Instead, they were asked to write them down on the answer form during the allowed breaks. Subjects were instructed not to share information about their responses with other subjects. After subjects had read the instructions these were reinforced by verbal directions clarifying the task and by using the first practice example from the answer form (Appendix I).

### Task

Subjects had to listen to the spliced first part of the experimental or control sentence, and check off in pencil on their answer form the Spanish or English clause that completed it. For example, if they heard "the group of tourists went out to eat" they had to select between "after visiting the museum" and "después de visitar al museo." As described under the tape construction section, approximately six seconds was allotted for a response after the presentation of each

sentence. No difficulties were noted with this inter-stimuli interval.

Quick intuitive responses were encouraged and subjects were told not to leave any blank spaces, but, rather, to guess if they had to. Subjects were allowed to change their responses during the response time following the presentation of the sentence. A break was taken after the last training sentence (#6) to insure that all subjects understood the task (answer forms were checked for alternation of language choice but not for accuracy). Breaks of two to three minutes were taken after experimental sentence #36, 56, and 76. Longer breaks (10 to 15 minutes) were taken between the first and second tapes, and the second and third tapes. At the end of the session an additional 10 minutes was allowed to fill out the language history questionnaire either in English (Appendix J) or in Spanish (Appendix K). The length of the entire experiment (administration of the three tapes plus questionnaire) was an average of 2 1/2 hours plus or minus 15 minutes.

Answer forms were reviewed after the last sentence was played. If a subject left an answer blank, which occurred only twice, the sentence was played again

immediately after the last sentence of the experiment, and before the questionnaire was administered. Subjects who had apparent difficulties understanding the task despite clarification (e.g., marked all answers the same) were not informed of their lack of understanding, but were allowed to participate in the study, and were paid accordingly. Their data, however, were not used.

## CHAPTER FIVE

### RESULTS

The results of this research will be presented in two parts. The first will present the analyses and results obtained with the accuracy scores (responses to code-switched sentences and control sentences combined), and the second will present the analyses and results obtained with the degree of bias scores (responses only to the control sentences). In each part the direction effect will be considered that is, the effects of whether a sentence was code-switched from one language to another or continued in the same language (accuracy), and whether a sentence continued in the same language or was felt to switch into the other language when it did not (bias).

The accuracy data reflect the ability of the different bilingual groups to predict the occurrence of code-switches when confronted with both unilingual control sentences and experimental (i.e., code-

switched) sentences with their pre-switch conditions: pristine--no deliberate cues placed before the switch, prolongation-- sound extended before the switch, phonological anticipation-- accent of the incoming language in the section immediately preceding the switch, and audible hesitation--language specific filler vowel sound preceding the code-switch. The degree of bias data reflect the tendency to predict code-switches when confronted with single language control sentences, hence, the less accurate a bilingual person is in predicting no switch, the more of a bias is present. This bias results from the bilingual's tendency to predict that one or the other language is going to occur.

#### Data

Accuracy scores were calculated by adding the total number of correct responses to the unilingual control sentences to the total correct responses to the code-switched sentences and then dividing the total by the possible number of correct responses. The raw data used for these calculations are found in Appendices L (balanced bilinguals), M (Spanish-dominant bilinguals),

and N (English-dominant bilinguals). Bias scores were calculated by summing correct responses to unilingual control sentences (both Spanish and English) and dividing by the total number of control sentences presented. The resulting degree of bias data are found in Appendices O (balanced bilinguals), P (Spanish-dominant bilinguals), and Q (English-dominant bilinguals). For both the accuracy and the degree of bias scores a Repeated Measures Analysis of Variance (ANOVA) program was used (BMDP2V). Each appendix shows scores for the control sentences and the code-switched sentences under each of the four experimental conditions, for sentences beginning in Spanish or in English. As no significant differences were found between a repeated measures analysis of variance (ANOVA) of all the factors involved (4x2x2) using raw proportional scores, and their arcsine-transformed equivalents, all subsequent analyses were done on the raw non-transformed data.

### I. Accuracy Results

The means and standard deviations of the accuracy scores for the different groups and conditions are

shown in Table 5.1. In it are found the results when the direction of the sentence is considered or when it is ignored.

Also found are the difference scores, from the 50% random point, of the collapsed marginal means with their  $t$ -values. The standard error used for the  $t$ -tests, to determine whether differences from the 50% level for each condition were significant, was derived from the error term for Condition (3.373) and the mean square value (.022) presented in Table 2. Standard error of 2.02 percentage points resulted from taking the square root of  $.022/54$  (mean square value over total  $N$ ) times 100.  $t$ -values resulted by dividing the difference score (from 50%) by the standard error. For example, a  $t$ -value of 3.91 resulted from dividing 7.9 (accuracy score for pristine switches of 57.9% - 50%) by the standard error of 2.02. All  $t$ -values were highly significant ( $p < .001$ ) indicating that responses obtained from the bilinguals for each condition, including pristine code-switches, where no deliberate cues were inserted, were significantly different from the random 50% score.

The raw accuracy data were subjected to a repeated measures analysis of variance, which is shown in Table

Table 5.1.

Means and Standard Deviations (in parentheses) of Raw Accuracy Percentage Data of Balanced, Spanish-dominant, and English-dominant Bilinguals in the Four Experimental Conditions (Con.): Pristine (Pris), Prolongation (Prol), Phonological Anticipation (PhAn), Audible Hesitation (AuHe), and All Conditions Collapsed (All). Direction (Dir.) of Code-Switching is either Spanish to English (S-->E), English to Spanish (E-->S), or Collapsed (Both). Accuracy Data were calculated by adding Total Correct Responses for Control Sentences to Total Correct Responses for Code-switched Sentences and dividing by Total Number of Stimuli presented. Difference percentage scores of Marginal (Marg.) Means minus 50% are presented with their  $t$ -values for collapsed scores (Both) under each condition. N=18/group.

Con.	Dir.	Bilingual Groups			Marg. Means	Marg. Means-50	$t$ -value*
		Balanced	Spanish-d.	English-d.			
Pris	S-->E	61.7 (11.6)	61.4 (13.4)	56.8 ( 7.8)	60.0		
	E-->S	54.9 ( 8.7)	54.0 ( 9.5)	58.3 ( 9.9)	55.7		
	Both	58.3	57.7	57.6	57.9	7.9	3.91***
Prol	S-->E	71.6 (14.2)	65.4 (14.3)	67.3 (15.5)	68.1		
	E-->S	63.9 (14.7)	67.0 (18.7)	67.9 (15.0)	66.3		
	Both	67.8	66.2	67.6	67.2	17.2	8.51***
PhAn	S-->E	79.0 (15.9)	68.8 (10.8)	76.2 (13.6)	74.7		
	E-->S	71.6 (14.0)	66.1 (16.4)	68.2 (15.9)	68.6		
	Both	75.3	67.5	72.2	71.7	21.7	10.74***
AuHe	S-->E	72.8 (20.0)	74.0 (15.6)	71.9 (19.0)	72.9		
	E-->S	79.3 (16.0)	82.7 (14.4)	73.8 (18.9)	78.6		
	Both	76.1	78.4	72.9	75.8	25.8	12.77***
All	S-->E	71.3 (12.6)	67.4 ( 7.8)	68.1 ( 9.0)	68.9		
	E-->S	67.4 (10.1)	67.4 ( 9.8)	67.1 ( 9.3)	67.3		
	Both	69.4	67.4	67.6	68.1		

\*Standard Error used for this  $t$ -test was calculated from the error term (3.373) for Condition in Table 5.2.

\*\*\*significant,  $p < .001$

Table 5.2

Three-Factor Repeated Measures ANOVA on Responses to Four Experimental Conditions, Exploring Ability to Predict No Switches and Code Switches, by Balanced, Spanish-dominant, and English-dominant Bilinguals. Data analyzed are the Raw Accuracy Scores. N=18/group.

Source	Sum of Squares	df	Mean Square	F	Tail Prob.
Group (G)	0.034	2	0.017	0.26	0.77
Error	3.277	51	0.064		
Condition (C)	1.911	3	0.637	28.90	0.000***
C x G	0.142	6	0.024	1.07	0.38
Error	3.373	153	0.022		
Direction (D)	0.028	1	0.028	2.02	0.16
D x G	0.029	2	0.014	1.03	0.37
Error	0.716	51	0.014		
C x D	0.215	3	0.072	7.65	0.000***
C x D x G	0.099	6	0.017	1.77	0.11
Error	1.433	153	0.009		
Total	11.257	431			

\* significant,  $p < .05$   
 \*\* significant,  $p < .01$   
 \*\*\* significant,  $p < .001$

5.2. It will be seen that the main effect of condition is highly significant ( $F(3,153) = 28.90, p < .001$ ), as is the interaction between the direction of the language and the conditions ( $F(3,153) = 7.65, p < .001$ ). The main effects of group ( $p = .77$ ) and direction ( $p = .16$ ) are not significant, nor are there significant interactions between condition x group ( $p = .38$ ), direction x group ( $p = .37$ ), and condition x direction x group ( $p = .11$ ).

#### Condition effect

The significant condition effect found with the accuracy data indicates that the pre-switch cues are not equally effective. The highest scores are obtained for the audible hesitation (specific filler vowels) and phonological anticipation conditions, and the lowest scores for the pristine code-switches. This is illustrated in Figure 5.1 (means drawn from Table 5.1).

In a post-hoc analysis, summarized in Table 5.3, of the main condition effect using the Tukey procedure (Shearer, 1982), all of the conditions containing pre-switch cues are significantly different ( $p < .01$ ) from the no-cue condition (pristine code-switches), and

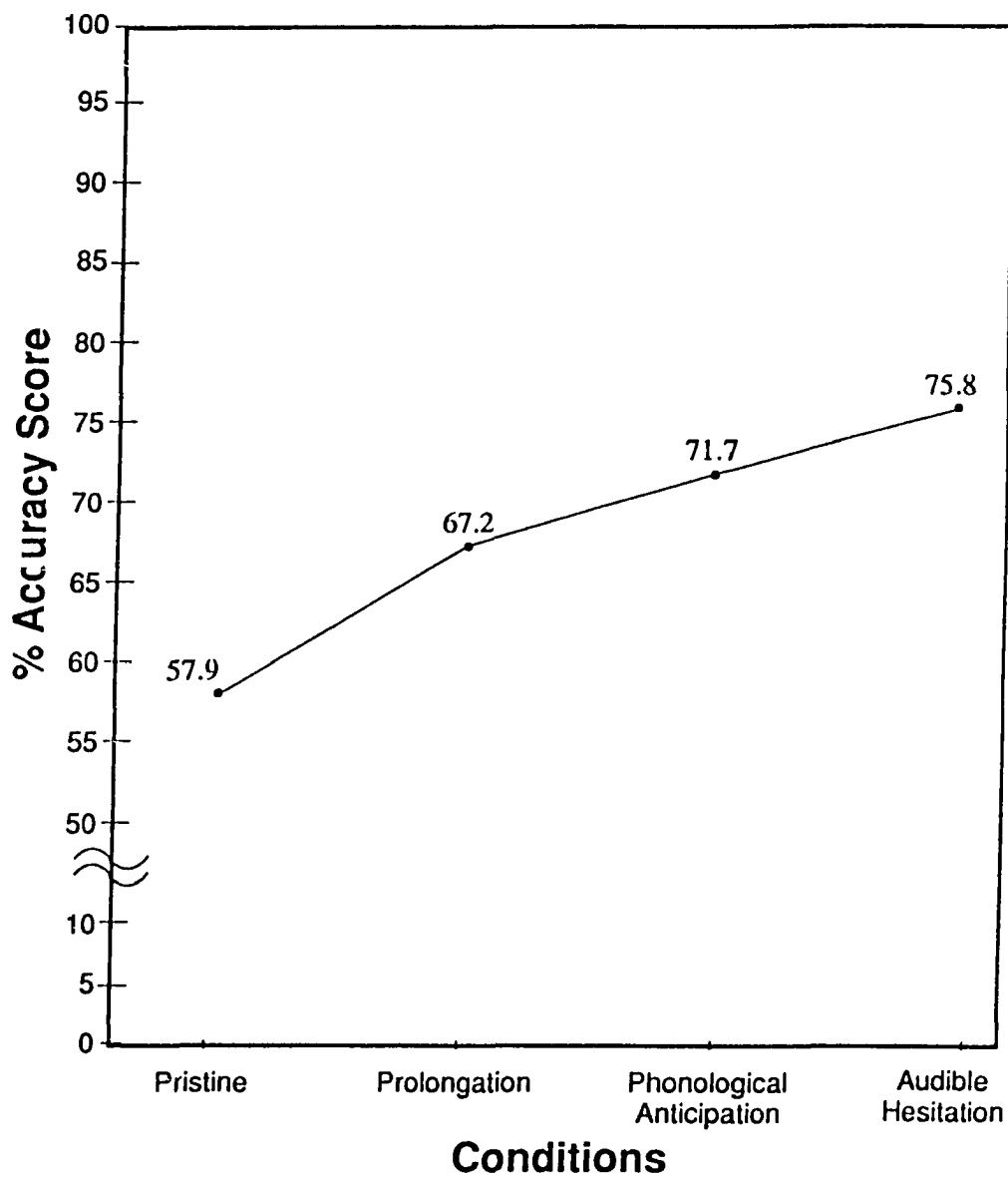


Figure 5.1: Unbiased estimates of bilinguals' ability to detect code-switches combined across direction of language change. Each data point is the mean of 54 subjects.

Table 5.3

Post-Hoc Analysis (Tukey Test) Results on the Differences between the Condition Means (collapsed across groups classified according to language dominance) based on the Accuracy Percentage Data. Scores reflect the capacity to predict Code Switches and No Switches (i.e., Control Sentences).

CONDITIONS			
CONDITIONS	Prolongation	Phonological Anticipation	Audible Hesitation
Pristine	.093**	.138**	.179**
Prolongation		.045	.086**
Phonological Anticipation			.041

\* significant,  $p < .05$  (critical value of .051)

\*\* significant,  $p < .01$  (critical value of .062)

#### Key to Conditions

Pristine = code switches not intentionally preceded by cues

Prolongation = code switches preceded by an extended sound

Phonological Anticipation = code switches preceded by an accented segment

Audible Hesitation = code switches preceded by a filler vowel sound

there is a significant difference ( $p < .01$ ) between the audible hesitation and prolongation conditions. No significant differences are found between the phonological anticipation condition when compared to the results obtained with the conditions of prolongation or audible hesitation although the values obtained (.045, .041) approximated the critical value (.051) needed for the 5% level of significance.

#### Direction x condition interaction

The significant interaction effect between the direction of the sentence and the different conditions indicates that accuracy performance under the different conditions differs depending on whether the sentence begins in one language or the other. This interaction is illustrated in Figure 5.2 (values are marginal row means found in Table 5.1 under each direction). Accuracy scores for sentences beginning in Spanish are greater than those with sentences beginning in English in all conditions except for the audible hesitation condition in which the reverse is true. Post-hoc testing was performed with one-way repeated measures analyses of variance (ANOVAS) for each condition. All conditions, except the prolongation of the sound

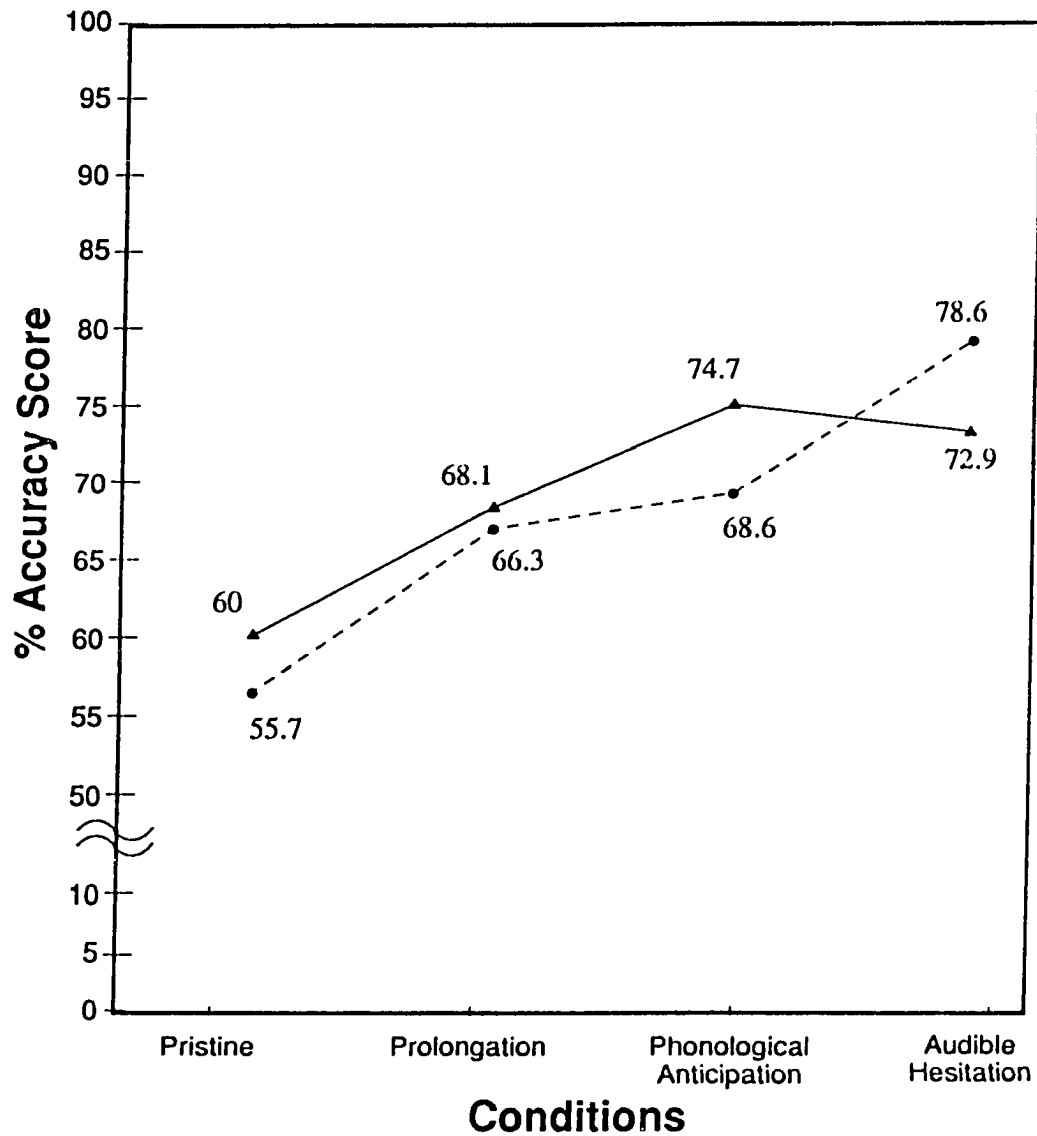


Figure 5.2: Unbiased estimates of bilinguals' ability to detect code-switches in sentences beginning in Spanish and in sentences beginning in English. Each data point is the mean of 54 subjects.

—▲—▲— Sentences beginning in Spanish (S to E)  
 -●- -●- Sentences beginning in English (E to S)

preceding the code switch ( $p > .05$ ), are significantly different when results obtained in one direction are compared to the results obtained in the other direction (collapsed across groups). Specifically, the following values are obtained for each: Pristine ( $F(1,53) = 6.45, p < .02$ ); Audible Hesitation ( $F(1,53) = 7.83, p < .01$ ); and Phonological Anticipation ( $F(1,53) = 7.90, p < .01$ ).

#### Group and direction effects and interactions

Non-significant results with the grouping factor indicate that the groups are equally effective in predicting impending code-switches or non-switches (non-significant group  $\times$  condition effect) despite a better performance by the balanced bilingual group as compared to the Spanish-dominant group with the condition of phonological anticipation (see Table 5.1). Also, it is noted that direction by itself does not differentiate the groups (non-significant direction effect) but does so, as discussed, when it is interacting with each condition, and that the relative effectiveness of the conditions and/or direction effects were similar for the three bilingual groups (non-significant interaction effects involving the grouping factor).

To summarize, highly significant  $t$ -tests on the marginal collapsed mean difference scores revealed that subjects are sensitive to each one of the experimental conditions, including the pristine code-switches. Further analyses on the accuracy raw proportional data, which measure the different bilingual groups' ability to predict code-switching (experimental sentences) or no switches (control sentences), show that there are differences in the effectiveness of the different pre-switch cues (highly significant condition effect), that accuracy differs in the different conditions depending on whether the sentence begins in one language or the other with scores for sentences beginning in Spanish being higher in all conditions except for the audible hesitation one (highly significant condition  $\times$  direction interaction), that the groups react similarly to the pre-switch cues (non-significant main group effect), that direction of the sentence alone is not sufficient to differentiate between the groups (non-significant direction effect), and that the relative effectiveness of the conditions and direction of the sentences are similar for all three bilingual groups (non-significant interaction effects involving the grouping factor). Post-hoc

testing on the main condition effect also reveals that all conditions are significantly different from each other except when the condition of phonological anticipation is compared to the conditions of prolongation and audible hesitation. One-way repeated measures ANOVAS on the significant condition x direction effect indicate that all conditions, except for prolongation, are significantly different as a result of whether a sentence began in one language or the other.

## II. Degree of Bias Results

In order to determine whether or not any bias existed towards English or Spanish, only the responses to the control sentences were analyzed assuming that responses to these sentences reflect the purest form of bias. Specifically, the unilingual control sentences were expected to be void of any pre-switch cues. Hence, ideally, a subject should respond in each case that the speaker continued in the same language. If the subject predicts that a switch into the other language will occur when hearing the control sentence, one can assume that a bias existed on the part of that

subject towards that language at that moment. This would be reflected by a decrease in the accuracy score for the control sentences. As mentioned previously, to obtain a measure of the degree of bias, accuracy scores for control sentences were calculated for each bilingual group as the total number of correct responses to both Spanish and English control sentences divided by the total number of control sentences possible under each condition they served. The reader is reminded that the control sentences were unilingual and contained no deliberate cues. Hence, any condition effects for control sentences reflect the degree of bias obtained when these sentences were grouped according to the conditions for which they served as controls, and does not reflect any types of conditions.

Shown in Table 5.4 are the means and standard deviations of the accuracy scores for the control sentences in either language. These scores reflect the degree of bias when the direction of the sentence (language) is considered or when it is ignored.

The raw accuracy data for control sentences used for each condition were subjected to a repeated measures analysis of variance, results of which are

Table 5.4.

Means and Standard Deviations (in parentheses) of Raw Degree of Bias Percentage Data of Balanced, Spanish-dominant, and English-dominant Bilinguals for the Four Experimental Conditions: Pristine, Prolongation (Prolong.), Phonological Anticipation (Phon.Ant.), Audible Hesitation (Aud.Hesit.), and All Conditions Collapsed (All Condit.). Direction (Direc.) of Control Sentence is either Spanish to Spanish (S-->S), English to English (E-->E), or Collapsed (Both). N=18/group. Degree of Bias Data were calculated by adding Total Correct Responses for Control Sentences divided by Total Number of Control Sentences presented.

Condition	Direc.	Bilingual Groups			Marginal Means
		Balanced	Spanish-dom.	English-dom.	
Pristine	S-->S	95.1 (10.9)	90.1 (11.4)	92.6 (11.4)	92.6
	E-->E	85.8 (14.7)	87.1 (16.3)	80.9 (21.2)	84.6
	Both	90.5	88.6	86.8	88.6
Prolong.	S-->S	87.1 (10.3)	73.5 (20.2)	92.0 (11.3)	84.2
	E-->E	88.9 (13.7)	92.0 (16.1)	84.6 (19.5)	88.5
	Both	88.0	82.8	88.3	86.4
Phon.Ant.	S-->S	93.2 ( 9.4)	78.4 (19.6)	90.8 (12.2)	87.5
	E-->E	85.2 (19.4)	87.7 (15.2)	74.7 (21.8)	82.5
	Both	89.2	83.1	82.8	85.0
Aud.Hesit.	S-->S	84.6 (17.9)	80.9 (20.1)	87.7 (14.7)	84.4
	E-->E	83.3 (16.7)	94.5 ( 8.7)	75.9 (25.1)	84.6
	Both	84.0	87.7	81.8	84.5
All Condit.	S-->S	90.0 ( 8.7)	80.7 (15.1)	90.8 (10.4)	87.2
	E-->E	85.8 (13.2)	90.3 (10.8)	79.0 (18.2)	85.0
	Both	87.9	85.5	84.9	86.1

shown in Table 5.5. Again, the main effect of condition is significant ( $F(3, 153) = 3.06, p < .05$ ), and the interaction between the language of the sentence (direction) and the conditions is again highly significant ( $F(3, 153) = 6.04, p = .001$ ). With these degree of bias data, contrary to the accuracy data, a significant interaction is found between the different conditions and the bilingual groups ( $F(6, 153) = 2.54, p < .05$ ). The main effects of group ( $p = .72$ ) and direction ( $p = .19$ ) are not significant nor is there a significant interaction between condition  $\times$  direction  $\times$  group ( $p = .29$ ).

#### Condition effect for control sentences

The significant condition effect when analyzing the control sentences is not readily explainable since the control sentences do not contain any pre-switch cues but, rather, exist in one or the other language as a control to the experimental sentences (i.e., the code-switched sentences). It is interesting to note, however, that percentage correct scores decrease for the control sentences used for the pristine condition to the control sentences used for the audible hesitation condition (Figure 5.3). Accuracy scores for

Table 5.5

Three-Factor Repeated Measures ANOVA on Responses to Four Experimental Conditions, Exploring Ability to Predict No Switches, by Balanced, Spanish-dominant, and English-dominant Bilinguals. Data analyzed are the Degree of Bias Raw Scores (Accuracy Scores for Control Sentences Only). N=18/group.

Source	Sum of Squares	df	Mean Square	F	Tail Prob.
Group (G)	0.073	2	0.036	0.33	0.72
Error	5.651	51	0.111		
Condition (C)	0.109	3	0.036	3.06	0.03*
C x G	0.182	6	0.030	2.54	0.02*
Error	1.820	153	0.012		
Direction (D)	0.048	1	0.048	1.78	0.19
D x G	0.839	2	0.419	15.53	0.000***
Error	1.377	51	0.027		
C x D	0.242	3	0.081	6.04	0.001***
C x D x G	0.099	6	0.017	1.24	0.29
Error	2.042	153	0.013		
Total	12.482	431			

\* significant,  $p < .05$   
 \*\* significant,  $p < .01$   
 \*\*\* significant,  $p < .001$

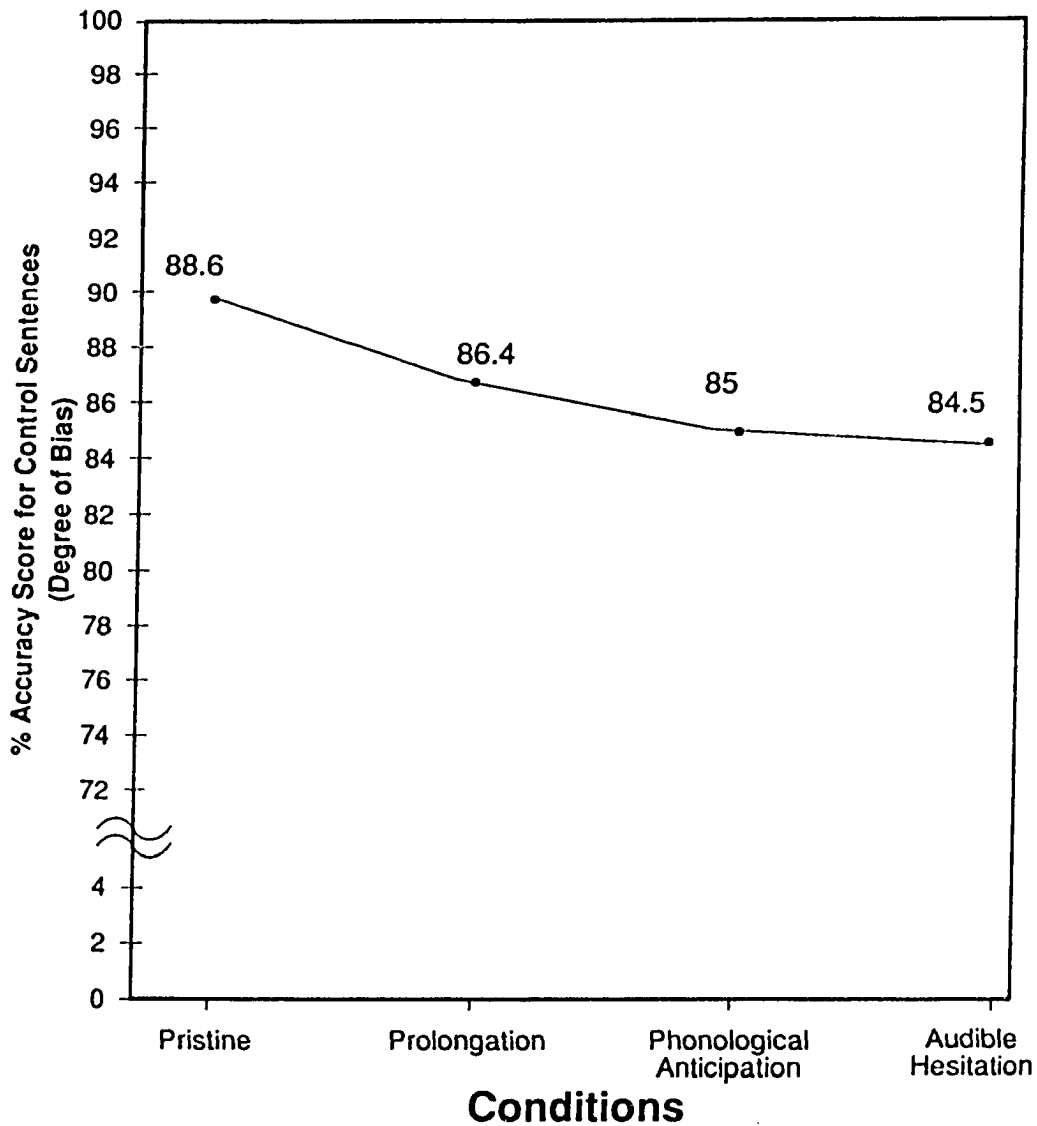


Figure 5.3: Mean Accuracy Scores for all bilinguals measuring the ability to detect the no switch conditions (control sentences) in either direction in each of the four conditions. Each data point is the mean of 54 subjects. To the extent that the score is less than 100% this is taken as an indication of bias.

the control sentences ranged from 84.5% to 88.6% when they were grouped under each condition, as determined by their experimental counterparts. This indicates that in general subjects were very accurate in predicting the language of the control sentences. The exact mean scores for all bilinguals for the set of sentences used as controls for each experimental condition, regardless of the language of the control sentence, are illustrated in Figure 5.3 (values are the marginal means with direction collapsed in Table 5.4).

Results of the post-hoc testing on the significant condition effect, using the Tukey procedure, are summarized in Table 5.6. It can be seen that the only difference causing the significance is the one between the sentences used as controls for the conditions of no cues (pristine) and audible hesitation cues ( $p < .05$ ). The difference between sentences used for the pristine and phonological anticipation conditions approaches significance (value of .036 near the .040 critical value needed for significance at the .05 level). All other comparisons between the different groupings are non-significant ( $p > .05$ ) including accuracy for control sentences when the language factor is taken into account (i.e., Spanish control sentences versus English control sentences).

Table 5.6

Post-Hoc Analysis (Tukey Test) Results on the Differences between the Condition Means (collapsed across groups classified according to language dominance) based on the Degree of Bias Data. Scores reflect the capacity to predict No Switches (i.e., Control Sentences).

CONDITIONS			
CONDITIONS	Prolongation	Phonological Anticipation	Audible Hesitation
Pristine	.023	.036	.041*
Prolongation		.013	.018
Phonological Anticipation			.005

\* significant,  $p < .05$  (critical value of .040)

Key to Conditions

Pristine = code switches not preceded by cues

Prolongation = code switches preceded by an extended sound

Phonological Anticipation = code switches preceded by an accented segment

Audible Hesitation = code switches preceded by a filler vowel sound

Direction x condition interaction

Results with the accuracy scores for the control sentences, indicating degree of bias, show that responses differ depending on whether the control sentences were in Spanish or in English and depending on the experimental condition for which they served as control sentences. The values of this interaction can be found in Table 5.4 (marginal row means) and are illustrated in Figure 5.4. Results indicate that degree of bias is greater for those Spanish sentences used as controls for the condition of prolongation (least accurate), and for those English sentences used as controls for the pristine and the phonological anticipation conditions. Performance is similar in either language for control sentences used for the condition of audible hesitation. Post-hoc testing with one way repeated measures ANOVAS indicates that the sentences causing the significant difference are those that were used as controls for the pristine condition (  $F(1,53) = 14.52, p < .001$  ). Specifically, as seen in Table 5.4, subjects are less accurate with the English control sentences used for the pristine condition (mean of 84.6%) as compared to their

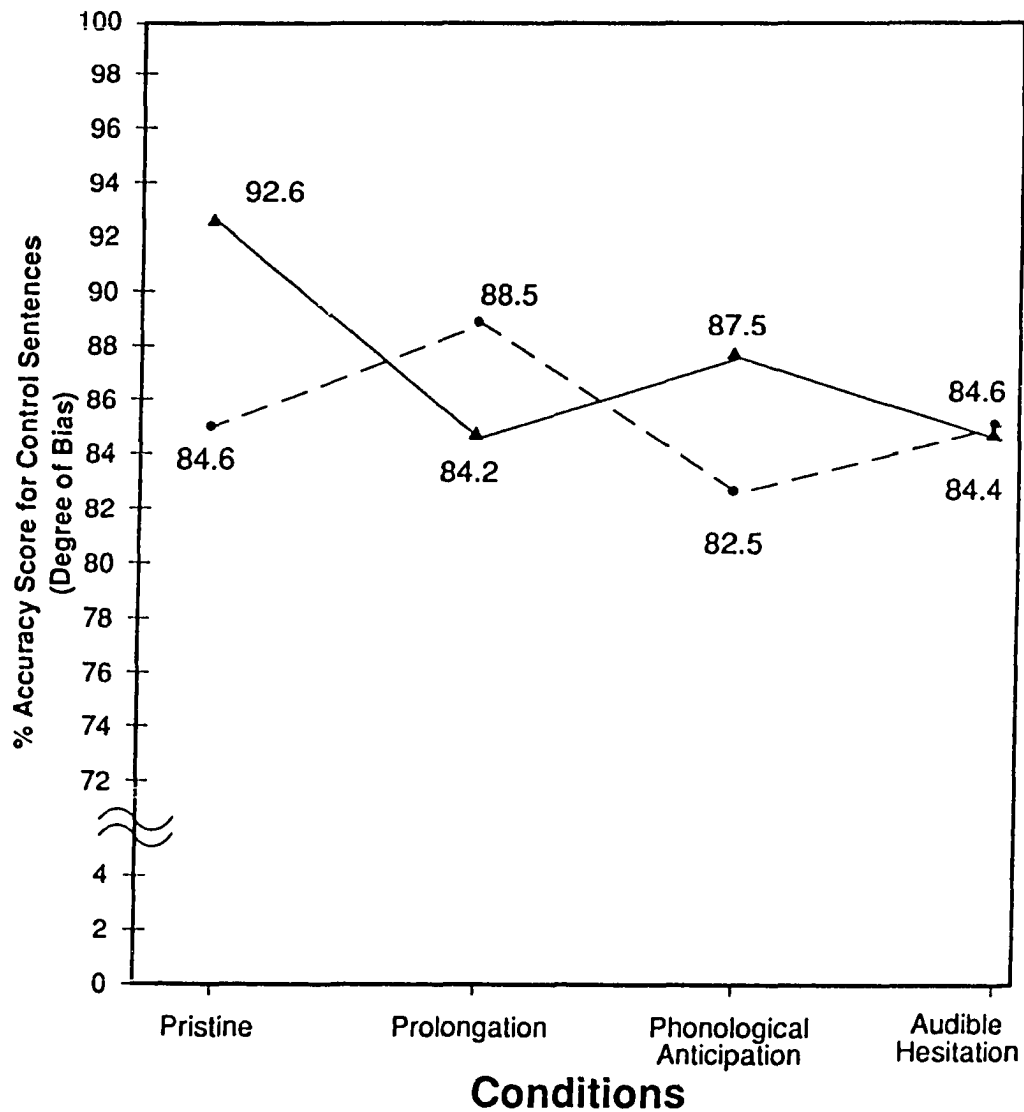


Figure 5.4: Mean Accuracy Scores for all bilinguals measuring the response to the no switch conditions in Spanish control sentences and in English control sentences. Each data point is the mean of 54 subjects and reflects degree of bias present with each language.

—▲—▲— Sentences beginning in Spanish (S ---> S)  
 -●- -●- Sentences beginning in English (E ---> E)

performance with the Spanish control sentences used for the pristine condition (mean of 92.6%). Comparisons between all other conditions are non-significant ( $p > .05$ ).

#### Extent and direction of the language bias

In order to determine the extent and direction of the bias that existed when responding to the control sentences, a weighted score for the group of control sentences used for each condition was obtained by subtracting the Spanish accuracy percentage score from the English accuracy percentage score. A negative value would indicate that the subject had a bias to respond that the sentence continued in Spanish, and a positive value would indicate that the subject had a bias to respond that the sentence continued in English. For example, to calculate the bias present with the balanced bilingual group when presented with the control sentences for the pristine condition one would refer to Table 5.4 and subtract 95.1% (accuracy score for the Spanish control sentences) from 85.8% (accuracy score for the English control sentences) resulting in a value of -9.3 percentage points. This then indicates that the balanced group is 9.3 percentage points more

likely to respond "Spanish" when confronted with sentences, beginning in either language, that were created as controls for the experimental sentences used for the pristine condition. Table 5.7 summarizes the extent and direction of bias values for the three groups calculated from the accuracy scores obtained with the sentences used as controls for the experimental sentences used for each condition. The total extent of the bias, and towards what language, for all the groups combined and overall means are also presented in this table.

Extent of the bias in the condition x direction effect

The marginal row means of Table 5.7 represent the language direction and extent of the bias shown by all bilinguals (collapsed across groups) when responding to the control sentences used for each experimental condition. These results are illustrated in Figure 5.5, which illustrates the finding that when responding to control sentences there is a bias towards Spanish with control sentences used for the pristine (no cue) condition and for the phonological anticipation condition, a bias towards English with the control

Table 5.7.

Degree of Bias towards English (positive value) and towards Spanish (negative value) found for Balanced, Spanish-dominant, and English-dominant bilinguals for the four Experimental Conditions: Pristine, Prolongation (Prolong.), Phonological Anticipation (Phon.Ant.), and Audible Hesitation (Aud.Hesit.). Value under each Condition for each Group of Bilinguals results from subtracting the Spanish Accuracy Score for Spanish Control Sentences from the English Accuracy Score for English Control Sentences. N=18/group.

Conditions	Bilingual Groups			Totals	Marginal Means
	Balanced	Spanish-dom.	English-dom.		
Pristine	- 9.3	- 3.0	-11.7	-24.0	- 8.0
Prolong.	+ 1.8	+18.5	- 7.4	+12.9	+ 4.3
Phon.Ant.	- 8.0	+ 9.3	-16.1	-14.8	- 4.9
Aud.Hesit.	- 1.3	+13.6	-11.8	+ 0.5	+ 0.17
Totals	-16.8	+38.4	-47.0	-25.4	
Column Means	- 4.2	+ 9.6	-11.75		

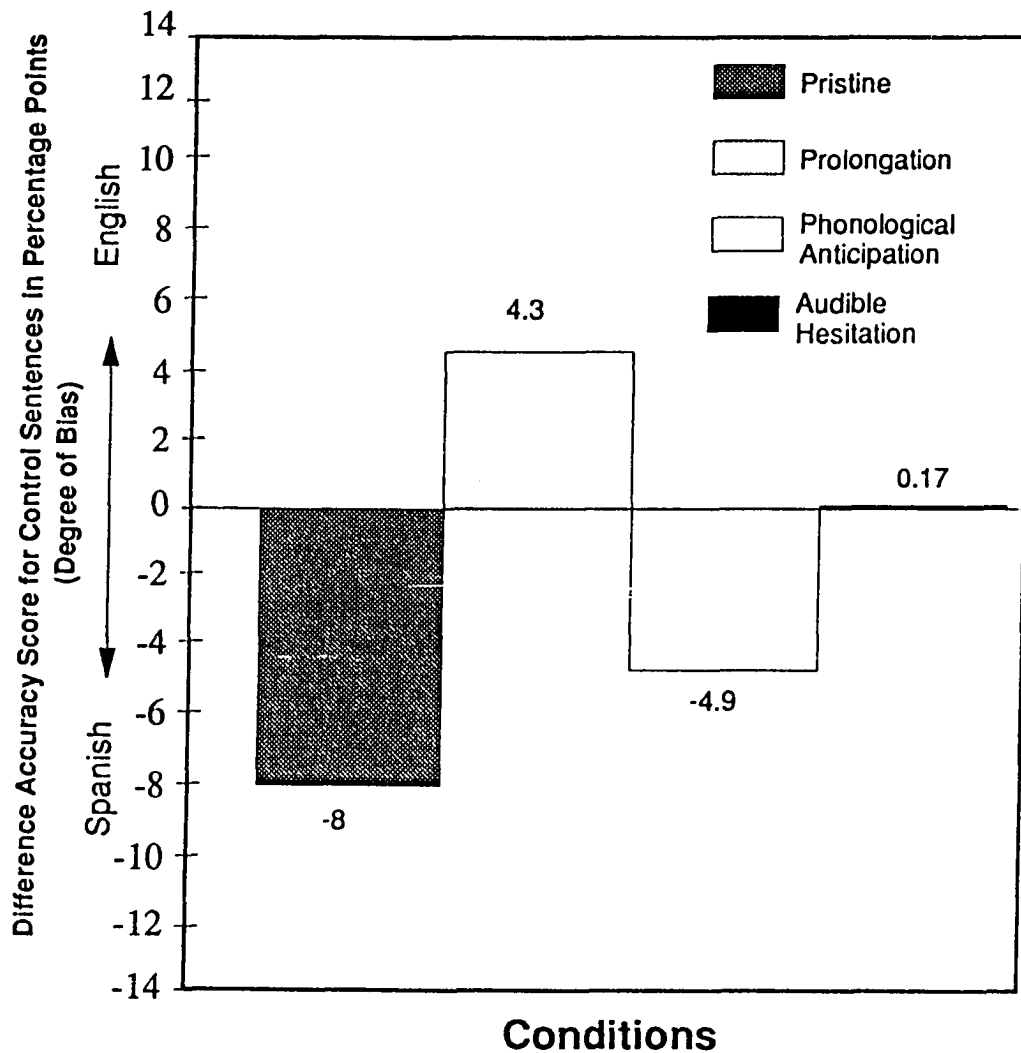


Figure 5.5: Mean degree of bias scores in percentage points derived from the Accuracy Scores for control sentences for all bilinguals measuring the direction of the bias. A positive value indicates a bias towards English. A negative value indicates a bias towards Spanish. Each data point was calculated by subtracting the % Spanish Accuracy Score from the % English Accuracy Score under each condition, summing, and averaging across the 54 bilingual subjects across the three bilingual groups.

sentences used for the prolongation condition, and a negligible bias towards English with the control sentences used for the audible hesitation condition. These findings indicate that the some control sentences may not have been totally devoid of cues. This will be discussed in the next chapter.

#### Direction x group interaction

When analyzing the responses to the control sentences only, one obtains a significant group x direction effect. The means presented in Table 5.4, when scores for all of the conditions are collapsed, indicate that the Spanish-dominant group has a bias towards their non-dominant (marked) language which means that they have a tendency to respond "English." This results in a higher accuracy score for English control sentences and a lower accuracy score for Spanish control sentences. The reverse bias is present for the English-dominant group and also for the balanced bilinguals. That is, they tend to respond "Spanish," which results in a higher accuracy score for the Spanish control sentences and a lower accuracy score for the English control sentences. These findings are illustrated in Figure 5.6. Hence, at this time, it is

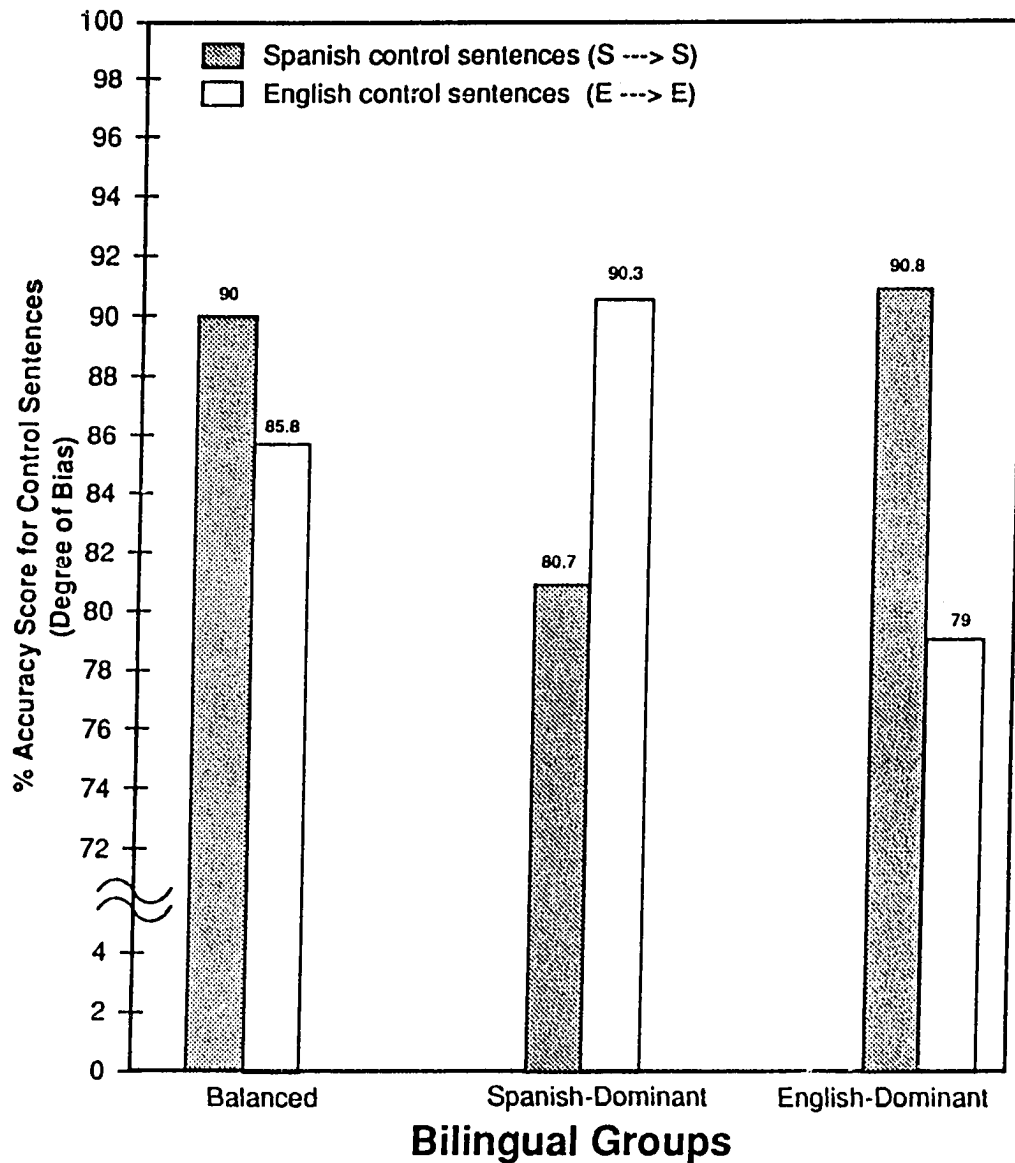


Figure 5.6: Mean Accuracy Scores for balanced bilinguals, Spanish-dominant bilinguals, and English-dominant bilinguals for Spanish control sentences and English control sentences.  $N=18/\text{group}$ . Each data point is collapsed across all four conditions and reflects degree of bias.

unclear whether correct responses to code-switched sentences, used in the calculations of overall accuracy scores along with the responses to control sentences, are due to a true sensitivity to the different cues, or in the case of pristine switches to co-articulatory factors, or result from a bias towards the unmarked language, or from a combination of all of these factors. The values for the direction of the bias for each bilingual group are the column means of Table 5.7 and are illustrated in Figure 5.7. Again it is clear that the dominant groups have a strong bias towards their non-dominant language whereas the balanced bilingual group has a lesser bias towards Spanish.

Post-hoc testing with one way repeated measures ANOVAS confirmed that the dominant bilingual groups are reacting significantly different to the language of the sentence whereas the balanced bilingual group is not. Specifically, the values obtained with the language dominant groups are: Spanish dominant group ( $F(1,17) = 10.17, p < .01$ ) and English dominant group ( $F(1,17) = 16.35, p < .001$ ).

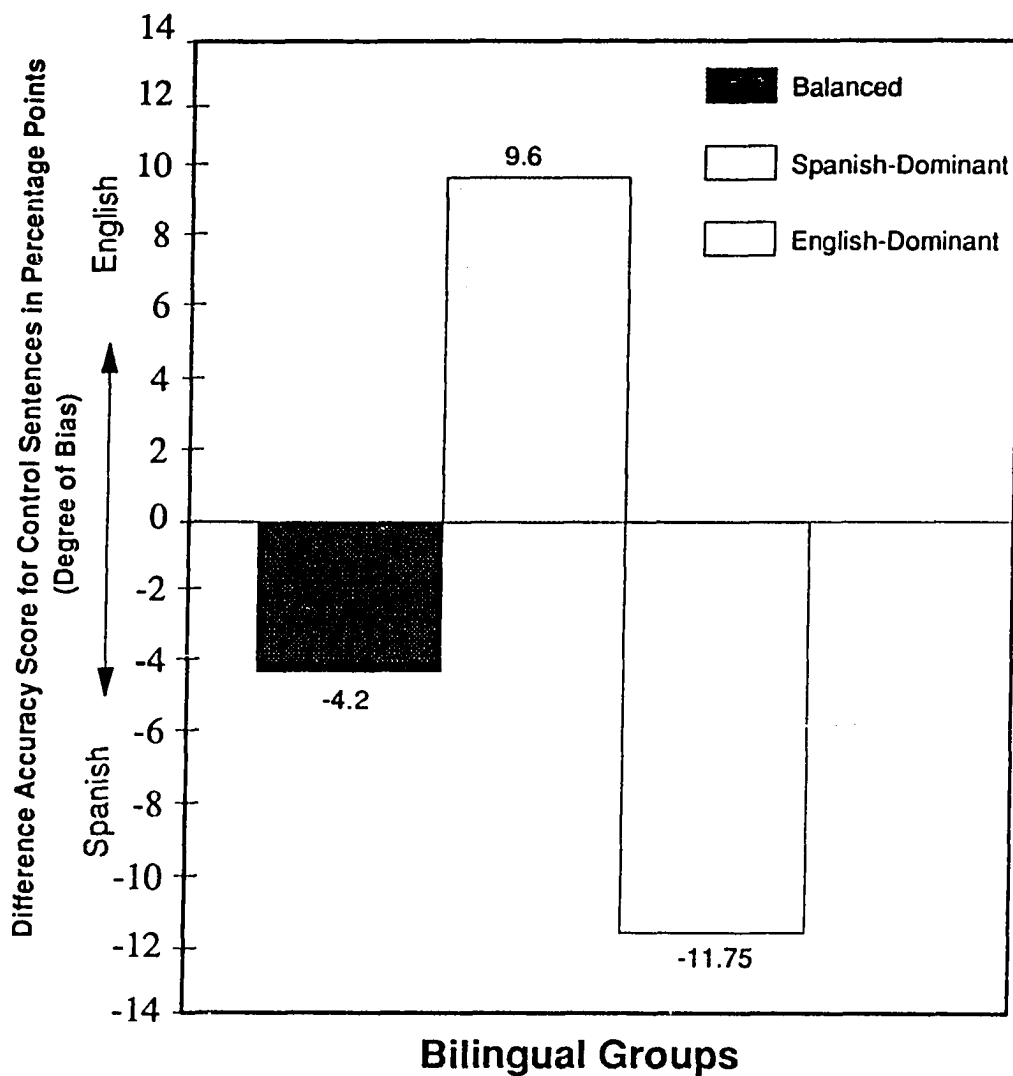


Figure 5.7: Differences in percentage points between Mean Accuracy Scores for control sentences for balanced bilinguals, Spanish-dominant bilinguals, and English-dominant bilinguals for sentences beginning in Spanish and in English. Each score is collapsed across four conditions and was calculated by subtracting the % Spanish Accuracy Score from the % English Accuracy Score obtained for each group to indicate degree of bias. N=18/group.

Condition x group interaction

Contrary to what was found within the accuracy context, a significant group effect is found for the extent of the bias when subjects' responses to the control sentences for the different conditions are considered within each group and when the direction of the language is ignored. Results are presented in Table 5.4 (see values under "both"), and are illustrated in Figure 5.8. As can be seen, the balanced bilinguals perform best with control sentences used for the conditions of pristine code-switched sentences and for the control sentences used for the condition of phonological anticipation. Hence, most bias was exhibited with sentences used for the conditions of prolongation and, especially, audible hesitation. The Spanish-dominant bilinguals are most accurate for the control sentences used for the condition of pristine code-switches and for those used for the condition of audible hesitation. They exhibited a similar degree of bias for the control sentences used for the conditions of prolongation and phonological anticipation. The English-dominant bilinguals, on the other hand, perform best with

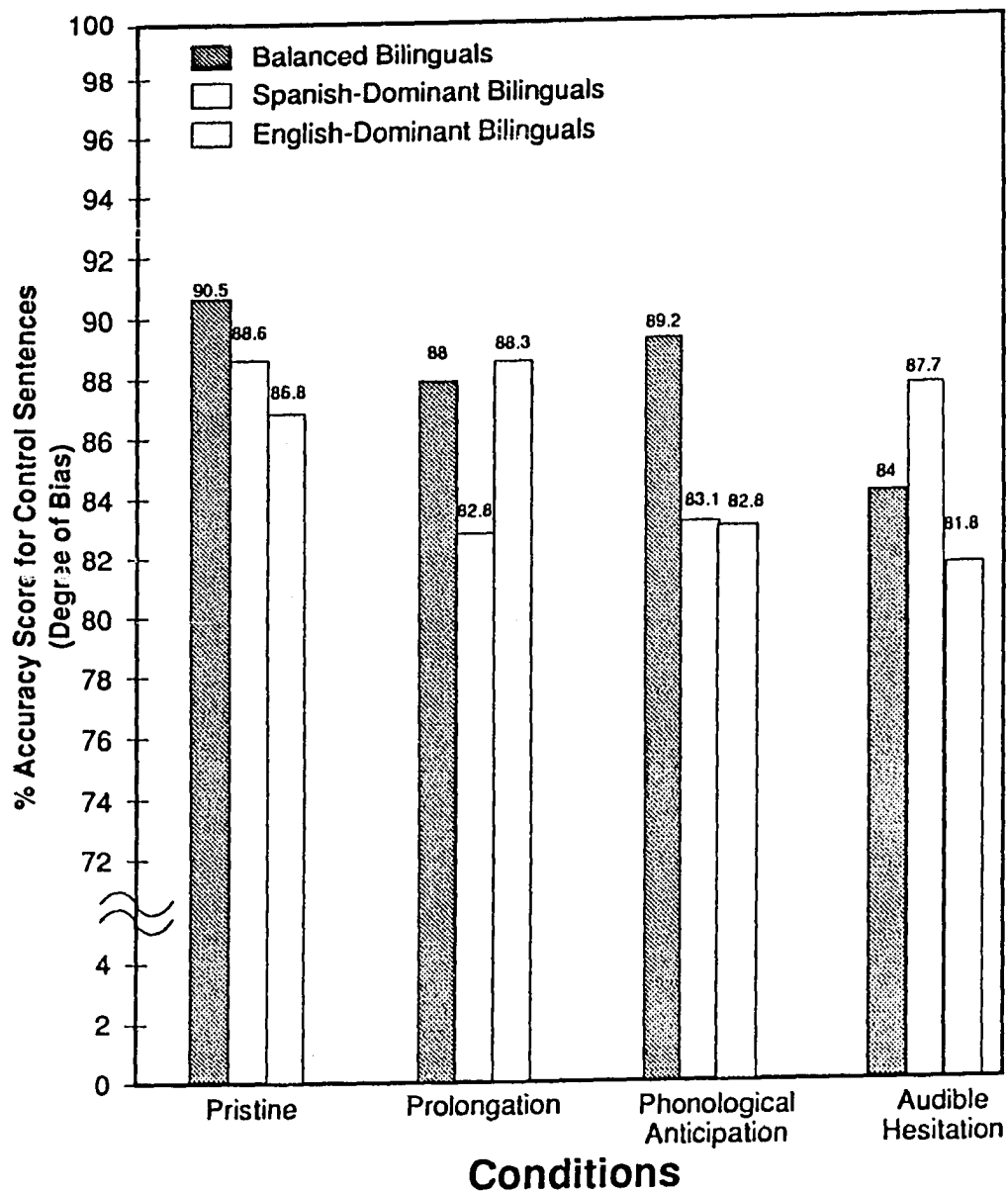


Figure 5.8: Mean Accuracy Scores for control sentences for balanced bilinguals, Spanish-dominant bilinguals, and English-dominant bilinguals in each of the four conditions. These scores reflect the amount of bias present. Scores obtained in either direction of code-switching are collapsed.  $N=18/\text{group}$ .

control sentences used for the condition of prolongation and exhibit a bias for sentences used for the condition of pristine code-switches. They exhibited a greater bias with sentences used for the conditions of phonological anticipation and audible hesitation. As is illustrated in Figure 5.8, the bilingual group that exhibited the most bias was the English-dominant one for the control sentences used for all conditions except for the one of prolongation for which the Spanish-dominant group exhibited significantly more bias than the other two bilingual groups. In general, the balanced bilingual group exhibited less bias than the dominant bilingual groups.

The results concerning the extent of the bias and its direction, calculated as described before by subtracting the accuracy score for the Spanish control sentences from the accuracy score for the English control sentences, are found in Table 5.7 and are illustrated in Figure 5.9. The balanced bilingual group shows a bias towards Spanish for the control sentences used for the conditions of pristine code-switches, and phonological anticipation; a slight Spanish bias for the control sentences used for the audible hesitation condition; and a slight English bias

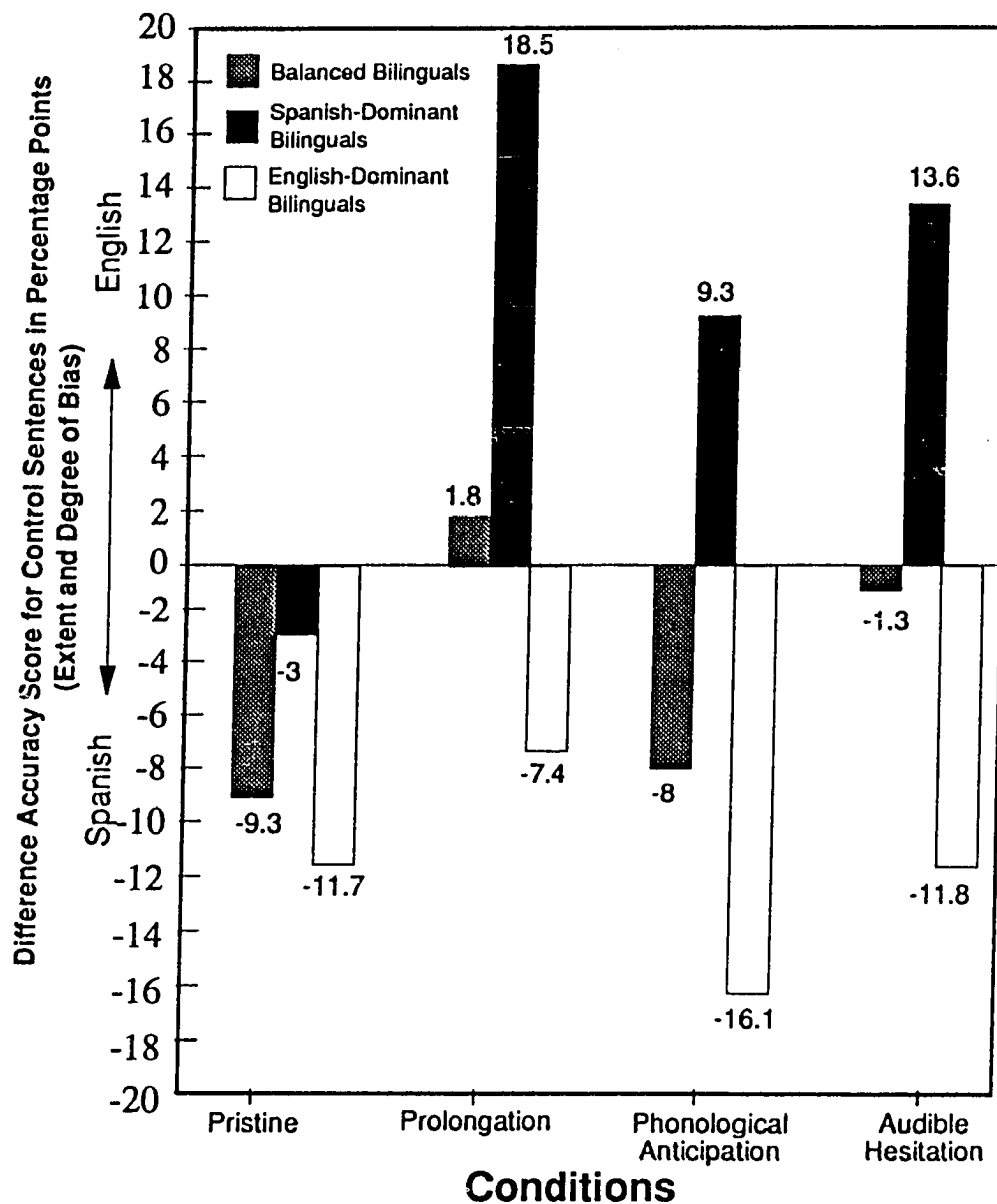


Figure 5.9: Degree of bias in percentage points for each bilingual group under each condition. Each data point results from subtracting the Spanish % Accuracy Score for control sentences from the English % Accuracy Score for control sentences. A positive value indicates a bias towards English. A negative value indicates a bias towards Spanish.  $N=18/\text{group}$ .

for the control sentences used for the condition of prolongation. The Spanish-dominant group on the other hand shows a general bias towards English except for the control sentences used for the pristine condition where a slight Spanish bias is obtained. The English-dominant group shows a consistent bias towards Spanish for the control sentences used for all of the conditions.

Post-hoc testing with one way repeated measures ANOVAS indicates that the performance of the balanced bilingual group ( $F(3,51) = 3.20, p < .05$ ) and of the Spanish-dominant group ( $F(3,51) = 3.19, p < .05$ ) is significantly different when responding to control sentences used for the different conditions, whereas, the performance of the English-dominant group is not significantly different ( $p > .05$ ) when responding to control sentences used for the different conditions.

#### Group and direction effects and interactions

As with the accuracy context, a non-significant group effect is obtained with the degree of bias data indicating in this case that the groups are equally effective in responding that the control sentence

continued in the same language. As can be seen in Table 5.4, under all conditions and with the language factor collapsed, percent correct with the control sentences is very similar for the three bilingual groups. In this case a direction effect is non-significant, as with the accuracy context, which again indicates that direction by itself does not differentiate the groups in terms of their accuracy, and degree of bias that each group exhibits when responding to control sentences. Also, again, a non-significant condition x group x direction interaction is found indicating that the relative effectiveness of the control sentences used for each condition, and of the language of the control sentences, is similar for the three bilingual groups.

To summarize, statistical analyses on the degree of bias data, derived from the accuracy raw proportional data for control sentences measuring the different bilingual groups' ability to predict no language change, show that there are differences in the degree of correct responses for the different control sentences used for each condition (highly significant condition effect). Statistical analyses also show that extent and direction of the bias for the control

sentences (Spanish accuracy score subtracted from the English accuracy score) differ: (1) for the different control sentences under each condition depending on whether the sentence begins in one language or the other (highly significant condition x direction interaction); (2) in the different groups depending on whether the control sentence was in Spanish or in English (significant direction x group interaction), and, (3) across the different bilingual groups, only with these bias data, depending on the condition for which the control sentences are being used (significant condition x group interaction).

Post-hoc testing reveals that the difference between the control sentences used for the conditions of pristine code-switches and those used for code-switched sentences containing audible hesitations before the switch is responsible for the significant condition effect. Post-hoc testing on the interaction effects, using the control sentences for the different experimental conditions, reveals that for the condition x direction interaction the pristine condition is significant; for the direction x group interaction the dominant bilingual groups are responsible for the significance; and for the condition x group

interaction, obtained only with the bias data, the responsible groups are the balanced bilinguals and the Spanish-dominant bilinguals.

Results also indicate that all groups have a similar degree of bias for control sentences across all conditions when the language factor is collapsed (non-significant main group effect), that the language used is not sufficient in itself to differentiate between the groups (non-significant direction effect), and that the relative effectiveness of the control sentences used for the experimental conditions, with consideration of the language of the control sentence, is similar for all three bilingual groups (non-significant interaction between condition x direction x group).

#### Overall Summary of the Results

The highly significant t-tests on the marginal collapsed accuracy scores for each one of the conditions revealed that bilinguals of this study are sensitive to deliberate pre-switch cues (three experimental cues) or possible inadvertent ones

(pristine code-switches).

The significant main results and significant interactions, found for the three bilingual groups based on language dominance, are summarized in Table 5.8. Analyses of variance performed on the accuracy data (included both control and code-switched sentences), and the degree of bias data (included responses only to the control sentences created for each experimental condition) reveal that significant condition effects and significant condition x direction interactions are obtained with both types of data. A significant direction x group interaction and a significant condition x group interaction are found with the degree of bias data only. All other main effects (group, direction) and interactions (condition x direction x group) are non-significant for both types of data.

Post-hoc testing reveals that for the accuracy data all differences between the conditions are significant except for the differences between the condition of prolongation and that of phonological anticipation, or between the condition of prolongation and that of audible hesitation. Post-hoc testing also

Table 5.8.

Summary of ANOVAS and Post-Hoc Results obtained with Balanced, Spanish-dominant, and English-dominant Bilinguals (N=18/group) with the Accuracy Data (both code-switched sentences and control sentences used), and with the Degree of Bias Data (only control sentences used).

Effects/ Interactions	Accuracy Data	Post-Hocs on Accuracy Data	Bias Data	Post-Hocs on Degree of Bias Data
Group	$p = .77$	not needed	$p = .72$	not needed
Direction	$p = .16$	not needed	$p = .19$	not needed
Condition	$p = .000***$	differences between X's significant at ** level except $p > .05$ for Phon.Ant. vs Prolong.& Phon. Ant.vs Aud.Hes.	$p = .03*$	Significance at * level found for difference between X's of Aud.Hes. and Pristine Stimuli.
C x D	$p = .000***$	Differences between English and Spanish significant at .02 level for all conditions except for prolong. ( $p > .05$ )	$p = .001***$	Significance due to results only with control sentences used for Pristine condition (***).
D x G	$p = .37$	not needed	$p = .000***$	Language heard affected results with Spanish-dom. ( $p < .01$ ) & English-dom. ( $p < .001$ ).
C X G	$p = .38$	not needed	$p = .02*$	Bal. & Spanish-dom. bilinguals perform significantly different ( $p < .05$ ) with control sentences under different conditions.
C x D x G	$p = .11$	not needed	$p = .29$	not needed

Significance: \*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$ . Code: G=Group; C=Condition; D=Direction; X=mean; Phon.Ant.=phonological anticipation; Aud.Hes.=Audible Hesitation; Prolong.=Prolongation; vs=versus.

reveals that all conditions, except for the one of prolongation, are responsible for the significant interaction effect between the condition and direction of the language.

Post-hoc testing with the degree of bias data reveals that the significant difference between control sentences used for the different conditions causing the main condition effect is the one between those sentences used for the pristine condition and those used for the condition of audible hesitation. The significant interaction effect between the condition and direction (language) is caused by the control sentences used for the pristine condition. Post-hoc testing also reveals that the groups interacting significantly with the language of the sentences (direction) are the dominant bilingual groups and that the groups interacting significantly with the control sentences under each condition (condition x group interaction) are the balanced bilinguals group and the Spanish-dominant bilingual group.

The answers to the five main questions presented at the end of chapter three are thus: 1) bilinguals are sensitive to cues preceding the code-switch (highly

significant differences from the random 50% mean for accuracy condition scores); 2) pre-switch cues are significantly different from each other in terms of their effectiveness (highly significant main condition effect) and more so when accuracy scores are used as opposed to degree of bias scores (many significant results with the post-hoc analyses on the accuracy condition scores and only one with the degree of bias scores); and 3) the subject's type of bilingualism: a) does not affect the ability to detect the cues (non-significant group effect with both types of scores), b) affects the relative effectiveness of the different cues only when the degree of bias scores (control sentences) are used (significant group x condition interaction) but not when the accuracy scores (control and code-switched sentences combined) are used (non-significant condition x group interaction) and, c) affects the degree of bias toward one language or the other when responses to the unilingual control sentences are used (significant interaction between direction x group). In addition, the results indicate that: 4) for both types of measures used here the performance within the different conditions is affected by whether the sentence began in one language or the other (significant condition x direction interaction)

and, 5) the different bilingual groups do not significantly differ in the degree to which they use the different pre-switch cues in order to predict the direction of the code-switch (non-significant group x condition x direction interaction with both sets of data).

#### Effects of Age of Second Language Acquisition and Degree of Exposure to Code-Switching

For this study, the question remained whether any significant group effects would be found if the populations were grouped in terms of age of acquisition of their second language (L2), and in terms of the amount of exposure to code-switching that they experienced. As noted in the literature review, there are many studies discussing whether the notion of the critical period hypothesis, first proposed by Lenneberg (1967) for first language learning, can be applied to second language learning. Several studies have indicated that age of second language acquisition and influence of the right hemisphere may influence the fluency with which a second language is learned (see for example, Seliger, 1978, 1981, 1982).

Hence, additional analyses were undertaken for this study to determine whether any significant group effects would result if the groups were divided in terms of age of acquisition of the second language, rather than on their language dominance. Two age cut-off points were analyzed: age of 9 years (found to be relevant in the Seliger, Krashen, and Ladefoged, 1975 study), and age of 13 years (to test the puberty notion).

Another factor, apparently not systematically researched, is whether a relationship exists between the ability to perceive code-switches and the amount of code-switching that a person is exposed to. As noted in the literature review (although there is little information on this topic) no differences in switching abilities have been reported for compound and coordinate bilinguals. The task of that study was one of translation which may involve an entirely different set of processes than that used for the perception of pre-switch cues. In any case, on the underlying assumption that exposure to code-switching is a given, as bilinguals frequently code-switch or are in contact with those that do, it is proposed here that there may

be differences in the perception of pre-switch cues related to the amount of exposure to code-switching. Two degrees of exposure to code-switching were used for this study: minimal code-switching and maximum code-switching. The regrouping of subjects according to age of second language acquisition and amount of exposure to code-switching can be found in Appendix R.

#### Grouping According to Age of L2 Acquisition

The subjects were regrouped according to the L2 age of acquisition. Two comparisons were selected: before and after 9 years of age, and before and after 13 years of age. All information was drawn from the questionnaires that the subjects filled out.

Criteria for selection. No difficulties were encountered with subjects who stated clearly at what age they started to learn the second language. Difficulties were encountered with some subjects who arrived here at the exact cut-off age, or who studied the language in an academic setting before moving into a more natural one for learning. The following criteria were followed:

a) If the L2 course was intensive then the age approximately a year after initiating the intensive studies was used as the acquisition age. For example, subject #1 (balanced bilingual) was placed in the after 9 years of age and before 13 years of age, because she started studying English intensively at the age of 11 years.

b) If the L2 course was not intensive, then the age at which the subject started consistently to attempt to speak the second language was considered the age of acquisition. For example, although subject #11 (balanced bilingual) took courses at age 12 she was placed in the after 13 years of age group as she reported that she did not become a serious language learner until she arrived to the U.S.A. as a young adult.

c) If a subject started learning the second language exactly at the cut-off ages of 9 or 13 years, then acquisition was presumed to be after that age to allow sufficient time for some competency to develop (for example with subjects # 15 balanced, #17 balanced, #35 Spanish-dominant).

Based on the above criteria all subjects (N=54) were accounted for when distributed into those that

learned their second language, whether it be English or Spanish, before or after 9 years of age and those that learned their second language before or after 13 years of age. The number of subjects resulting in each group, in terms of the age at which the second language was learned, is as follows:

- Before the age of 9 years: N=26
- After the age of 9 years: N=28
- Before the age of 13 years: N=33
- After the age of 13 years: N=21

#### Analyses of the age of acquisition data

Analyses of variance were run comparing the before/after 9 years of age group and the before/after 13 years of age group on both sets of data: accuracy (i.e., combining results to the control and code-switched sentences) and the degree of bias data (i.e., using the control sentences only). As was done previously, the factors of the different conditions and direction effects were considered in addition to the effects of the grouping factor. Although the results of these variables will be presented, in these additional analyses we are mostly interested in significant main group effects or significant interaction effects involving the different groups.

## Second Language Acquisition before/after 9 years

### Results using the accuracy data

The accuracy scores were reorganized according to the new groups of before/after 9 years of age of second language acquisition. The means and standard deviations for the accuracy scores, under each condition, for these two groups are presented in Table 5.9. In this table the results are presented when the direction of the sentence is considered or when it is ignored.

The raw data above were subjected to a repeated measures analysis of variance, results of which are shown in Table 5.10. As can be seen, a highly significant main condition effect ( $F(3,156) = 28.74, p < .001$ ), and a highly significant condition  $\times$  direction interaction effect ( $F(3,156) = 7.44, p < .001$ ) are found for these groups similar to our main results using the language dominance groups. Our main interest here, though, are the effects of group. However, as with the language dominance groups, no

Table 5.9.

Means and Standard Deviations (in parentheses) of Raw Accuracy Percentage Data of Two Bilingual Groups for the Four Experimental Conditions: Pristine, Prolongation (Prolong.), Phonological Anticipation (Phon.Ant.), Audible Hesitation (Aud.Hesit.), and All Conditions Collapsed (All Condit.). Direction of Code-Switching is either Spanish to English (S-->E), English to Spanish (E-->S), or Collapsed (Both). Groups are: Bilinguals who acquired their Second Language (L2) before age 9 years (N=26), and Bilinguals who acquired their L2 after age 9 years (N=28). Accuracy Data were calculated by adding Total Correct Responses for Control Sentences to Total Correct Responses for Code-switched Sentences and dividing by Total Number of Stimuli presented.

Condition	Direction	Bilingual Groups		Marginal Means
		L2 before 9	L2 after 9	
Pristine	S-->E	59.4 ( 9.9)	60.5 (12.4)	60.0
	E-->S	58.1 ( 9.2)	53.6 ( 9.2)	55.8
	Both	58.8	57.1	58.0
Prolong.	S-->E	69.0 (14.5)	67.3 (15.0)	68.1
	E-->S	67.9 (15.0)	64.7 (17.1)	66.3
	Both	68.5	66.0	67.2
Phon.Ant.	S-->E	79.3 (13.6)	70.4 (13.3)	74.8
	E-->S	70.7 (15.2)	66.7 (15.5)	68.7
	Both	75.0	68.6	71.8
Aud.Hesit.	S-->E	73.9 (18.0)	72.0 (18.2)	72.9
	E-->S	77.8 (17.8)	79.4 (15.8)	78.6
	Both	75.9	75.7	75.8
All Condit.	S-->E	70.4 (10.1)	67.6 ( 9.8)	69.0
	E-->S	68.6 ( 9.2)	66.1 ( 9.9)	67.4
	Both	69.5	66.8	68.2

Table 5.10

Three-Factor Repeated Measures ANOVA on Responses to Four Experimental Conditions, Exploring Ability to Predict No Switches and Code Switches, by Bilinguals who acquired their Second Language (L2) before age 9 years (N=26) and Bilinguals who acquired their L2 after age 9 years (N=28). Data analyzed are the Raw Accuracy Scores.

Source	Sum of Squares	df	Mean Square	F	Tail Prob.
Group (G)	.079	1	.079	1.27	0.27
Error	3.232	52	.062		
Condition (C)	1.91	3	.637	28.74	.000***
C x G	.058	3	.019	.87	.46
Error	3.457	156	.022		
Direction (D)	.029	1	.029	1.99	.16
D x G	.0002	1	.0002	.01	.91
Error	.744	52	.014		
C x D	.213	3	.071	7.44	.000***
C x D x G	.047	3	.016	1.63	.185
Error	1.49	156	.010		
Total	11.2592	431			

\* significant,  $p < .05$   
 \*\* significant,  $p < .01$   
 \*\*\* significant,  $p < .001$

significant main effects of group are found ( $p = .26$ ) nor are there any significant interaction effects involving these new groups based on the analyses of the accuracy data ( $p > .1$ ).

#### Results using the degree of bias data

The degree of bias data were also reorganized according to the age of acquisition factor of the second language as before/after 9 years of age. The means and standard deviations for the degree of bias scores, under each condition, for these two groups are presented in Table 5.11. In this table the results are presented when the direction of the sentence is considered or when it is ignored.

The raw degree of bias data above were subjected to a repeated measures analysis of variance, results of which are shown in Table 5.12. As can be seen, a significant main condition effect ( $F(3,156) = 2.92, p < .05$ ), and a highly significant condition  $\times$  direction interaction effect ( $F(3, 156) = 5.94, p < .001$ ) are found for these groups again similar to our main results using the language dominance groups. Of interest here are again the effects of group. As

Table 5.11.

Means and Standard Deviations (in parentheses) of Raw Degree of Bias Percentage Data of Two Bilingual Groups for the Four Experimental Conditions: Pristine, Prolongation (Prolong.), Phonological Anticipation (Phon.Ant.), Audible Hesitation (Aud.Hesit.), and All Conditions Collapsed (All Condit.). Direction of Sentence is either Spanish to Spanish (S-->S), English to English (E-->E), or Collapsed (Both). Groups are: Bilinguals who acquired their Second Language (L2) before age 9 years (N=26), and Bilinguals who acquired their L2 after age 9 years (N=28). Degree of Bias Data were calculated by adding Total Correct Responses for Control Sentences divided by Total Number of Control Sentences presented.

Condition	Direction	Bilingual Groups		Marginal Means
		L2 before 9	L2 after 9	
Pristine	S-->S	94.5 (10.1)	90.9 (12.1)	92.7
	E-->E	83.8 (19.2)	85.3 (16.0)	84.6
	Both	89.2	88.1	88.7
Prolong.	S-->S	90.6 (11.2)	78.2 (18.3)	84.4
	E-->E	86.8 (16.9)	90.1 (16.4)	88.5
	Both	88.7	84.2	86.4
Phon.Ant.	S-->S	92.3 (10.8)	82.9 (18.0)	87.6
	E-->E	77.8 (20.1)	86.9 (18.2)	82.4
	Both	85.1	84.9	85.0
Aud.Hesit.	S-->S	89.3 (13.1)	79.8 (20.1)	84.6
	E-->E	79.9 (22.5)	88.9 (15.1)	84.4
	Both	84.6	84.4	84.5
All Condit.	S-->S	91.7 ( 9.1)	82.9 (13.7)	87.3
	E-->E	82.1 (16.2)	87.8 (13.2)	85.0
	Both	86.9	85.4	86.2

Table 5.12

Three-Factor Repeated Measures ANOVA on Responses to Four Experimental Conditions, Exploring Ability to Predict No Switches, by Bilinguals who acquired their Second Language (L2) before age 9 years (N=26) and Bilinguals who acquired their L2 after age 9 years (N=28). Data analyzed are the Raw Degree of Bias Scores (Accuracy Scores for Control Sentences Only).

Source	Sum of Squares	df	Mean Square	F	Tail Prob.
Group (G)	.024	1	.024	.22	.64
Error	5.700	52	.110		
Condition (C)	.110	3	.037	2.92	.04*
C x G	.035	3	.012	.92	.43
Error	1.967	156	.013		
Direction (D)	.061	1	.061	1.92	.17
D x G	.565	1	.565	17.78	.000***
Error	1.652	52	.032		
C x D	.235	3	.078	5.94	.000***
C x D x G	.082	3	.027	2.07	.11
Error	2.060	156	.013		
Total	12.491	431			

\* significant,  $p < .05$   
 \*\* significant,  $p < .01$   
 \*\*\* significant,  $p < .001$

with the accuracy data, and as with the language dominance groups, no significant main effect of group is found ( $p = .64$ ). In this case though, contrary to the results with the accuracy data just discussed, a highly significant group  $\times$  direction interaction is found ( $F(1,52) = 17.78, p < .001$ ). This was also found with the language dominance groups using the degree of bias data. These results are illustrated in Figure 5.10. It can be seen that performance with the control sentences, used as previously to measure the degree of bias, is similar for sentences beginning in either language in the older L2 acquisition group (after 9 years) whereas there is a bias to respond "Spanish" in the younger L2 acquisition group (before 9 years of age), indicated by higher accuracy scores with the Spanish control sentences as compared to the scores with the English control sentences. Post-hoc testing, of the interaction between the groups and language (direction), with one way repeated measures ANOVAS confirmed that the significant difference was being caused by the performance of the younger group ( $F(1,25) = 16.97, p < .001$ ) as compared to the performance of the older group which was non-significant ( $p > .05$ ).

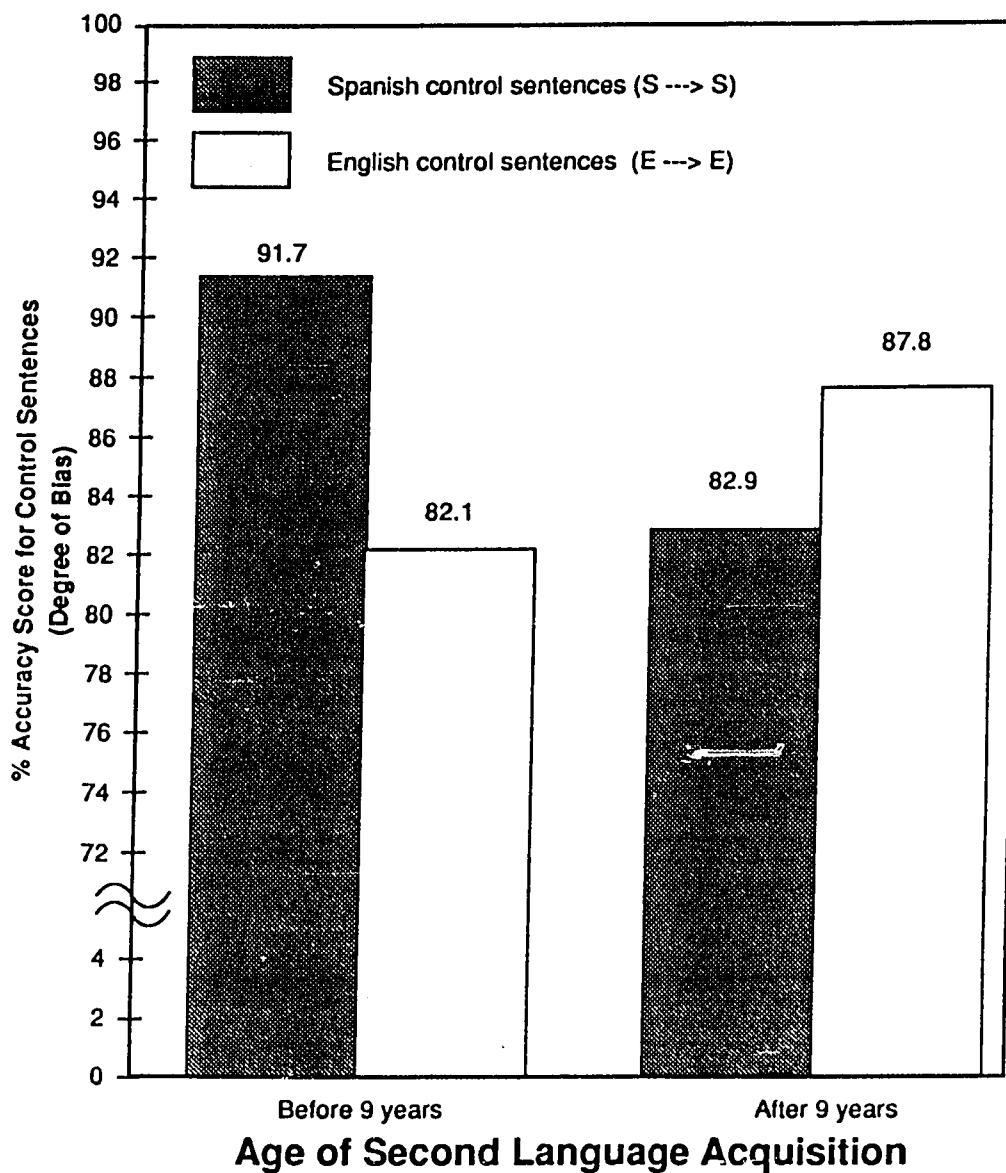


Figure 5.10: Mean Accuracy Scores for control sentences for bilinguals who acquired their second language (L2) before 9 years of age (N=26) and those who acquired their L2 after 9 years of age (N=28). Each data point is collapsed across control sentences used for the four conditions and reflects the degree of bias.

## Second Language Acquisition before/after 13 years

### Results using the accuracy data

The accuracy scores were reorganized according to the new groups of before/after 13 years of age of second language acquisition. The means and standard deviations for the accuracy scores, under each condition, for these two groups are presented in Table 5.13. In this table the results are presented when the direction of the sentence is considered or when the direction factor is ignored.

The raw accuracy data above were subjected to a repeated measures analysis of variance, results of which are shown in Table 5.14. A highly significant main condition effect ( $F(3,156) = 27.78, p < .001$ ), and a highly significant condition x direction interaction effect ( $F(3,156) = 7.15, p < .001$ ) are found for these groups similar to those found with the before/after 9 years of age L2 acquisition group and, as a result, also similar to the main results using the language dominance groups. In terms of the effect of the grouping variable, as with the before/after 9 years of

Table 5.13.

Means and Standard Deviations (in parentheses) of Raw Accuracy Percentage Data of Two Bilingual Groups for the Four Experimental Conditions: Pristine, Prolongation (Prolong.), Phonological Anticipation (Phon.Ant.), Audible Hesitation (Aud.Hesit.), and All Conditions Collapsed (All Condit.). Direction of Code-Switching is either Spanish to English (S-->E), English to Spanish (E-->S), or Collapsed (Both). Groups are: Bilinguals who acquired their Second Language (L2) before age 13 years (N=33), and Bilinguals who acquired their L2 after age 13 years (N=21). Accuracy Data were calculated by adding Total Correct Responses for Control Sentences to Total Correct Responses for Code-switched Sentences and dividing by Total Number of Stimuli presented.

Condition	Direction	Bilingual Groups		Marginal Means
		L2 before 13	L2 after 13	
Pristine	S-->E	59.3 ( 9.7)	61.1 (13.4)	60.2
	E-->S	57.6 ( 8.7)	52.9 (10.0)	55.3
	Both	58.5	57.0	57.8
Prolong.	S-->E	69.7 (14.5)	65.6 (14.9)	67.7
	E-->S	66.0 (15.8)	66.7 (16.8)	66.3
	Both	67.8	66.2	67.0
Phon.Ant.	S-->E	77.4 (15.2)	70.4 (10.9)	73.9
	E-->S	68.5 (15.5)	68.8 (15.5)	68.6
	Both	72.9	69.6	71.3
Aud.Hesit.	S-->E	72.4 (19.1)	73.8 (16.5)	73.1
	E-->S	77.8 (16.8)	79.9 (16.7)	78.8
	Both	75.1	76.8	76.0
All Condit.	S-->E	69.7 (10.8)	67.7 ( 8.7)	68.7
	E-->S	67.5 ( 9.6)	67.1 ( 9.8)	67.3
	Both	68.6	67.4	68.1

Table 5.14

Three-Factor Repeated Measures ANOVA on Responses to Four Experimental Conditions, Exploring Ability to Predict No Switches and Code Switches, by Bilinguals who acquired their Second Language (L2) before age 13 years (N=33) and Bilinguals who acquired their L2 after age 13 years (N=21). Data analyzed are the Raw Accuracy Scores.

Source	Sum of Squares	df	Mean Square	F	Tail Prob.
Group (G)	.014	1	.014	.23	.64
Error	3.297	52	.063		
Condition (C)	1.859	3	.620	27.78	.000***
C x G	.036	3	.012	.54	.66
Error	3.479	156	.022		
Direction (D)	.021	1	.021	1.51	.22
D x G	.006	1	.006	.45	.51
Error	.738	52	.014		
C x D	.201	3	.067	7.15	.000***
C x D x G	.070	3	.023	2.50	.06
Error	1.462	156	.009		
Total	11.183	431			

\* significant,  $p < .05$   
 \*\* significant,  $p < .01$   
 \*\*\* significant,  $p < .001$

age group and the original language dominance groups, no significant main effects of group are found ( $p = .64$ ) nor were there any significant interaction effects involving these new groups based on the analyses of the accuracy data ( $p > .05$ ).

#### Results using the degree of bias data

The degree of bias data were also reorganized according to the age of acquisition factor of the second language as before/after 13 years of age. The means and standard deviations for the degree of bias scores, under each condition, for these two groups are presented in Table 5.15. In this table the results are presented when the direction of the sentence is considered or when the direction factor is ignored.

The raw degree of bias data above were subjected to a repeated measures analysis of variance, results of which are shown in Table 5.16. A highly significant condition  $\times$  direction interaction effect ( $F(3,156) = 7.69, p < .001$ ) is found for these groups again similar to the one found for the before/after 9 years L2 acquisition groups and for the original language dominance groups. In this case, contrary to the

Table 5.15.

Means and Standard Deviations (in parentheses) of Raw Degree of Bias Percentage Data of Two Bilingual Groups for the Four Experimental Conditions: Pristine, Prolongation (Prolong.), Phonological Anticipation (Phon.Ant.), Audible Hesitation (Aud.Hesit.), and All Conditions Collapsed (All Condit.). Direction of Sentence is either Spanish to Spanish (S-->S), English to English (E-->E), or Collapsed (Both). Groups are: Bilinguals who acquired their Second Language (L2) before age 13 years (N=33), and Bilinguals who acquired their L2 after age 13 years (N=21). Degree of Bias Data were calculated by adding Total Correct Responses for Control Sentences divided by Total Number of Control Sentences presented.

Condition	Direction	Bilingual Groups		Marginal Means
		L2 before 13	L2 after 13	
Pristine	S-->S	92.9 (12.4)	92.1 ( 9.4)	92.5
	E-->E	83.2 (18.4)	86.8 (15.9)	85.0
	Both	88.1	89.4	88.8
Prolong.	S-->S	89.2 (11.9)	76.2 (19.3)	82.7
	E-->E	84.5 (19.4)	94.7 ( 7.5)	89.6
	Both	86.9	85.5	86.2
Phon.Ant.	S-->S	90.6 (12.8)	82.5 (18.5)	86.6
	E-->E	78.5 (21.9)	88.9 (13.1)	83.7
	Both	84.6	85.7	85.2
Aud.Hesit.	S-->S	86.5 (16.4)	81.0 (19.3)	83.8
	E-->E	80.1 (21.7)	91.5 (12.6)	85.8
	Both	83.3	86.2	84.8
All Condit.	S-->S	89.8 (10.9)	82.9 (13.7)	86.4
	E-->E	81.6 (16.7)	90.5 ( 9.4)	86.1
	Both	85.7	86.7	86.2

Table 5.16

Three-Factor Repeated Measures ANOVA on Responses to Four Experimental Conditions, Exploring Ability to Predict No Switches, by Bilinguals who acquired their Second Language (L2) before age 13 years (N=33) and Bilinguals who acquired their L2 after age 13 years (N=21). Data analyzed are the Raw Degree of Bias Scores (Accuracy Scores for Control Sentences Only).

Source	Sum of Squares	df	Mean Square	F	Tail Prob.
Group (G)	.011	1	.011	.10	.76
Error	5.714	52	.110		
Condition (C)	.098	3	.033	2.59	.06
C x G	.025	3	.008	.65	.58
Error	1.977	156	.013		
Direction (D)	.001	1	.001	.04	.84
D x G	.640	1	.640	21.11	.000***
Error	1.576	52	.030		
C x D	.299	3	.10	7.69	.000***
C x D x G	.123	3	.041	3.18	.03*
Error	2.018	156	.013		
Total	12.482	431			

\* significant,  $p < .05$   
 \*\* significant,  $p < .01$   
 \*\*\* significant,  $p < .001$

results with previous groupings, the accuracy data did not yield a significant main condition effect although it approached it ( $p = .06$ ).

In terms of the grouping variable, as with all previous groupings and as with the accuracy data, no main effect was found ( $p = .76$ ). However, contrary to the results with the accuracy data for these groups, and as with the results with the degree of bias data for the before/after 9 years of age L2 acquisition group, a highly significant group  $\times$  direction interaction is found ( $F(1,52) = 21.11, p < .001$ ). Again, this type of effect was also found with the language dominance groups using the degree of bias data. These results are illustrated in Figure 5.11. It shows that there are differences in the accuracy performance with the control sentences, used as before to measure the degree of bias, in both groups (before/after 13 years of age of L2 acquisition) depending on whether the sentence is in Spanish or English.

In the before 13 years of age group, as with the before 9 years of age group, there is a bias to respond "Spanish" reflected by higher accuracy scores with the

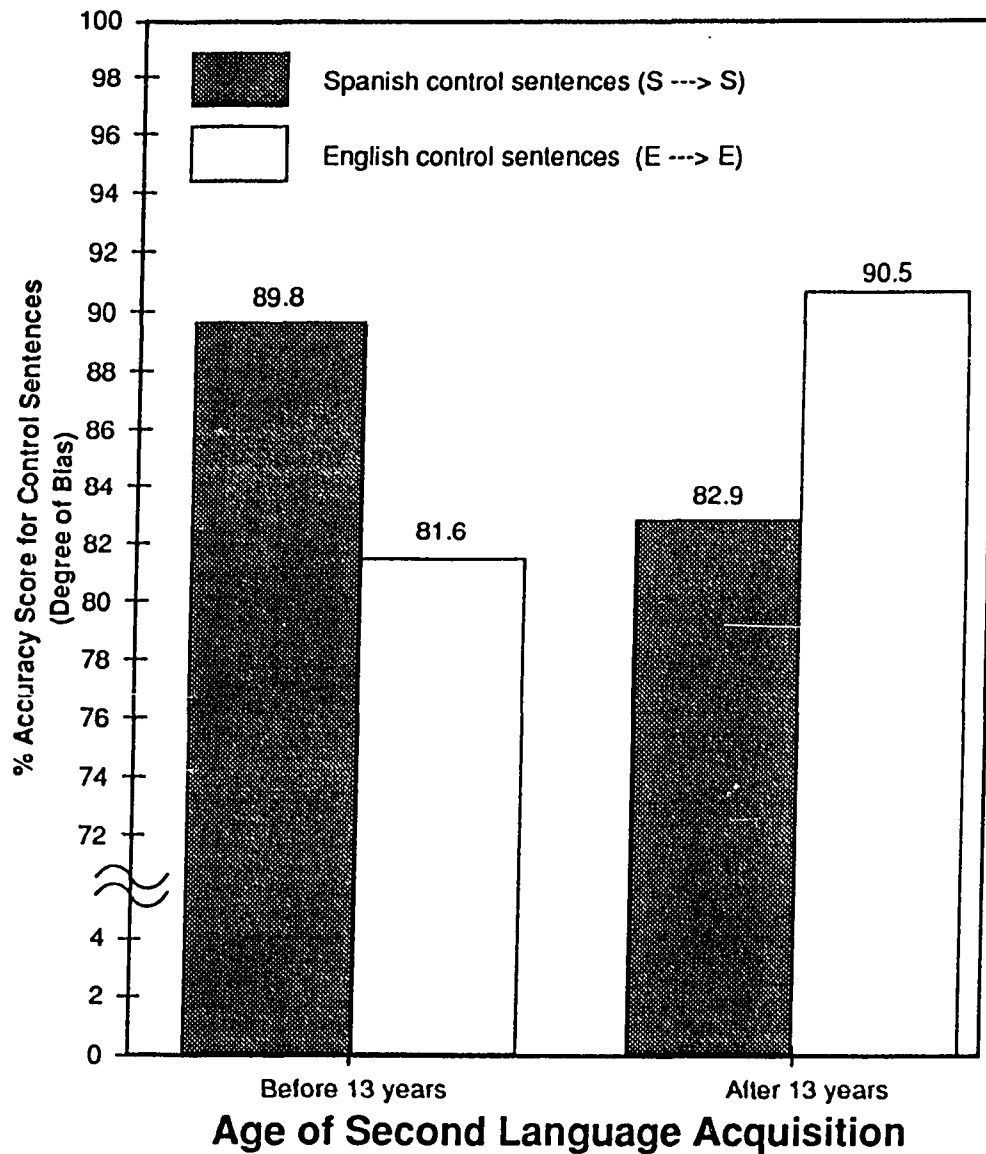


Figure 5.11: Mean Accuracy Scores for control sentences for bilinguals who acquired their second language (L2) before 13 years of age (N=33) and those who acquired their L2 after 13 years of age (N=21). Each data point is collapsed across control sentences used for the four conditions and reflects the degree of bias.

Spanish control sentences as compared to the scores with the English control sentences. In the after 13 years of age group, contrary to the after 9 years of age group where no significant bias was present, there is a bias to respond "English" reflected by higher accuracy scores with the English control sentences as compared to the scores with the Spanish control sentences. Post-hoc testing with one way repeated measures ANOVAS confirmed that there is a highly significant difference in the performance of the younger, before the age of 13 years, group ( $F(1,32) = 17.34, p < .001$ ), and that there is a significant difference in the performance of the older, after the age of 13 years, group ( $F(1,20) = 6.39, p < .05$ ). It should be noted that only with the after 13 years of age group, as compared to any other form of grouping, a significant three-way condition x direction x group interaction is found ( $F(3,156) = 3.18, p < .05$ ). It is beyond the scope of the intention of these additional analyses to explain this three-way interaction other than to say that it is probably a carry-over effect stemming from the highly significant condition effects, and highly significant condition x direction effects, rather than stemming from the grouping itself.

### Summary of the Age of L2 Acquisition Data

The analyses of the accuracy scores and of the degree of bias scores yield findings similar to those of the previous grouping based on language dominance. That is, in general, the condition effect is either highly significant or significant for both types of scores and for all age groups with the exception being the degree of bias scores for the after age 13 years group which is almost significant ( $p = .06$ ). Highly significant effects are found for all age groups in the condition x direction interaction as is found with the language dominance groups. Although no significant main effects of group are found, we find, as with the language dominance groups, highly significant interactions between the different groups and the language of the control sentence (group x direction effect). Both younger-learning age groups (before 9 years of age and before 13 years of age) are found to have a highly significant bias towards the Spanish language whereas the after 13 years of age group has a significant bias towards English. The after 9 years of age group does not exhibit any significant bias towards either language.

### Grouping According to Exposure to Code-Switching

The subjects were regrouped according to the amount of code-switching that they were exposed to. The degree of exposure was selected, versus the amount of actual code-switching that they engaged in, based on the premise that this psycholinguistic study is basically one of perception. A subject can be very perceptive to code-switching behaviors yet refrain from engaging in code-switching. Only one comparison was selected: minimum exposure to code-switching versus maximum exposure to code-switching. All information was drawn from the questionnaires that the subjects filled out.

Criteria for selection. No difficulties were encountered in placing all subjects (N=54) in either the minimum exposure to code-switching group or the maximum exposure to code-switching group. A subject was placed in the minimum exposure group if s/he was exposed to code-switching only a few times per month or a few times per year, whereas, a subject was placed in the maximum exposure group if s/he was exposed to code-

switching on a daily basis or every weekend. Based on these criteria a total of 14 subjects was exposed to a minimum amount of code-switching (most of them a few times per month) whereas a total of 40 subjects was exposed to a maximum amount of code-switching (all of them on a daily basis except for one female subject who was exposed to code-switching every weekend).

#### Analyses of the Exposure to Code-Switching Data

Accuracy data. The accuracy scores were reorganized according to the new groups of minimum/maximum exposure to code-switching. The means and standard deviations for the accuracy scores for these groups, under each condition, are presented in Table 5.17. In this table the results are presented when the direction of the sentence is considered or when the direction factor is ignored.

The raw accuracy data above were subjected to a repeated measures analysis of variance, results of which are shown in Table 5.18. As can be seen, a highly significant main condition effect ( $F(3,156) = 19.96, p < .001$ ), and a very significant condition x

Table 5.17

Means and Standard Deviations (in parentheses) of Raw Accuracy Percentage Data of Two Bilingual Groups for the Four Experimental Conditions: Pristine, Prolongation (Prolong.), Phonological Anticipation (Phon.Ant.), Audible Hesitation (Aud.Hesit.), and All Conditions Collapsed (All Condit.). Direction of Code-Switching is either Spanish to English (S-->E), English to Spanish (E-->S), or Collapsed (Both). Groups are: Bilinguals who are exposed to a Minimum Amount of Code-Switching (N=14), and Bilinguals who are exposed to a Maximum Amount of Code-Switching (N=40). Accuracy Data were calculated by adding Total Correct Responses for Control Sentences to Total Correct Responses for Code-switched Sentences and dividing by Total Number of Stimuli presented.

Condition	Direction	Bilingual Groups Exposure to Code-Switching		Marginal Means
		Minimum	Maximum	
Pristine	S-->E	59.5 ( 8.0)	60.1 (12.2)	60.0
	E-->S	54.0 (10.5)	56.4 ( 9.0)	55.2
	Both	56.8	58.3	57.6
Prolong.	S-->E	66.3 (14.5)	68.8 (14.8)	67.6
	E-->S	67.1 (16.7)	66.0 (16.0)	66.6
	Both	66.7	67.4	67.1
Phon.Ant.	S-->E	70.6 (14.8)	76.1 (13.6)	73.4
	E-->S	69.4 (16.0)	68.3 (15.3)	68.8
	Both	70.0	72.2	71.1
Aud.Hesit.	S-->E	69.4 (15.8)	74.2 (18.7)	71.8
	E-->S	73.8 (20.4)	80.3 (15.1)	77.1
	Both	71.6	77.3	74.5
All Condit.	S-->E	66.5 ( 7.4)	69.8 (10.7)	68.2
	E-->S	66.1 (11.1)	67.7 ( 9.1)	66.9
	Both	66.3	68.8	68.1

Table 5.18

Three-Factor Repeated Measures ANOVA on Responses to Four Experimental Conditions, Exploring Ability to Predict No Switches and Code Switches by Bilinguals exposed to a Minimum Amount of Code-Switching (N=14), and Bilinguals exposed to a Maximum Amount of Code-Switching (N=40). Data analyzed are the Raw Accuracy Scores.

Source	Sum of Squares	df	Mean Square	F	Tail Prob.
Group (G)	.052	1	.052	.83	.37
Error	3.259	52	.063		
Condition (C)	1.338	3	.446	19.96	.000***
C x G	.029	3	.010	.43	.73
Error	3.486	156	.022		
Direction (D)	.012	1	.012	.87	.35
D x G	.006	1	.006	.40	.53
Error	.739	52	.014		
C x D	.133	3	.044	4.60	.004**
C x D x G	.027	3	.009	.92	.43
Error	1.505	156	.010		
Total	10.586	431			

\* significant,  $p < .05$   
 \*\* significant,  $p < .01$   
 \*\*\* significant,  $p < .001$

direction interaction effect ( $F(3,156) = 4.60$ ,  $p < .01$ ) are found for these groups similar to those found with the age of L2 acquisition groups and the language dominance groups. In terms of the effect of the grouping variable, as with all other groups, no significant main effect of group is found ( $p = .37$ ) nor are there any significant interaction effects involving these new groups based on the analyses of the accuracy data ( $p > .05$ ).

Degree of bias data. The degree of bias data were also reorganized according to the amount of exposure to code-switching (minimum/maximum). The means and standard deviations for the degree of bias scores, under each condition, for these two groups are presented in Table 5.19. In this table the results are presented when the direction of the sentence is considered or when the direction factor is ignored.

The raw degree of bias data above were subjected to a repeated measures analysis of variance, results of which are shown in Table 5.20. As can be seen, a very significant condition x direction interaction effect ( $F(3,156) = 4.06$ ,  $p < .01$ ) is found for these groups, similar to the one found for all of the other groups,

Table 5.19

Means and Standard Deviations (in parentheses) of Raw Degree of Bias Percentage Data of Two Bilingual Groups for the Four Experimental Conditions: Pristine, Prolongation (Prolong.), Phonological Anticipation (Phon.Ant.), Audible Hesitation (Aud.Hesit.), and All Conditions Collapsed (All Condit.). Direction of Code-Switching is either Spanish to Spanish (S-->S), English to English (E-->E), or Collapsed (Both). Groups are: Bilinguals exposed to a Minimum Amount of Code-Switching (N=14), and Bilinguals exposed to a Maximum Amount of Code-Switching (N=40). Degree of Bias Data were calculated by adding Total Correct Responses for Control Sentences divided by Total Number of Control Sentences presented.

Condition	Direction	Bilingual Groups Exposure to Code-Switching		Marginal Means
		Minimum	Maximum	
Pristine	S-->S	90.5 (11.4)	93.3 (11.2)	91.9
	E-->E	80.2 (19.1)	86.1 (16.8)	83.2
	Both	85.3	89.7	87.5
Prolong.	S-->S	86.5 (18.1)	83.3 (15.9)	84.9
	E-->E	88.1 (18.2)	88.6 (16.2)	88.4
	Both	87.3	86.0	86.7
Phon.Ant.	S-->S	86.5 (12.5)	87.8 (16.6)	87.2
	E-->E	81.0 (25.2)	83.1 (17.4)	82.1
	Both	83.8	85.5	84.6
Aud.Hesit.	S-->S	85.7 (17.6)	83.9 (17.8)	84.8
	E-->E	75.4 (28.0)	87.8 (14.4)	81.6
	Both	80.6	85.8	83.2
All Condit.	S-->S	87.3 (12.0)	87.1 (12.7)	87.2
	E-->E	81.1 (20.5)	86.4 (12.4)	83.8
	Both	84.2	86.7	86.1

Table 5.20

Three-Factor Repeated Measures ANOVA on Responses to Four Experimental Conditions, Exploring Ability to Predict No Switches by Bilinguals exposed to a Minimum Amount of Code-Switching (N=14), and those exposed to a Maximum Amount of Code-Switching (N=40). Data analyzed are the Raw Degree of Bias Scores (Accuracy Scores for Control Sentences Only).

Source	Sum of Squares	df	Mean Square	F	Tail Prob.
Group (G)	.052	1	.052	.48	.49
Error	5.672	52	.109		
Condition (C)	.096	3	.032	2.56	.06
C x G	.055	3	.018	1.48	.22
Error	1.947	156	.013		
Direction (D)	.097	1	.097	2.35	.13
D x G	.062	1	.062	1.49	.23
Error	2.154	52	.041		
C x D	.163	3	.054	4.06	.008**
C x D x G	.055	3	.018	1.38	.25
Error	2.086	156	.013		
Total	12.439	431			

\* significant,  $p < .05$

\*\* significant,  $p < .01$

\*\*\* significant,  $p < .001$

however, the main effect for condition approached significance ( $p = .06$ ) and, contrary to the findings with the original language dominance groups and the L2 acquisition age groups, there is no significant group  $\times$  direction (language of the sentence) interaction in this case ( $p > .05$ ).

To summarize, the grouping according to the amount of exposure to code-switching (minimum or maximum) reveals a main condition effect for the accuracy data, and a condition  $\times$  direction interaction effect for both the accuracy and degree of bias data. However, it does not show any main condition effect with the degree of bias data nor any type of significant group effects, or interactions with the grouping variable, with either set of data.

## CHAPTER SIX

## DISCUSSION, SUMMARY, CONCLUSIONS

After an introduction about the reality of pre-switch cues, this chapter will concentrate on discussing the main findings of this research which are: bilinguals, regardless of their bilingual group classification, are highly sensitive to the pre-switch cues employed in this study; some pre-switch cues are more effective than others; there is no difference in the ability of bilingual groups, regardless of their bilingual group classification, to detect the different pre-switch cues; and the language heard influences the perception of the different pre-switch cues based on the extended use of markedness in this study. In addition, it is noted that degree of language dominance does not result in some pre-switch cues being perceived better than others; and the different bilingual groups do not significantly differ in their use of the pre-switch cues to predict the direction of the code-switch. The principal findings of this study are consistent with the existence of a bilingual monitor.

The possible role of the proposed monitor during the perception of bilingual speech is discussed within a model of bilingual speech perception. Finally, some summary statements, conclusions, and limitations of this study are presented.

#### Pre-Switch Cues do Exist

One of the main findings of this study is that phenomena termed here "pre-switch" cues do exist. Some pre-switch cues are common hesitation phenomena also used within the monolingual contexts (e.g., fillers, prolongations) hence, no additional analyses were needed to corroborate their existence. However, the phenomenon of phonological anticipation is introduced here, to our knowledge, for the first time in a formal manner, and it was verified spectrographically. Resulting spectrograms (see Chapter 4) indicated that phonological anticipations do not solely result from co-articulatory behaviors shaped by the incoming language, rather, may result from planning strategies. Evidence for this was the occurrence of these phenomena earlier within the speech stream than at the code-switch boundary. It is yet to be determined at what

level of consciousness the planning occurs. Past research noted pausal phenomena preceding the code-switch, but did not assign them much perceptual relevance (e.g., Zentella, 1981), even when their existence was evident in spectrograms used to study post-switch phenomena (e.g., Grosjean and Soares, 1986). This study indicates that bilinguals, regardless of their bilingual group classification, can process pre-switch cues in order to predict code-switches as discussed below.

#### Bilinguals are Sensitive to Pre-Switch Cues

Perception of pre-switch cues. The main question of this study was whether or not bilinguals are sensitive to pre-switch cues immediately preceding the onset of the code-switch. To review, bilinguals of this study listened to the first clause of compound sentences in a semi-randomized order. These clauses ended either with a cue (experimental sentences), no cue (control sentences), and supposedly no cue (pristine code-switches). Subjects had to predict whether a switch had occurred after the clause they heard. Pre-switch cues were not mentioned. Rather,

subjects relied on their "feelings" or "intuition" to respond quickly. The highly significant differences ( $t$ -tests) of the mean accuracy scores for bilinguals classified according to language dominance indicate that the bilinguals of the present study, mostly from the Puerto Rican and Dominican communities of the tri-state New York metropolitan area, are highly sensitive to, and perceive, the pre-switch cues analyzed in this study. Furthermore, although this study did not confirm with naturalistic data whether or not the subjects of this study also produced the cues that they so readily perceived, it is proposed here that these pre-switch cues may be produced naturally by the bilingual populations represented by our subjects. Evidence for this was obtained from the reactions of the speakers during the recording of the experimental tapes. Specifically, all three speakers easily produced sentences containing pre-switch cues, however, they experienced difficulty producing the pristine sentences which contained no deliberate cue before the code-switch. In addition, many subjects spontaneously used hesitation phenomena before they switched languages; this was informally observed by this author during the breaks during testing. Hence, it appears that bilinguals appear to produce and listen for these

pre-switch cues during the use of two languages. It is unlikely that these behaviors are confined to the laboratory situation, however, additional research is needed in this area.

The base language assimilation effects on guest words described in previous research (e.g., Grosjean and Soares, 1986), causing subjects to remain inaccurately within the base language context, were precluded here by using pre-switch cues. By preceding the code-switch these cues "alerted" bilinguals that there could be a change from the base language. One can postulate that during on-line processing, in ongoing conversations, the processing of these pre-switch cues "alerts" the bilingual that a change could occur resulting in the activation of the incoming language. In this manner information is not lost if such a switch does occur. It should be mentioned that a main condition effect was also found for some bilinguals when responding to certain control sentences. Some possible explanations for these confounding false labellings are proposed in Note 1.

Regardless of the few false labellings of cues, results indicate that bilinguals are not responding

randomly to these pre-switch cues, but, rather, that they are perceiving and apparently interpreting them as code-switching signals. This supports both the no-monitor view (Paradis, 1980) and the monitor view (Obler and Albert, 1978). That is, the no-monitor view would be supported if it is found that these bilingual perceptual processes are not significantly different from those found for monolinguals. On the other hand, the monitor view would be supported if it is found that despite the similar perceptual processes of monolinguals and bilinguals, the bilinguals interpret the cues differently. Follow-up research, now in progress, should clarify this issue. However, if bilinguals do interpret the pre-switch cues differently, as suggested by the results of the pilot study, a bilingual monitor may exist. This proposed monitor, as suggested by Obler and Albert (1978), would scan the speech for cues about the language being used. This monitor, however, may not be "on" continuously as proposed by these authors but rather, may need a certain minimum threshold level before being activated. This will be elaborated when models of bilingual speech processing are discussed further on.

Some Pre-Switch Cues are More Effective than Others

Another main question of this study was whether some pre-switch cues were more effective than others. The highly significant main condition effect obtained with bilinguals of this study, regardless of how they were classified, indicated that they were more sensitive to some cues than others, hence, some cues were indeed more effective than others. This may be related to the degree to which they belong to a monolingual or bilingual context as explained below.

Results of the pilot study supported the presence of a hierarchy of pre-switch cues that differed in their ambiguity depending on the degree to which they belonged to monolingual and bilingual contexts. Specifically, the hierarchy was as follows: prolongation (undistinguishable from normal drawls in monolingual contexts), audible hesitation (vowel fillers specific to each language which could be used either within monolingual contexts, or within bilingual contexts to indicate a code-switch), and phonological anticipation (specific to the bilingual context as an accent should result only as an anticipation of a code-switch).

Based on this postulated hierarchy, and on the results of the pilot, it was predicted that higher scores should be obtained with the condition most tied to the bilingual context (i.e., phonological anticipation). Results indicated, however, that in this study the hierarchy, from more to less ambiguous cues based on the degree to which they belonged to a monolingual or bilingual context, was as follows: prolongation, phonological anticipation, and audible hesitation. Significant differences were not found between adjacent points of the hierarchy (i.e., audible hesitation and phonological anticipation, nor between phonological anticipation and prolongation). They were, however, found between the first and last conditions of the hierarchy (i.e., audible hesitation and prolongation). We propose that these results reflect phonological characteristics, discussed below, inherent to these pre-switch cues.

Some phonological aspects of pre-switch cues. The conditions analyzed for this study are similar in that they all involve the phonological systems of the languages. The Spanish and English audible hesitation vowels are used either with their respective languages

in their monolingual contexts, or within bilingual contexts (where both languages are used) followed, or not followed, by code-switches. These hesitation vowels are also found within words that are produced with phonological anticipations. For example, the Spanish vowel used as hesitation pre-switch cue in this study could be part of an English word that is accented with the incoming Spanish phonology due to phonological anticipation. In turn, both the audible hesitation and the phonological anticipation conditions are similar to the one of prolongation which is also a modification at the phonetic level.

Specifically, during prolongation the final sound of a word is extended. The significant difference between audible hesitations and prolongations may be a result of contextual variables. That is, with prolongations any final sound can be extended by monolinguals or bilinguals. The filler hesitation vowels, however, are used by monolinguals and bilinguals with great specificity. Spanish monolinguals would use the Spanish filler vowel and English monolinguals would use the English filler vowel. Although bilinguals could do the same in the monolingual or bilingual contexts (i.e., use the filler

vowel with the respective languages correctly), they also have the choice, at a conscious level or not, to use the filler vowel of their other language (contrasting with the phonology of the base language at the time) to indicate a possible switch into the other language. Also, bilinguals may change their minds and not switch into the other language in which case one would have an apparent misuse of the hesitation vowel. It may also be that some bilinguals may not always distinguish between the different vowel forms. They may use either one indiscriminately, or use one vowel form with both languages but not the other, or use an intermediate vowel form. Some bilinguals, however, may not use vowel filler forms at all in either or both languages. For example, Kowal and O'Connell (1980) have noted that Spanish speakers prefer to use parenthetical remarks (e.g., "este"), rather than filled pauses. With these cases the hierarchy of the effectiveness of pre-switch cues may be different.

It has also been suggested that certain bilinguals, or multilingual speakers, may not use phonological anticipation as a pre-switch cue, or, that if they do, it is not noticeable, since they use a similar phonology for all of their languages (Stewart,

1989, personal communication). With these individuals one may find that other forms of pre-switch cues prevail. This area warrants more investigation. Finally, this study indicated that pristine code-switches were perceived significantly better than chance, probably because of subtle phonological anticipations (see Note 2). Suffice it to say that the results of the present research show that the proposed monitoring device for bilingual speech does not appear to consist only of perceptual skills. Rather, this monitoring device appears to also consist of interpretive skills shaped by each bilingual's experience with the languages in question. The bilingual will use her/his interpretive skills to process pre-switch cues as predictors of potential incoming code-switches. We also maintain that these pre-switch cues appear to be "salient" or "stand out" against the base language due to a special form of markedness discussed below.

#### Markedness Influences the Perception of Pre-Switch Cues

This study also asked whether bilinguals, regardless of their classification, perceive pre-switch

cues differently depending on the language in which the sentence started. This question was motivated by the notion of markedness presented in the review of the literature. To review, two forms of markedness are proposed here. One is the notion of markedness extended to whole languages, that is, one language sounds "foreign" (marked) when contrasted to the subject's dominant language (unmarked). The other form of "markedness" is related to specific contexts within the sentence where, for example, a word with a phonotactic configuration specific to just one of the languages is "marked" against the base language that preceded it. However, for these cases the term "marked" was not used in order to distinguish this situation from the whole-language markedness. Instead, other terms, such as "salient," were used. The reader, however, is asked to keep in mind that in a sense these words are "marked." Hence, the pre-switch cues, with their distinct phonological aspects discussed above, would be "salient" against the preceding base language. This in turn will result in their better perception as compared to the perception of prolongations or borrowings which are difficult to distinguish from the base language as they appear to be mere extensions of the latter.

Results, based on the accuracy scores, indicate that the perception of all conditions, except the one of sound prolongation, is affected by whether the sentence begins in one or the other language. For the condition of pristine code-switches we again postulate that subjects are perceiving subtle phonological co-articulatory cues (see Note 2). The significant results with the conditions of audible hesitations, and phonological anticipations can be explained according to the markedness notion discussed above. An audible hesitation vowel sound, belonging to the phonology of the incoming language, is "salient" against the preceding base language. The same applies to phonological anticipations which are accented according to the phonology of the incoming language.

The non-significant results obtained with the interpretation of prolongation, following either language, are also explained according to our use of markedness in this study. In this case, however, results are not caused by a lack of "saliency," as a prolongation cue "stands out" by differing in tempo from the preceding speech segment, rather, by a lack of phonological "saliency" needed to unequivocally cue the

incoming language. Hence, even if prolongations are perceived, they do not contain sounds directing the listener to the phonology of the other language. In addition, the prolongation cue is also frequently found within monolingual discourse, or within the monolingual discourse of bilinguals learning a second language in order to maintain an impression of fluency (Dechert, 1980; Raupach, 1980). Hence, due to the lack of phonological specificity of prolongation, and to the pervasive use of this cue across monolingual contexts, subjects, both in the pilot and main study, frequently failed to interpret it as a pre-switch signal. In contrast, subjects did not fail as much with unambiguous cues, such as phonological anticipations, since their perception and interpretation unequivocally pointed to the upcoming language switch.

Many of the results obtained in previous studies can be reinterpreted according to the markedness effects that we propose are influencing the perception of pre-switch cues. For example, the findings by Altenberg and H. Cairns (1983), that phonotactic constraints influenced the access of lexicon by bilinguals and monolinguals, is consistent with the markedness effects found in this study. That is, the

more "salient" the phonotactic configuration, the quicker the access.

The work by Grosjean and Soares (1986), and by Grosjean (1988), can be reinterpreted in a similar manner. For example, the 1988 Grosjean indicates that word recognition in mixed bilingual speech is influenced by the phonotactics of a guest word, the presence or absence of a base language homophone, the language phonetics of a word (i.e., whether it is pronounced in the guest language as a code-switch or in the base language as a borrowing), and the language that precedes the word. He found that code-switches were perceived faster than borrowings. Again, code-switches, according to the premises discussed in this research, would be "salient" against the base language whereas borrowings, which are integrated into the base language phonologically and morphologically, would be less so. In this case the dynamics discussed for less salient signals, such as prolongations, could be said to be in effect for the "difficult-to-isolate" borrowings (e.g., Grosjean, 1988). Borrowings appear to be a continuation of the base language just as prolongations are a continuation of a sound in the base language.

In addition, Grosjean's finding that subjects had great difficulty isolating code-switches pronounced with the base language phonology provides further support for the hypothesis that processing of mixed speech is affected by the degree to which the targets are "salient." Since code-switches pronounced with the base language phonology are not "salient" they would be difficult to isolate. To identify these words top-down, higher level, semantic information was often required (e.g., words following the offset of the target gated word). Some of these ambiguous words, however, were never identified. Perhaps these types of word identification tasks would be facilitated with the use of additional information before the onset of the first gate of the target word. Specifically, the use of pre-switch cues, such as those explored in this research, may clarify these particular situations. This topic will be discussed further in the next chapter. The finding of a direction effect only for the control sentences used for the pristine code-switches is again confounding. Explanations for the false labelling of cues are also proposed here (see Note 1). Another main question of this study was whether type of bilingualism affected the perception of

the pre-switch cues. We shall now turn to this subject.

Bilinguals do not Differ in their Perception of Pre-Switch Cues

As noted in the literature review, production and perceptual studies to date indicate that group differences may exist depending on the bilingual's language dominance, or the age at which the second language was learned. For example, balanced bilinguals produce more intra-sentential code-switches (Poplack, 1980), and are better than dominant bilinguals in various metalinguistic tasks (see Obler and Albert, 1978 for a review). Studies also show that early language learners achieve a more native-like, less accented fluency (see e.g., Seliger, Krashen, and Ladefoged, 1975; Seliger, 1988; McLaughlin, 1984).

Perceptual differences are also found among different bilingual groups. In studies comparing the performance between balanced and dominant bilinguals, balanced bilinguals benefited the most from a language switch in recall tasks (Goggin and Wickins, 1971),

dominant bilinguals performed better in their weaker language in sentence recognition tasks (Berkovits, Abarbanel and Sitman, 1984, cited by Hamers and Blanc, 1989), and balanced bilinguals have longer response times in mixed speech tasks (e.g., Soares and Grosjean, 1984; Grosjean and Soares, 1986). Also, early language learners are better at perceptual tasks, which is frequently attributed to the role of the minor, right hemisphere (e.g., see Vaid, 1983). No studies, to our knowledge, have questioned whether exposure to code-switching affects the production and perception of mixed speech.

The results of the pilot further strengthened our belief that group differences existed. Specifically, in the perception of pre-switch cues, balanced bilinguals (N=5) performed significantly better than Spanish-dominant bilinguals (N=4), and, subjects learning their second language before age 6 years (N=4) performed significantly better than those learning their second language after the age of 14 years (N=3). Hence, it was predicted in this study that balanced bilinguals and early language learners would be better at monitoring the pre-switch cues. In addition, it was predicted that those bilinguals exposed to much code-

switching were probably better at perceiving them than those bilinguals who heard little code-switching.

The results of the present research failed to support any of the above predictions. That is, there were no significant differences, when responses to all the pre-switch cues were pooled, among the performance of groups of bilinguals classified according to language dominance, age of second language acquisition, or amount of exposure to code-switching. Hence, these results seem to support the null hypothesis of no-difference between the bilingual groups. Some possible reasons for these results are explored below.

Processing at the phonological level. The possibility exists that processing of these pre-switch cues is mostly at the phonological level making it a subtle task. Hence, regardless of the different grouping factors, perceptual differences cued by these pre-switch cues may be minimal due to a similar performance at this level by most persons, and, greater differences may occur only when the perceived pre-switch cues are interpreted. It is proposed here that differences found in various studies with bilingual populations may be tied to the level the tasks are

probing. Differences in the realm of production, mentioned above, are mostly from studies involving higher metalinguistic functions where significant differences in abilities are frequently found. In the present study one could postulate that processing is occurring mainly at a prelinguistic, phonological/phonetic, surface-structure level where fewer group differences are obtained.

Support for differences in performance depending on the level of processing can also be found in related areas such as with short-term memory research (e.g., Craik, 1979; Crowder, 1971; Crowder and Morton, 1969; Marks and Miller, 1964; Massaro, 1972; Rosenberg and Schiller, 1971; Shulman, 1970, 1971, 1972). Primary memory is maintained by many to be acoustic or articulatory in nature (Adams, 1967; Craik and Levy, 1970; Craik and Lockhart, 1972; Neisser, 1967). Research indicates that significant group differences disappear depending on the level of processing. Specifically, differences in short-term memory capacity, between children with or without language disorders, became non-significant in a study which systematically reduced the level of familiarity of the stimuli to be processed from the semantic level to an unfamiliar phonological one (Mahecha, 1981).

It is proposed here that the pre-switch cues were processed at a phonological level, similar to the level used by primary memory processes. The subjects either perceived or did not perceive the cues. If they perceived the pre-switch cues then they had to remember them and immediately, intuitively, interpret them as a gestalt that was either "salient" or unremarkable. Hence, either there was no cue (i.e., control sentence), the cue was salient in reference to the preceding section of speech (e.g., English hesitation form following Spanish sentence) or it was not (e.g., same English hesitation form but following English sentence).

The study by Altenberg and H. Cairns (1983), on the influence of phonotactic constraints on access to bilingual lexicon, found, as in this study, condition effects but no group differences. The task used for their study was also mostly at the surface-structure level. The research by Grosjean (1988) can also be said to support the hypothesis that processing occurs mostly at the phonological level. Results of his work indicated that the recognition of a guest word was influenced by its phonotactic configuration, by the

presence or absence of a base language homophone, by the language phonetics of the word, and by the language that preceded the word. He found that the language phonetics of a word was especially important if the word had a homophone in the other language. If such a word was said as a code-switch it was identified sooner than if it was said as a borrowing. As discussed before, these results are explainable according to our extended use of markedness ('saliency'). He found that higher levels, for example semantics, were accessed in order to isolate target guest words if insufficient surface-structure information was provided. The results of these studies, and of the present research, suggest the existence of a bilingual monitor. The possible role of this proposed monitor in a model of bilingual speech perception will be discussed later on in this chapter. First, some possible experimental artifacts perhaps influencing the lack of group differences, and the effects of language dominance and age of second language acquisition on the perception of the direction of the code-switches will be discussed.

Difficulties with dominance measures. Possible inaccurate measures of dominance could partly account for the lack of differences between the balanced and

dominant groups. It is possible, that due to our criteria, the "balanced" bilingual group may be slightly dominant in one or the other language. Difficulties with the measuring of dominance have been discussed in the past. Grosjean (1982) discussed the shortcomings of dominance measures. In his research he corroborated that both bilinguals and monolinguals stated that in order to be called "bilingual" a person had to be fluent in both languages. Grosjean makes the point that bilinguals who speak both languages with native-like fluency are the exception, rather than the rule. This led many to view bilingualism as a continuum (e.g., see Haugen, 1969; MacNamara, 1967) in which the four basic skills are considered: speaking, listening, reading, and writing. This encouraged research trying to separate the "balanced" bilinguals from the "non-balanced" bilinguals (i.e., more dominant in one of the languages). MacNamara (1967, 1969) divides the tests used into rating scales, fluency tests (e.g., Lambert, 1955), flexibility tests (e.g., Lambert, Havelka, and Gardner, 1959), and dominance tests. If a bilingual obtains a score of zero, or close to zero, on a rating scale she/he is considered to be "balanced." Romaine (1989) cited other terms used to indicate balance such as "equilingual"

(Baetens-Beardsmore, 1982), or "ambilingual" (Halliday, McIntosh and Strevens, 1968). The dominance tests, as described by Grosjean (1982), test bilinguals on their ability to identify or interpret ambiguous words, and the language used most is considered to be the dominant one.

A thorough discussion of all these measures is beyond the scope of this discussion. Grosjean (1982) stated that many methods, especially those which measure speed of response, are inaccurate. Rating scales, similar to the ones used for this research; which include language background questionnaires, language usage rating scales, experimenter interviews, and self-rating scales; were reviewed favorably by Grosjean (1982). Jakobovits (1969), however, criticized rating scales for failing to take into account the different domains in which languages are used. Cooper (1971) found that Spanish-English bilinguals responded differently on word naming tasks depending on the context proposed (e.g., family, school, neighborhood, religion). These same subjects were considered balanced in some contexts and dominant in others. Hence, perhaps the language history questionnaire used in this study did not tap the

appropriate parameters relating to the contexts in which each language was used.

Some factors concerning age of L2 acquisition.

With regard to second language acquisition, differences may become apparent if extreme groups are selected and compared: very early second language learners (e.g., learning the second language before the age of 5 years), and very late language learners (e.g., learning the second language after the age of 14 years). Other factors not explored in this study, such as whether both languages were learned simultaneously or separately, may also influence the degree to which the pre-switch cues are perceived. More thorough language history questionnaires should address these factors in future studies.

Difficulties in measuring exposure to code-switching. The lack of group differences depending on their amount of exposure to code-switching appears to be related to inaccuracies in the self-reporting by the subjects. Self-reporting is considered an accurate measure of language fluency, as reported above. According to Stewart (1989, personal communication) subjects are usually accurate when reporting their

degree of fluency in a language. They have, however, been found to be less accurate in self-reporting of socio-linguistic variables. For example, several subjects of this study were observed to code-switch naturally between the two languages despite their claims that they never engaged in such behavior. These same subjects, based on their personal dislike of code-switching, perhaps inaccurately claimed that they were exposed minimally to code-switching. Romaine (1989) also commented that self-assessment reliability is affected, among several variables, by "the attitudes which the person has towards a particular language and the relative status of the languages in a particular context" (p. 15). Future studies should design a better measure of degree of exposure to code-switching, such as observing the subject across a variety of contexts without her/his awareness. Romaine (1983), cited by Romaine 1989, also uses a language diary method whereby she asks school children to keep track of the languages they use each day. Some form of variation of this method could also be used for adults. Although no group differences were found with the groups themselves, differences were obtained when their particular language biases were taken into account, which we will discuss next.

Influence of Language Dominance and Age of L2 Acquisition on the Perception of the Direction of Code-Switches

Based on the results of the pilot, this study asked whether a subject's language dominance affected the sensitivity to the direction of the code-switch. Specifically, the pilot showed that balanced bilinguals (N=5) perceived more pre-switch cues regardless of the direction of the code-switch whereas Spanish-dominant bilinguals (N=4) perceived code-switches moving into their marked language (i.e., English) better. Hence, based on our notion of markedness applied to whole languages, as discussed earlier, the dominant bilinguals had a bias towards their "marked" language, whereas no such bias was found for the balanced bilinguals, indicating that for them both languages were similarly marked. This question was also explored when subjects were classified according to age of L2 acquisition, and amount of exposure to code-switching.

Although no significant results were obtained in this study with the accuracy scores, a markedness

effect was found with the degree of bias scores (control sentences) with subjects classified according to language dominance and age of L2 acquisition. The results with the bilinguals classified according to language dominance were unequivocal. As predicted by our whole-language markedness theory, of one language being familiar and the other "foreign," the Spanish-dominant group exhibited a bias to respond "English" (thereby decreasing their accuracy with the Spanish control sentences) whereas the English-dominant group exhibited a bias to respond "Spanish" (thereby decreasing their accuracy with the English control sentences). The balanced bilinguals, as predicted, did not show a significant bias towards either language as neither one seemed "foreign" to them. This bias towards the other language would aid the dominant, non-fluent bilingual to be on the "alert" for any introduction of the other language within the conversation. In this manner, as mentioned before, the possibility of losing information is greatly reduced. It appears that these dominant bilinguals are following the old adage of "better safe than sorry."

The markedness effect, was also exhibited in the bias scores (control sentences) by bilinguals when

classified according to the age of second language (L2) acquisition. Specifically, subjects who acquired their L2 before age 9 or 13 years (younger-learning) had a bias towards "Spanish," whereas, subjects who acquired their L2 after 13 years (later-learning) had a bias towards "English." This led us to believe that the younger-learning groups were more dominant in English (hence responded "Spanish" more often) and that the older-learning group was more dominant in Spanish (hence responded "English" more often).

In order to validate the above prediction the ratings on the self-rating scales were subjected to t-tests. Specifically, three different types of scores were compared between each pair of age groups: scores given to English, scores given to Spanish, and a weighted score resulting from subtracting the Spanish score from the English score. A positive score would indicate dominance in English and a negative score would indicate dominance in Spanish. The mean values for each type of score, the t-value, and the significance are summarized in table 6.1. All differences were highly significant ( $p < .001$ ). The younger-learning groups judged themselves to be stronger in the English language and the older-learning

Table 6.1.

English, Spanish, and Weighted Mean Scores for Self-Rating of Language Proficiency for Bilingual Groups Classified according to Age of Second Language (L2) Acquisition. Groups compared are: L2 acquired before age 9 years (N=26), L2 acquired after age 9 years (N=28), and L2 acquired before age 13 years (N=33), L2 acquired after age 13 years (N=21). Positive Weighted Scores indicate Higher Scores were obtained for English, and Negative Weighted Scores indicate Higher Scores were obtained for Spanish. Scale was 5-point: 1 (fair), 2 (average), 3 (good), 4 (very good), 5 (excellent).  $t$ -values are based on 52 Degrees of Freedom.

	English	Self-Rating Scores Spanish	Weighted
Means of before 9 group	4.54	3.42	1.25
Means of after 9 group	3.43	4.71	-1.29
$t$ -value	5.73***	-6.24***	10.14***
Means of before 13 group	4.45	3.48	0.97
Means of after 13 group	3.19	4.88	-1.69
$t$ -value	6.90***	-6.46***	10.91***

\*\*\* significant,  $p < .001$

groups, even the above nine years of age, judged themselves to be more dominant in Spanish. Despite these encouraging results, indicating that, as expected, one learns more about a language the longer one experiences it, future studies should also include some independent measure of proficiency to insure that the self-rating scales are valid measures of dominance.

The question remained whether the amount of exposure to code-switching would also show markedness effects as found for bilinguals classified according to language dominance, and age of L2 acquisition. Non-significant results, however, indicate that markedness effects seem not to be related to the degree of exposure to code-switching. Rather, they may be more related to years of experience with the language itself, which, as we have discussed above, is related to language dominance. Perhaps the measure of exposure to code-switching was too gross in this study. It may be that there are differences in the manner in which languages are mixed in a formal, classroom setting as opposed to more naturalistic settings (Grosjean, 1982). Hence, future studies should determine whether amount of exposure within varying code-switching contexts influences the perception of pre-switch cues.

Before turning to our discussion on the proposed bilingual monitor, and its possible role in a model of bilingual speech perception, it should be mentioned that based on the pilot data we predicted that the balanced bilinguals would be better at perceiving phonological anticipation and prolongation pre-switch cues, and the direction of the code-switches cued by these pre-switch cues, than the dominant groups. Results of the present research failed to support these predictions. Reasons may be similar to the ones proposed for the lack of main group differences.

Monitoring of Pre-Switch Cues and Implications for a Model of Bilingual Speech Processing.

The results of this study are consistent with the notion that the pre-switch cues exist and that they are perceived by different groups of bilinguals. In addition, we propose that the perception of such cues may be based on the aspects of markedness presented in this study. Specifically, the differential perception of pre-switch cues may be influenced by context-specific markedness rendering some cues more "salient"

than others at the phonological level. In addition, there appears to be a whole-language markedness effect reflected by a bias towards the "marked" (less fluent) language found for dominant bilinguals and for bilinguals who learned their second language after puberty, which frequently resulted in "overshooting," perhaps to prevent missing any code-switches. We further propose that both forms of markedness are being used by the proposed bilingual monitor, at a surface-structure, non-semantic, phonetic/phonological level in order to perceive incoming code-switches as discussed below.

Monitoring is occurring at surface-structure levels. The pre-switch cues of this study were apparently perceived by the proposed monitor, as in primary memory studies, at a non-semantic, phonetic, surface-structure level. That is, subjects perceive and interpret the pre-switch cues intuitively. Altenberg and H. Cairns (1983) also proposed that perception of the phonotactic cues used in their study was most likely at "a preconscious, automatic level of processing followed by an attentional level in which percepts are essentially selected with reference to contextual factors of various sorts " (p. 187). Hence,

the pre-switch, phonological cues of this study must have activated, at this surface-structure level, the proposed monitors of different bilinguals who then intuitively felt "alerted" that a language change could occur.

The strength of the bilingual's "feeling" will be greater with "salient" language-specific cues that contrast with the preceding base language, such as fillers and phonological anticipations, than with less salient cues, such as prolongations, that do not stand out as "foreign" against the preceding base language. As discussed previously, the research by Grosjean and Soares (1986), and of Grosjean (1988) on word isolation tasks were affected by phonotactic configurations and language phonetics. Their results, of base language effects and failure to identify some words such as borrowings, were reinterpreted according to the principles of context-specific markedness proposed in this study. Hence, the use of pre-switch cues in these types of experiments should accelerate the perception of code-switches, should diminish the assimilation effects of the base language, and should aid the perception of non-salient guest words (e.g., borrowings).

Stage at which the monitor becomes active. In his recent work, Grosjean (1988) stated that the proponents of a monitor do not specify at what stage it becomes active, whether it was during the acoustic to phonetic mapping of the speech sounds or afterwards, and he further stated that his results added support to the idea that processing can occur without the use of a monitor. However, he also wondered how processing of mixed language can be so rapid and efficient. In his earlier work along with Soares (Grosjean and Soares, 1986) Grosjean stated that a bilingual will expect items of a sentence to be in the base language unless alerted otherwise by, for example, the phonotactics of a word.

The results of this study present an alternative theory that rapid processing of mixed speech, at a surface-structure level, is further aided when pre-switch cues are used during mixed speech exchanges. These pre-switch cues would "warn" the listener's hypothetical bilingual monitor that a language switch may occur. Hence, it would prevent the listener from remaining inappropriately within the base language context, as found in previous research (e.g., see

Grosjean, 1988). We suggest then that the use of pre-switch cues aids the proposed bilingual monitor to swiftly and correctly identify a language switch at the initial, surface-structure level. If no pre-switch cues are present, nor other cues such as phonotactic constraints, then subjects will access information at higher levels (e.g., semantics) in order to correctly process mixed speech. For example, as mentioned before, previous research (Grosjean and Soares, 1986; Grosjean, 1988) indicated that subjects needed several words following the target guest word to identify it if it appeared to belong to the preceding base language.

The proposed bilingual monitor, however, is maintained not to be "on" in a "continuous" fashion as proposed by some authors (e.g., Obler and Albert, 1978). To propose that the bilingual monitor continuously and simultaneously monitors all languages, besides being an exhausting proposition for the bilingual person, contradicts present models of learning and cognition (Stewart, 1989, personal communication). For example, it would be non-productive to activate maps from previous known cities while traveling within a specific one. By analogy, it would be inefficient to activate all language systems

when only one is being used. Rather, it may be that the proposed bilingual monitor may be inactive, or minimally activated, when not being used and that it needs a certain "threshold" in order to be accessed. However, once the system has been activated it may remain on in a continuous fashion. We propose that the pre-switch cues used in this study activated the system to allow it to process the incoming code-switches. It is unclear how much of a pre-switch cue is needed to alert the other language system that a code-switch may occur. For example, what is the minimum length of a prolongation, or, how much of a phonological anticipation is needed before the respective system is activated? This will be discussed further in the next chapter.

The results of our research indicate that the processing of mixed speech may be enhanced once the bilingual monitor proposed here is "alerted" that a switch may occur. The proposed monitor would become alerted after the threshold is reached caused by, for example, missing information due to an unexpected language switch, or by perceiving pre-switch cues. Once the proposed monitor is activated it will continue to scan relevant information, such as phonological

"saliencies" discussed. In addition, if the bilingual has a language bias, this too is activated to further decrease any loss of information during on-line processing (e.g., by "overshooting"). Hence, in this manner, the bilingual person can process mixed speech in a rapid and apparently facile manner. As mentioned earlier, besides perceiving pre-switch cues at a surface-structure level, some forms of interpretive skills may be mediated by the proposed bilingual monitor. This was suggested by the pilot data which showed that some monolinguals perceived the pre-switch cues but failed to interpret them as code-switching signals.

Monitoring of extra-linguistic factors. Other factors that may "alert" the listener that a language switch may occur are, as presented in the literature review, the knowledge that the other speaker is bilingual, hearing other members of the group code-switch, the context of the conversation, the locality of the conversation, etc. (e.g., see Blom and Gumperz, 1972; McClure, 1977; Aver, 1984; Zentella, 1981; Gumperz and Hernandez-Chavez, 1969; Timm, 1975).

It has also been noticed by this author, and others (e.g., Stewart, 1988, personal communication)

that there is a shift in body language patterns when switching from one language to another. This author will bring more hand movements into the conversation and will move closer to the listener when switching from English into Spanish. Stewart (1989, personal communication) has noticed that Haitians frequently change their body language, similar to what was just described for this author, when switching from Haitian French to Creole French. These observations would agree with Birdwhistell's (1970) belief, as cited by Hamers and Blanc (1989, p. 106), that "each cultural group possesses a unique non-verbal behavioural repertoire inseparable from language." All of these areas, which in themselves would also be interesting avenues of future research, are most likely being processed, perhaps at higher levels, by a monitoring system once it is alerted.

#### Summary, Conclusions, and Limitations

This study has shown that in mixed bilingual speech certain phenomena, termed here pre-switch cues, frequently occur to cue the change into the other language. The phenomenon of phonological anticipation,

an "accent" of the phonology of the incoming language, was shown to occur not only on the segment immediately preceding the switch but also earlier within the speech stream. This finding supports the hypothesis that some form of planning took place to produce this early phonological anticipation, and that it cannot simply be the effect of co-articulatory effects. That is, the bilingual speaker may decide to switch into the other language which begins to "tinge" the base language early on during the on-line production of the code-switched sentence.

Another major finding is that bilinguals, regardless of their classification, perceive these pre-switch cues and use them to predict a language change. In addition, some pre-switch cues were more effective than others. We also proposed that the differential effectiveness of the pre-switch cues is related to phonological factors of the cues themselves which, in turn, are perceived according to markedness effects. Specifically, cues such as phonological anticipations and audible hesitations were more "salient" against the base language compared to prolongations. The latter are less salient as they are merely an extension of base language sounds. Also, prolongations are

"trusted" less as pre-switch cues as they frequently occur as draws within monolingual contexts. In conclusion, the results of the present research indicate that context-specific markedness will render some pre-switch cues more "salient" than others resulting in their better perception and use to anticipate code-switches. Results of previous research, indicating better perception of some words over others, may also be the result of "saliency" effects discussed here.

An unexpected finding of this study was that bilinguals, regardless of their classification, perceived the pre-switch cues similarly. Some factors, such as lack of differences with processing at the surface-structure level, possible inaccurate measures of dominance, and insufficient measures of language learning and code-switching exposures, possibly influenced the results. It could be, however, that indeed bilinguals, regardless of their classification, do not differ in the overall perception of pre-switch cues, mainly due to their apparent surface-structure level processing. This may also account for the finding in this study, contrary to the pilot results, that balanced bilinguals did not perceive more pre-

switch cues, regardless of the direction of the code-switch, than the dominant bilinguals.

Bilinguals did differ, however, on their bias towards either language. Specifically, bilinguals differed when classified according to language dominance, and age of second language acquisition, but not according to exposure to code-switching. The dominant bilinguals had a bias towards their less fluent language, and the balanced bilinguals, as predicted, did not show significant biases towards either language. The younger-learning bilinguals were English-dominant, resulting in a bias towards Spanish, and the opposite was true for the older-learning bilinguals. We propose that the bias found for dominant bilinguals, and early and late language learners, may result from a whole-language markedness effect where the least fluent language sounds "foreign" (marked) against the most fluent language (unmarked). Furthermore, this bias towards the marked language frequently resulted in an "overshoot" response whereby subjects predicted code-switches incorrectly. The advantage of this "overshoot" could be to insure on-line processing of code-switches were they to occur.

The main conclusion drawn from this study is that the use of pre-switch cues may facilitate the processing of mixed speech by the proposed bilingual monitor. Results indicate that the proposed bilingual monitor perceives these pre-switch cues at an acoustic, phonetic/phonological, surface-structure level. Their interpretation, however, would most likely occur at higher levels of processing. Indeed, processing of ambiguous "guest" words should be facilitated by the use of pre-switch cues as it would prevent the bilingual subject from remaining in her/his incorrect base language set. If pre-switch cues are absent, the listener then will have to access higher levels of processing (e.g., semantics) as more information is received. In conclusion, the existence of pre-switch cues, which to our knowledge have not been previously researched, would aid the rapid and apparently facile processing of code-switched sentences by bilingual listeners.

Limitations. As with any research endeavor, there were limitations to this study. The use of self-rating scales, complemented by information obtained with a language history questionnaire, may have been insufficient to measure dominance accurately. The use

of an objective measure such as a timed listing of as many words as possible in each language, as used by Altenberg and H. Cairns (1983) in their adaptation of the test by Johnson (1953), could have been used to confirm the self-rating score. Romaine (1989), however, stated that word naming "has been shown to be a weak predictor of bilingual proficiency" (p. 17). In this study, perhaps more questions on language-use contexts could have been included in the language history questionnaire. However, the measures used here seemed reliable as this author judged that only two subjects, out of a total of 54, "misrated" their dominance. Interestingly, the performance by these particular subjects in this study confirmed this author's impression. Specifically, both subjects who rated themselves as "balanced," judged by the examiner to be slightly Spanish-dominant, exhibited a bias towards English. Hence, the task used in this study would be a better measure of dominance than those available at present. This point will be elaborated on in the next chapter.

Another possible limitation of this study has to do with subject selection. Specifically, it may be that group differences do exist if only the most

language-dominant subjects were compared to the most balanced, or if the youngest-learning subjects were compared to the latest-learning subjects. These analyses could be done in the future on partial data from this dissertation, or in future research selecting only these types of subjects.

### Notes

1. A significant main condition effect was obtained with the control sentences (used to measure bias) when the different groups of bilinguals classified according to language dominance were compared, and also when bilinguals who acquired their second language before age 9 years were compared to those who acquired their second language after 9 years. Analyses with the language dominance groups, indicated that significance was due only to the difference between the control sentences used for the pristine code-switches and the control sentences used for the condition of audible hesitation.

One possible explanation (Stewart, 1989, personal communication) is that bilinguals preferred to

"overshoot," due to the nature of the task, rather than to miss any code-switches. Another possibility (Obler, 1989, personal communication) is that the speakers inadvertently produced subtle pre-switch cues as they had to produce specified cues in 46 out of 90 sentences. Future studies should confirm this spectrographically, a task which is beyond the scope of this dissertation. Perception of cues in some control sentences may also have resulted from the manner in which the sentences of this study were recorded (Boothroyd, 1990, personal communication). Specifically, speakers recorded a block of six experimental sentences immediately followed by its block of six control sentences for all of the conditions used (foil and experimental). This explanation could be tested in a follow-up using experimental sentences that were all recorded in sequence before the recording of all of the control sentences, preferably with a break in between, in order to minimize possible effects of the cues on the control sentences. This author believes that the obtained results most likely stem from a combination of one or more of the above proposed factors, rather than a single one.

2. The perception of pristine code-switches indicates that some subjects, such as sophisticated bilinguals, may have perceived subtle forms of phonological anticipations produced naturally by the speakers who, as a group, found it difficult to produce code-switches in a pristine manner. Instead, the speakers tended to insert naturally some type of hesitation phenomena at the boundary. Monolinguals, in the pilot study, performed better (53%) than the bilinguals (20%) in the perception of pristine code-switches, whereas, the reverse was true for the condition of phonological anticipations (64% of bilinguals versus 37% for monolinguals) despite the fact that some monolinguals reported noticing the accents of the phonological anticipations. The abilities of monolinguals on the task of this study is being explored further in a follow-up study.

## CHAPTER SEVEN

## IMPLICATIONS AND FUTURE RESEARCH

The results of this research basically have implications for the measurement of underlying language dominance; for the role of the pre-switch cues during the perception, by the proposed bilingual monitor, of mixed speech; and for further comparisons between the proposed monolingual and bilingual monitors. We will now discuss the implications, future studies, and, where relevant, applications found under each of these areas.

Difficulties in Measuring Degrees of Bilingualism

Many problems in the measurement of degree of bilingualism have been described. For example, Grosjean (1982) stated that definitions of bilingualism, like his own, should stress the use of both languages (when and how) as done, for example, by many researchers in the field (e.g., Weinreich, 1968;

Mackey, 1968). Several authors propose a multitude of measures in order to obtain a composite picture of a person's bilingualism. For example, Mackey (1968) proposed that a bilingual be measured in the different modalities in both languages, in her or his different linguistic levels (from the phonological to the stylistic), and in the different communication contexts. In addition, Mackey listed a number of factors as possibly influencing the bilingual's aptitude, such as age, sex, intelligence, memory, language attitude and motivation. Furthermore, Mackey would also measure the bilingual's ability with language alternation, and the amount of interference between the two languages. Grosjean (1982) explains the difficulties with such complex measures and provides examples of how language dominance will vary depending on the language-usage history of the individual. Romaine (1989) also points out that ability on one level does not imply abilities on other levels, and that "a bilingual might have good pronunciation, but weak grammatical knowledge in one of the languages, or vice versa" (p. 13).

McLaughlin (1984) states that there is a great need to design an accurate, yet simple, measure of

dominance. He discusses how the notion of "dominance" is vague and imprecise. He further states that researchers "have abandoned the concept of language dominance as scientifically worthless and have gone on to develop instruments that test knowledge of the functional uses of language in various situations" (p. 244). However, in McLaughlin's words "these tests are long and complex and the school systems need something short and simple" (p. 244). Hence, there appear to be no easy solutions to the measurement of dominance. The results of the present research may contribute towards an efficient and accurate measure of dominance as described in the next section.

#### Perception of Pre-Switch Cues as a Dominance Measure

The finding that responses to pre-switch cues are specific to some state of language dominance within the bilingual subjects, which responds to markedness effects proposed in this study, has serious implications for the field dedicated to the measurement of dominance. Instead of having to give subjects a whole battery of time-consuming measurements to obtain a composite picture of language dominance, one can

envision in the near future a short dominance test based on the perception of a small set of the pre-switch cues mixed within a set of control sentences. Such a test could be called, for example, the dominance screening test (DST). The response of bilingual subjects to both types of sentences, according to the whole-language markedness effect employed here, would indicate whether they were dominant in one language or "truly" balanced, which according to many (e.g., Grosjean, 1982), is a rare state indeed. The results of the DST would refine the notion of "balance." Indeed, as discussed, the present research revealed that two subjects who rated themselves to be "balanced," but who were judged by the experimenter to be slightly Spanish-dominant, behaved more like Spanish-dominant bilinguals (evidencing bias towards English). The reader is reminded that the results obtained in this study were based on a specific bilingual population (mostly Puerto Rican and Dominican) representative of the tri-state, New York metropolitan area. In fact, data obtained with the three Mexican bilingual subjects who participated in this study indicate that they were less sensitive to the pre-switch cues than the Puerto Rican or Dominican bilinguals. Hence, care should be taken not to extend

the results of this study to bilingual populations which may differ from the ones studied here. With this caveat in mind, the following future studies are suggested to construct and field test the dominance screening test.

Construction of the Dominance Screening Test. One of the first applications of the results of the present research would be to construct and validate the dominance screening test (DST) for different language pairs. Each version would test dominance in a pair of languages although, much further down the line, tests for polyglots could also be constructed inserting cues from three languages or more, in addition to the unilingual control sentences. Language differences are obscured at times during code-switching. The fact that differences were obtained during code-switching indicates that the effects of pre-switch cues appear to be very robust. Hence, differences should be found between languages that are code-switched frequently (as found with Spanish and English in this study). Greater differences, however, should be found with languages that are not code-switched frequently (e.g., German and English) as the differences between them are less blurred (more marked). Needless to say, the

researchers involved in the construction of these tests should be bilingual or polyglot themselves.

Several versions of the DST should be tested. If similar results are obtained it would imply that pre-switch cues are sufficiently robust to withstand methodological variance. Once reliable results are consistently obtained with a selected version of the test, the results should be compared to the composite dominance scores obtained for the subjects via traditional, accepted methods. If high correlations are obtained, then one can state that the dominance screening test is a reliable and valid measure of language dominance. All testing should be done with different age groups of bilinguals, that is, children, adolescents, and adults to better determine the influence of total language experience on ultimate proficiency. In addition, future studies should explore whether there are any differences in performance by the different genders across the different age groups.

Use of the dominance screening test with adults.

The dominance screening test (DST) proposed here has the potential of wide applications for the research on

bilingual adults. This measure could be used in any future linguistic, psycholinguistic or neurolinguistic study concerned with language organization within the bilingual adult. Results with this test could be compared to results with any of the other dominance measures in any of these studies. In fact, if this test proves to be robust, researchers may choose to use it to confirm other measures of dominance.

Use of the DST with brain-damaged bilinguals. The DST could also be used with brain-damaged bilinguals, such as with different types of aphasics. However, with less severe aphasics who have "lost" their ability to switch between languages at will, or who can do so one day but not the next, (see for example the case studies presented by Paradis, Goldblum and Abidi, 1982; Perecman, 1984) it would be interesting to determine whether the proposed bilingual monitor can be activated to perceive the pre-switch cues even though the production modality is "out." If this is supported, it would indicate that the perception of pre-switch cues by the proposed bilingual monitor is separate from the production system. In turn, this could shed light on why research frequently does not find significant

differences between the groups on perceptual tasks yet frequently does on production tasks.

An interesting comment by Crockett (1989), based on Albert and Obler's views (1978) that the right hemisphere may play a role in learning a second language in adolescents and adults, is that aphasics who do not respond to traditional methods of therapy might benefit from being taught a second language. Crockett stated that this method might provide them with a language while "simultaneously acting as a 'deblocking' method for the individual's primary language" (p. 45).

Crockett (1989) also concluded that future advances in understanding language dominance in bilinguals "promises to provide speech-language pathologists with methods to treat both aphasic and head-injured bilinguals" (p. 45). The use of a dominance test such as the DST, rather than long comprehension tests, could determine if the "lost" language is still being activated. This in turn would indicate that continued therapy in that language may be more appropriate than teaching another language. On the other hand, if the target language is not activated

by the task of the DST, then teaching another language may encourage recovery.

Use of the DST with children with or without language problems. This test could be used with children who are bilingual, who are learning another language, who are having difficulties learning the second language, and with bilingual children who are demonstrating a variety of language delays or disorders. Several types of studies, with adapted versions of the DST, could be conducted with normal children who are judged, by experts in the field, to be bilingual or in the process of becoming bilingual. Specifically, future research should determine at what age normal children become aware of the pre-switch cues. An instrument could even be constructed, as proposed by Stewart (1989, personal communication), called, for example, the Bilingual Maturity Index (BMI). This index could be standardized on groups of children at specific stages during their acquisition of two languages. The task would be that of the DST but adapted to the pediatric populations.

The use of such an instrument as the BMI has enormous clinical implications for children with

language delays or disorders, or with children who are having difficulty acquiring a second language. Results with such an index, as compared to the results obtained with normal controls, would aid concerned teachers, parents, and professionals on the decision to continue to input two languages to the child, to input just one until it is established before introducing the other one, or to eliminate the other language completely. The child who is exposed to bilingualism, despite concerns, could be periodically retested to measure her/his progress and to adapt the intervention plan as needed. Having an instrument as the BMI for children could also show that seemingly pathological mixed speech patterns are indeed within normal limits. This in turn will have clinical applications in terms of the program of therapy advised. Again, the reader is reminded that new populations, whether adult or child, would need to be tested first on tasks of this research to determine if they respond as the main populations of this study (i.e., Puerto Rican and Dominican) before any further applications are attempted.

### Future Studies of the Pre-Switch Cues.

Future research is needed at this pre-switch stage to further determine the characteristics of the pre-switch cues needed to facilitate anticipation of code-switches. Research should concentrate on determining the efficiency with which the proposed bilingual monitor processes pre-switch cues under different contexts (e.g., against background cafeteria noise). The role of pre-switch cues in comprehension needs further exploration. Specifically, does perception of pre-switch cues enhance comprehension? If pre-switch cues aid word recognition it should then improve comprehension during on-line processing. The following studies should provide additional information.

#### The role of pre-switch cues in word recognition.

The results of this study indicate that additional research should explore the portion of the utterance preceding the code-switch. Hence, studies, as conducted by Grosjean (1988), could be repeated but with the addition of pre-switch cues before the presentation of the gated stimuli. It should prove interesting to explore the effects of the pre-switch

cues on speed of recognition. More important, however, would be to determine whether the subject's tendency to go down the "base language path" is prevented by the presence of pre-switch cues. Specifically, if the pre-switch cue is specific to one language then the subject may make the correct language choice even with difficult-to-identify borrowings. However, if the cue is not language-specific then the subject may incorrectly remain within the base language context. Hence, the correct language choice may aid in the recognition process.

Additional research can also address whether the use of pre-switch cues reduces the ambiguity of "ragged" switches (i.e., those that are pronounced with a strong accent of the base language). These "ragged" switches are frequently confused with borrowings, because of their phonology. The use of pre-switch cues may reduce the perceptual confusions with these switches which, in turn, would result in their better recognition.

Method of presentation may affect perception of pre-switch cues. The present dissertation chose not to use a blocked form of presentation in order to prevent

one block from bleeding into the other, and/or fatiguing the listeners as has been found in related research in the field of short-term memory (e.g., Dempster, 1978). Instead, a semi-random presentation was chosen in order to minimize such effects. Future studies, however, should specifically test the effects of different presentations on the perception of pre-switch cues. Specifically, a study could present blocks of control sentences alternated with blocks of code-switched sentences to determine if one block of responses bleeds into the other block. For example, after listening to a block of unilingual control sentences the subject may miss a pre-switch cue, or after listening to a block of code-switched sentences the subject may falsely perceive a cue. On the other hand, the juxtaposition of blocks may increase the saliency of cues versus no cues thereby increasing accuracy.

Regardless of the presentation method, the hypothesis proposed in this study, that subjects sometimes "overshoot," apparently as an effort to prevent missing any potential code-switches, can be further explored through post-test questionnaires. Subjects would be asked whether they marked that code-

switches were to occur even if they were unsure of their answers based on the information received. If their responses are affirmative, then a survey of their reasons should be obtained to determine if patterns emerge accounting for this overshooting.

Threshold levels of pre-switch cues. Another area of research would be to determine if there are minimum threshold levels needed to activate the bilingual's "monitoring" system to process an incoming language. Specifically, future studies could start to answer the following questions: are there subtle phonological anticipations, due to co-articulatory factors, present in pristine code-switches?; is there a minimum duration needed for a cue to be interpreted as a pre-switch cue?; does phonological anticipation have to occur on more than one word or sections of the sentence preceding the switch or can more subtle ones (e.g., part of the word just preceding the switch) still be used by the processing system described here?; what types of phonological cues are most effective?; will an ambiguous prolongation cue, because it may belong either to a monolingual or bilingual context, be interpreted differently if its length is increased or shortened?; are semantic cues interpreted unambiguously

in all contexts and how do they compare with the use of pre-switch cues (e.g., will the Spanish filler "este" always be interpreted as a code-switch cue)?; are thresholds affected by the length of inter-stimuli intervals?; are thresholds lowered or heightened according to method of presentation (e.g., blocked versus semi-random)?; and are equivalent processes activated when code-switching occurs in different modalities. For example, Hamers and Blanc (1989, p. 108), citing Kyle and Woll, 1985, stated that research on processing skills of deaf individuals, who learned a natural language in addition to sign language, has shown that they "develop a form of bilinguality." It would be interesting to see if there are any "cues" used by deaf speakers who code-switch between sign languages for different languages (e.g., English versus Spanish), between American Sign Language and the more cumbersome signed English, between American and British Sign Language, or between combinations of any of these languages. Cues may also exist when a native signer, who is not deaf, switches from a deaf to a hearing person, or to another hearing native signer.

An additional potential factor not explored in this study is whether there was an incremental effect

with the cues which might result in subjects reaching a threshold sooner. That is, it is possible that a pre-switch cue also occurred with other pre-switch information that preceded the occurrence of the pre-switch cue itself. For example, it is feasible that a phonological anticipation was preceded by a slight prolongation. In the real world, subjects may use a combination of cues instead of attempting to use just one at a time as intended in this study. This would need to be confirmed with naturalistic data on the production patterns of mixed speech by different types of bilinguals.

#### Future Studies Comparing Performances of Monolinguals with Bilinguals

A series of studies can be done comparing the performance of the monolinguals and bilingual populations to answer the basic question of whether or not they are perceiving the same phenomena but interpreting them differently, or whether the monolinguals fail initially to perceive these phenomena. A follow-up study is now in progress which is comparing the performance of a monolingual group to

the results obtained with the bilinguals of this study. They were asked to respond to the stimuli of this study spontaneously, based on intuitions as asked of the bilinguals, and also after training was provided on the perception of the pre-switch cues. If monolinguals do not perceive the pre-switch cues initially but do so after training, then one would know that the difficulties do not lie in the realm of perception, rather, in the interpretation.

#### Studies in the Area of Production of Pre-Switch Cues

Another vast area of future research lies in the realm of production. Basically, much research within different contexts, naturalistic and formal, should be conducted to record the production of pre-switch cues. Many questions remain about the pre-switch cues such as: How and when are they produced? Are subtle cues produced during pristine code-switches? Are several cues produced together to increase their perception? Are similar behaviors observed when bilinguals are interacting within monolingual contexts? Do all pairs of languages use these pre-switch cues? Are pre-switch cues used in an integrated manner with body language

pre-switch cues, or does one form dominate over the other depending on the communicative contexts? Are there any sex, age, education differences in the efficiency with which these pre-switch cues are used?

In sum, these are some of the implications, applications, and future studies engendered by the present research. It is hoped that much of this research can be carried out during our lives. One thing is for certain: "No nos vamos a aburrir!" ("We will not be bored!").

APPENDIX A: Stimuli presented to subjects

Code: [C ]=control sentence  
 [P ]=pause  
 [::]=prolongation of sound  
 [ɛ ]=audible hesitation (Spanish phonology)  
 [^ ]=audible hesitation (English phonology)  
 [Λ]=throat clearing  
 /=pristine code switch  
 [phonetic]=phonological anticipation as noted

First six sentences were for practice only. Not scored.

1. My old cat scratches the couch [C].
2. El policia miró dentro del carro [C].
3. That tall runner trains a lot [P].
4. Mi prima invirtió todo su dinero [::].
5. The school principal talks a lot to students [ɛ].
6. El panadero mezcla la masa [^].
7. Mi amiga le pagó una fortuna a su dentista [::].
8. My next door neighbor went to a new hairdresser [C].
9. Antes de ayer fue que escribí una carta [C].
10. La niña no dejó de llorar [P].
11. El cura viejo fue al [αβoʋ-gádoʋ].
12. When she goes on a trip she takes medicine [C].
13. The author spent his summers on an island [^].
14. The new students attended an orientation [C].
15. The city kids were excited to see so many animals [C].
16. El guardiá revisó las cerraduras [C].
17. The other night I slept in a hotel [C].
18. Mi hermana tiene un profesor viejo [ɛ].
19. When my sister was small she climbed a large tree [::].
20. Muchos sordos hablan con las manos [C].
21. En el campo uno camina mucho tiempo [C].
22. The dance teacher practices every day [C].
23. El veterinario bondadoso examinó al monito/.
24. No es bueno tomar mucho alcohol [C].
25. My daughter's class goes to the movies [Λ].
26. That young scientist works in his lab [C].
27. The new students attended an orientation [P].
28. Su padre, quien es un piloto, le manda postales [C].
29. A mi único nieto le encanta ir al circo [C].
30. Los basureros limpian las calles de la ciudad [C].
31. The author spent his summers on an island [C].
32. La pareja sin niños se mudaron del campo/.
33. My daughter's class goes to the movies [C].
34. When she goes on a trip she takes medicine [::].
35. Los campesinos trabajaban duro todos los días [C].
36. That student studies hard every day [C].
37. On Friday my new boss skips his lunch hour [C].

38. In the evening I always drink coffee [C].
39. It's unhealthy to exercise a lot [P].
40. The history teacher gave oral exams [C].
41. Ese juez tranquilo da sentencias leves [C].
42. I like to eat a lot of fruit for breakfast [C].
43. The city kids were excited to see so many animals/.
44. Ese perrito les ladra a las palomas [C].
45. The nurse gave the transfusions [ε].
46. The other night I slept in a hotel [MM].
47. Muchos sordos hablan con las manos [Λ].
48. That student studies hard every day [P].
49. Ese juez tranquilo da sentencias leves [MM].
50. The president of the company has a nice view [Λ].
51. My next door neighbor went to a new hairdresser/.
52. El dentista joven estaba un poco nervioso [C].
53. It's unhealthy to exercise a lot [C].
54. La joven esposa trabajó en su tesis [C].
55. A el le gusta comer un almuerzo liviano [C].
56. The dedicated doctor gave the shots [ε].
57. El cura viejo fué al abogado [C].
58. Su padre, quien es un piloto, le manda postales [Λ].
59. Durante el mes de agosto salgo mucho con mi hija [C].
60. Mi hermana tiene un profesor viejo [C].
61. The group of tourists went out to eat [C].
62. When my sister was small she climbed a large tree [C].
63. The emergency nurse gave the transfusions [C].
64. On Friday my new boss skips his lunch hour [ε].
65. The president of the company has a nice view [C].
66. The other day I [ῥωέν d'ér].
67. El veterinario bondadoso examinó al monito [C].
68. La joven esposa trabajó en su tesis [MM].
69. El guardia revisó las [σελαδύλας].
70. A el le gusta comer un almuerzo liviano [::].
71. Los campesinos trabajaban duro todos los días [P].
72. The group of tourists went out to eat/.
73. The dedicated doctor gave the shots [C].
74. Durante el mes de agosto salgo mucho con mi hija/.
75. A mi único nieto le encanta ir al circo [MM].
76. The other day I went there [C].
77. La pareja sin niños se mudaron del campo [C].
78. La niña no dejó de llorar [C].
79. Ese perrito les ladra a las palomas [ε].
80. En el campo uno camina mucho tiempo [P].
81. The history teacher gave [ῥα\ εῤσαίμς].
82. The dance teacher practices every day [::].
83. In the evening I always [driη K5fί].
84. No es bueno tomar mucho alcohol [Λ].
85. Mi amiga le pagó una fortuna a su dentista [C].
86. That young scientist works in his lab [MM].
87. Antes de ayer fué que escribí una carta [::].
88. I like to eat a lot of fruit for breakfast [Λ].
89. El dentista joven estaba un poco [νελεβίούσοῦ].
90. Los basureros limpian las calles de la ciudad [ε].

APPENDIX B: English subject screening form

Phone Screening Form (Speak to subject in non-dominant language first)

Name: \_\_\_\_\_

Referred by: \_\_\_\_\_

Phone: (\_\_\_\_\_) \_\_\_\_\_

Age (17-59): \_\_\_\_\_

Education (H.S. min.): \_\_\_\_\_

Primary dialect of Spanish (Spain no): \_\_\_\_\_

How old were you when you learned Spanish \_\_\_\_\_

How old were you when you learned English \_\_\_\_\_

Knowledge of other languages \_\_\_\_\_

Comprehends (call back maybe): \_\_\_\_\_

Speaks (sorry, other study): \_\_\_\_\_

Interviewer's impression of dominance: \_\_\_\_\_

Self-rating scale (Ask subject to draw 5-point scale)

	FAIR	AVERAGE	GOOD	VERY GOOD	EXCELLENT
ENGLISH Comprehension	1	2	3	4	5
ENGLISH Speaking	1	2	3	4	5
ENGLISH AVERAGE _____					
SPANISH Comprehension	1	2	3	4	5
SPANISH Speaking	1	2	3	4	5
SPANISH AVERAGE _____					
DOMINANCE _____					
APPOINTMENT DATE _____					
LOCATION _____					
BEST TIME TO CONFIRM DATE _____					

APPENDIX C: Spanish subject screening form

Phone Screening Form (Speak to subject in non-dominant language first)

Nombre: \_\_\_\_\_

Referido(a) por: \_\_\_\_\_

Teléfono: (\_\_\_\_\_) \_\_\_\_\_

Edad (17-59): \_\_\_\_\_

Educación (H.S. min.): \_\_\_\_\_

Qué variedad de español hablas? (Spain no): \_\_\_\_\_

A qué edad aprendiste el español? \_\_\_\_\_

A qué edad aprendiste el inglés? \_\_\_\_\_

Conocimiento de otros idiomas \_\_\_\_\_

Comprende (tal vez llamar de nuevo): \_\_\_\_\_

Habla (lo siento, otro estudio): \_\_\_\_\_

Interviewer's impression of dominance: \_\_\_\_\_

Self-rating scale (dibuje una escala de 5 puntos)

	FAIR	AVERAGE	GOOD	VERY GOOD	EXCELLENT
INGLÉS La Comprensión	1	2	3	4	5
INGLÉS El Habla	1	2	3	4	5
INGLÉS AVERAGE _____	1	2	3	4	5
ESPAÑOL Comprensión	1	2	3	4	5
ESPAÑOL El Habla	1	2	3	4	5
ESPAÑOL AVERAGE _____	1	2	3	4	5
DOMINANCIA _____					
FECHA DE LA CITA _____					
LOCALIDAD _____					
MEJOR HORA DE CONFIRMAR LA FECHA _____					

APPENDIX D  
SUBJECT INFORMATION FOR BALANCED BILINGUALS

Subject	Order of Tapes	Sex	Age (years)	Education (years)
1	1-2-3	F	21	15
2	1-2-3	F	25	17
3	1-2-3	F	27	14
4	2-1-3	F	29	18
5	2-3-1	F	22	16
6	1-3-2	F	32	18
7	1-3-2	F	36	12
8	3-2-1	F	19	13
9	3-2-1	F	23	15
10	3-1-2	F	35	12
11	3-1-2	F	33	21
12	2-1-3	M	19	13
13	2-1-3	M	35	16
14	2-3-1	M	32	18
15	2-3-1	M	26	18
16	1-3-2	M	23	15
17	3-2-1	M	22	13
18	3-1-2	M	19	12
Column Means			26.6	15.3

## APPENDIX E

## SUBJECT INFORMATION FOR SPANISH-DOMINANT BILINGUALS

Subject	Order of Tapes	Sex	Age (years)	Education (years)
19	1-2-3	F	22	14
20	2-1-3	F	22	14
21	2-1-3	F	19	13
22	2-1-3	F	23	15
23	2-3-1	F	22	16
24	2-3-1	F	30	13
25	3-2-1	F	30	12
26	3-2-1	F	23	14
27	3-1-2	F	20	13
28	3-1-2	F	30	19
29	3-1-2	F	29	16
30	1-2-3	M	21	13
31	1-2-3	M	28	19
32	2-3-1	M	29	17
33	1-3-2	M	22	12
34	1-3-2	M	45	16
35	1-3-2	M	23	14
36	3-2-1	M	32	18
Column Means			26.1	14.9

## APPENDIX F

## SUBJECT INFORMATION FOR ENGLISH-DOMINANT BILINGUALS

Subject	Order of Tapes	Sex	Age (years)	Education (years)
37	1-2-3	F	24	16
38	1-2-3	F	22	15
39	2-1-3	F	19	13
40	2-1-3	F	21	14
41	2-3-1	F	23	16
42	2-3-1	F	22	15
43	1-3-2	F	39	14
44	1-3-2	F	24	16
45	3-2-1	F	19	14
46	3-2-1	F	20	14
47	3-1-2	F	30	18
48	1-2-3	M	27	15
49	2-1-3	M	19	12
50	2-3-1	M	26	17
51	1-3-2	M	19	12
52	3-2-1	M	19	13
53	3-1-2	M	33	16
54	3-1-2	M	18	13
Column Means			23.6	14.6

APPENDIX G: English InstructionsPLEASE TAKE YOUR TIME TO READ CAREFULLY.

I want to thank you again for participating in my Dissertation study. You will listen to three tapes and also fill out a short questionnaire after the end of the last tape. There will be a ten minute rest after each tape and three brief breaks during each tape. The entire task (that is the three consecutive tapes and the questionnaire) will take between 2 and 2.5 hours. You will receive \$5/hour for your participation. I want to assure you that any personal information, such as your name and address, will remain confidential. Also, let me assure you that this study has nothing to do with bilingual education.

As I explained to you beforehand, some of you may have to return for an additional session. Most of you will be done today. I want to ask you to please concentrate on your own work and do not distract others. If you have comments please write them on the margin of your response form during the breaks. Do not comment about this study to other potential subjects.

Now let me tell you a little more about this study. I am interested in how bilinguals can be sensitive to both Spanish and English. You know how sometimes we start a sentence in English y terminamos en español o empezamos una oracion en español and we finish in English. What I did was to tape three bilingual speakers speaking the same set of sentences. Sometimes the sentence was all in one language, for example, "I went to the university to study biology", or sometimes the sentence would begin in one language and end in the other, for example, "Fuí a la universidad to study biology" or "I went to the university para estudiar biología".

Next, I chopped off the last part of every sentence so that what I present to you today are the beginnings of the sentences. All you have to do in this study is to hear the beginning of the sentence, for example, "fuí a la universidad". Then you mark on the answer form whether you feel that the sentence was completed in Spanish or English; that is, whether the part that was chopped off and that followed the part you heard was "para estudiar biología" or "to study biology".

DON'T WORRY ABOUT BEING RIGHT OR WRONG! This is not a test to see how good your Spanish or English is. Your answers will vary depending on your particular language history. You are not expected to know why you feel that one language was used or the other. In fact, it is best to respond quickly based on your intuitions or feelings.

Now please look in your answer form at number 1. You will soon hear "my old cat scratches the couch". As soon as you hear this you must decide whether the ending that I chopped off was "cuando está aburrida" or "when she's bored" which are listed under number 1. So, listen to the sentence and based on what you hear, quickly decide whether the person continued in the same language or whether the person completed the sentence in the other language.

DON'T LEAVE ANY BLANK SPACES! Guess if you have to! Remember you have to mark which ending was the one that was chopped off and that you feel goes best with the beginning that you just heard.

APPENDIX H: Spanish instructionsPOR FAVOR TOME SU TIEMPO PARA LEER ESTO  
CUIDADOSAMENTE.

Quiero darle las gracias de nuevo por participar en mi disertación del Doctorado. Oirá tres cintas y también llenará un cuestionario corto después del final de la última cinta. Habrá un descanso de diez minutos después de oír cada cinta y habrán tres descansos breves durante cada cinta. Toda la tarea (o sea las tres cintas consecutivas y el cuestionario) tomará entre 2 y 2.5 horas. Recibirá \$5/hora por su participación. Quiero asegurarle que cualquiera información personal, como su nombre y dirección, se mantendrá confidencial. También quiero asegurarle que este estudio no tiene nada que ver con la educación bilingüe.

Como le expliqué antes, es posible que algunas personas tengan que volver para una sesión adicional. La mayoría de Uds. acabarán hoy. Quiero pedirle que por favor se concentre en su propio trabajo y que no distraiga a los demás. Si tiene comentarios, por favor escríbalos en el margen de su formulario de respuestas durante los descansos. No comente sobre este estudio con otras personas que sean posibles candidatas.

Ahora déjeme decirle un poco más sobre este estudio. Estoy interesada en la sensibilidad de personas bilingües hacia ambos idiomas, el inglés y el español. Ud. sabe como algunas veces empezamos una oración en español and we finish in English or we start a sentence in English y terminamos en español. Lo que yo hice fué grabar a tres personas bilingües diciendo el mismo grupo de oraciones. Algunas veces la oración era toda en un idioma, por ejemplo, "Fuí a la universidad para estudiar biología", o a veces la oración empezaba en un idioma y terminaba en el otro, por ejemplo, "I went to the university para estudiar biología" o "Fuí a la universidad to study biology".

Después lo que hice fué remover la última parte de cada oración, así que lo que le presento hoy son los principios de las oraciones. Todo lo que tiene que hacer en este estudio es oír el principio de la oración, por ejemplo, "I went to the university". Entonces marque en el formulario de respuestas si Ud. siente que la oración fué completada en español o en inglés; o sea, si la parte que fué cortada y que seguía a la parte que escuchó era "para estudiar biología" o "to study biology".

NO SE PREOCUPE DE ESTAR CORRECTO(A) O INCORRECTO(A)! Esto no es un examen para ver lo bueno que es su español o inglés. Sus respuestas variarán dependiendo de la historia particular de sus idiomas. No espero que sepa porqué siente que un idioma fué usado y no el otro. En realidad, lo mejor es responder rápidamente, basándose en sus intuiciones o sentimientos.

Ahora, por favor, mire en su formulario de respuestas al número 1. Pronto oirá "my old cat scratches the couch". Tan pronto oiga esto, tiene que decidir si el final que corté fué "cuando está aburrida" o "when she's bored", las cuales están presentadas debajo del número 1. Así que escuche la oración, y basándose en lo que oiga, rápidamente decida si la persona continuó en el mismo idioma o si la persona completó la oración en el otro idioma.

NO DEJE NINGUNA PREGUNTA EN BLANCO! Adivine si es necesario! Recuerde que tiene que marcar cuál parte final fué cortada y cuál parte siente Ud. va mejor con el principio que Ud. acaba de oír.

APPENDIX I: Answer form used by subjects

THIS IS A LANGUAGE STUDY TO FIND OUT HOW BILINGUALS PROCESS LANGUAGE. IT HAS NOTHING TO DO WITH BILINGUAL EDUCATION. YOUR NAME WILL REMAIN CONFIDENTIAL. YOU WILL RECEIVE \$5/HOUR FOR YOUR PARTICIPATION. THANKS!

Name: \_\_\_\_\_ Date: \_\_\_\_\_

1. cuando está aburrida \_\_\_\_\_  
when she's bored \_\_\_\_\_
2. to win the marathon \_\_\_\_\_  
para ganar el maratón \_\_\_\_\_
3. sobre muchas cosas \_\_\_\_\_  
about many things \_\_\_\_\_
4. to buy that beauty shop \_\_\_\_\_  
para comprarse ese salon \_\_\_\_\_
5. para encontrar a un fugado \_\_\_\_\_  
to find a runaway \_\_\_\_\_
6. before baking it \_\_\_\_\_  
antes de hornearlo \_\_\_\_\_
7. para arreglarse los dientes \_\_\_\_\_  
to get her teeth fixed \_\_\_\_\_
8. to dye her hair \_\_\_\_\_  
para teñirse el cabello \_\_\_\_\_

9. en la oficina \_\_\_\_\_  
at the office \_\_\_\_\_
10. during the trip \_\_\_\_\_  
durante el viaje \_\_\_\_\_
11. para hacer su testamento \_\_\_\_\_  
to make his will \_\_\_\_\_
12. to prevent nausea \_\_\_\_\_  
para no marearse \_\_\_\_\_
13. para escribir sus libros \_\_\_\_\_  
to write his books \_\_\_\_\_
14. in the afternoon \_\_\_\_\_  
por la tarde \_\_\_\_\_
15. en la finca \_\_\_\_\_  
on the farm \_\_\_\_\_
16. while the prisoners slept \_\_\_\_\_  
mientras los prisioneros dormían \_\_\_\_\_
17. para estar cerca del aeropuerto \_\_\_\_\_  
to be near the airport \_\_\_\_\_
18. with a great sense of humor \_\_\_\_\_  
con un gran sentido del humor \_\_\_\_\_

19. durante una tormenta \_\_\_\_\_  
during a storm \_\_\_\_\_
20. to communicate their thoughts \_\_\_\_\_  
para comunicar sus ideas \_\_\_\_\_
21. para llegar al colegio \_\_\_\_\_  
to get to school \_\_\_\_\_
22. to stay in shape \_\_\_\_\_  
para mantenerse en forma \_\_\_\_\_
23. mientras su ayudante miraba \_\_\_\_\_  
while his assistant watched \_\_\_\_\_
24. before going to bed \_\_\_\_\_  
antes de ir a la cama \_\_\_\_\_
25. al final del año \_\_\_\_\_  
at the end of the year \_\_\_\_\_
26. until very late \_\_\_\_\_  
hasta muy tarde \_\_\_\_\_
27. por la tarde \_\_\_\_\_  
in the afternoon \_\_\_\_\_
28. from exotic places \_\_\_\_\_  
desde lugares exóticos \_\_\_\_\_
29. para ver a los payasos \_\_\_\_\_  
to see the clowns \_\_\_\_\_

30. during the night \_\_\_\_\_  
durante la noche \_\_\_\_\_
31. para escribir sus libros \_\_\_\_\_  
to write his books \_\_\_\_\_
32. to live in the city \_\_\_\_\_  
para vivir en la ciudad \_\_\_\_\_
33. al final del año \_\_\_\_\_  
at the end of the year \_\_\_\_\_
34. to prevent nausea \_\_\_\_\_  
para no marearse \_\_\_\_\_
35. en los sembrados de maiz \_\_\_\_\_  
in the corn fields \_\_\_\_\_
36. to get an A in English \_\_\_\_\_  
para obtener una A en inglés \_\_\_\_\_
37. para ir al banco \_\_\_\_\_  
to go to the bank \_\_\_\_\_
38. when I'm sleepy \_\_\_\_\_  
cuando tengo sueño \_\_\_\_\_
39. después de una comida pesada \_\_\_\_\_  
after a heavy meal \_\_\_\_\_

40. to his students \_\_\_\_\_  
a sus estudiantes \_\_\_\_\_
41. a ladrones jóvenes \_\_\_\_\_  
to young shoplifters \_\_\_\_\_
42. when I get up \_\_\_\_\_  
cuando me levanto \_\_\_\_\_
43. en la finca \_\_\_\_\_  
on the farm \_\_\_\_\_
44. to make them fly \_\_\_\_\_  
para hacerlas volar \_\_\_\_\_
45. mientras los doctores operaban \_\_\_\_\_  
while the doctors operated \_\_\_\_\_
46. to be near the airport \_\_\_\_\_  
para estar cerca del aereopuerto \_\_\_\_\_
47. para comunicar sus ideas \_\_\_\_\_  
to communicate their thoughts \_\_\_\_\_
48. to get an A in English \_\_\_\_\_  
para obtener una A en inglés \_\_\_\_\_
49. a ladrones jóvenes \_\_\_\_\_  
to young shoplifters \_\_\_\_\_

50. from his office \_\_\_\_\_  
desde su oficina \_\_\_\_\_
51. para teñirse el cabello \_\_\_\_\_  
to dye her hair \_\_\_\_\_
52. with his first patient \_\_\_\_\_  
con su primer paciente \_\_\_\_\_
53. después de una comida pesada \_\_\_\_\_  
after a heavy meal \_\_\_\_\_
54. while the others slept \_\_\_\_\_  
mientras su familia dormía \_\_\_\_\_
55. si tiene que regresar al trabajo \_\_\_\_\_  
if he has to go back to work \_\_\_\_\_
56. to all the children \_\_\_\_\_  
a todos los niños \_\_\_\_\_
57. para hacer su testamento \_\_\_\_\_  
to make his will \_\_\_\_\_
58. from exotic places \_\_\_\_\_  
desde lugares exóticos \_\_\_\_\_
59. a la playa \_\_\_\_\_  
to the beach \_\_\_\_\_
60. with a great sense of humor \_\_\_\_\_  
con un gran sentido del humor \_\_\_\_\_

61. después de visitar al museo \_\_\_\_\_  
after visiting the museum \_\_\_\_\_
62. during a storm \_\_\_\_\_  
durante una tormenta \_\_\_\_\_
63. mientras los doctores operaban \_\_\_\_\_  
while the doctors operated \_\_\_\_\_
64. to go to the bank \_\_\_\_\_  
para ir al banco \_\_\_\_\_
65. desde su oficina \_\_\_\_\_  
from his office \_\_\_\_\_
66. to get a newspaper \_\_\_\_\_  
para conseguir un periódico \_\_\_\_\_
67. mientras su ayudante miraba \_\_\_\_\_  
while his assistant watched \_\_\_\_\_
68. while the others slept \_\_\_\_\_  
mientras su familia dormía \_\_\_\_\_
69. mientras los prisioneros dormían \_\_\_\_\_  
while the prisoners slept \_\_\_\_\_
70. if he has to go back to work \_\_\_\_\_  
si tiene que regresar al trabajo \_\_\_\_\_

71. en los sembrados de maiz \_\_\_\_\_  
in the corn fields \_\_\_\_\_
72. after visiting the museum \_\_\_\_\_  
después de visitar al museo \_\_\_\_\_
73. a todos los niños \_\_\_\_\_  
to all the children \_\_\_\_\_
74. to the beach \_\_\_\_\_  
a la playa \_\_\_\_\_
75. para ver a los payasos \_\_\_\_\_  
to see the clowns \_\_\_\_\_
76. to get a newspaper \_\_\_\_\_  
para conseguir un periódico \_\_\_\_\_
77. para vivir en la ciudad \_\_\_\_\_  
to live in the city \_\_\_\_\_
78. during the trip \_\_\_\_\_  
durante el viaje \_\_\_\_\_
79. para hacerlas volar \_\_\_\_\_  
to make them fly \_\_\_\_\_
80. to get to school \_\_\_\_\_  
para llegar al colegio \_\_\_\_\_

81. a sus estudiantes \_\_\_\_\_  
to his students \_\_\_\_\_
82. to stay in shape \_\_\_\_\_  
para mantenerse en forma \_\_\_\_\_
83. cuando tengo sueño \_\_\_\_\_  
when I'm sleepy \_\_\_\_\_
84. before going to bed \_\_\_\_\_  
antes de ir a la cama \_\_\_\_\_
85. para arreglarse los dientes \_\_\_\_\_  
to get her teeth fixed \_\_\_\_\_
86. until very late \_\_\_\_\_  
hasta muy tarde \_\_\_\_\_
87. en la oficina \_\_\_\_\_  
at the office \_\_\_\_\_
88. when I get up \_\_\_\_\_  
cuando me levanto \_\_\_\_\_
89. con su primer paciente \_\_\_\_\_  
with his first patient \_\_\_\_\_
90. during the night \_\_\_\_\_  
durante la noche \_\_\_\_\_

APPENDIX J: English subject questionnaire

THIS IS A LANGUAGE STUDY TO FIND OUT HOW BILINGUALS PROCESS LANGUAGE. IT HAS NOTHING TO DO WITH BILINGUAL EDUCATION. YOUR NAME, ADDRESS, AND PHONE NUMBER WILL REMAIN CONFIDENTIAL. THANKS!

NAME: \_\_\_\_\_ TODAY'S DATE: \_\_\_/\_\_\_/\_\_\_

Please complete the following questions about yourself as best you can:

Date of Birth: \_\_\_\_\_

City and Country of Birth: \_\_\_\_\_ Sex: \_\_\_\_\_

Address : \_\_\_\_\_

Phones (optional, but appreciated): \_\_\_\_\_

1) If you were not born in mainland U.S.A., at what age did you arrive here? \_\_\_\_\_

2) Do you live alone? yes \_\_\_\_\_ no \_\_\_\_\_

3) If you live with others please indicate what THEY speak at home: Spanish and English, English, or Spanish.

\_\_\_\_\_ Spanish & English \_\_\_\_\_ Spanish \_\_\_\_\_ English

Adults

Adolescents

Children

4) Please mark whether YOU speak Spanish, English, or both languages separately (mark all that apply):

	<u>Spanish</u>	<u>English</u>	<u>Both</u>
a) At home	_____	_____	_____
b) At work	_____	_____	_____
c) At school	_____	_____	_____
d) Social life	_____	_____	_____
e) Other places (specify)	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

5) Mark whether Spanish, English, or both languages were used in the following situations:

	<u>Spanish</u>	<u>English</u>	<u>Both</u>	<u>Other</u> <u>(specify)</u>
a) Which did you use as a child with your primary caretakers (e.g., parents)?	_____	_____	_____	_____
b) Which did you use as a child with your neighborhood friends?	_____	_____	_____	_____
c) Which did you use on the playground while in elementary school?	_____	_____	_____	_____

- |  | <u>Spanish</u> | <u>English</u> | <u>Both</u> | <u>Other</u><br><u>(specify)</u> |
|--|----------------|----------------|-------------|----------------------------------|
| d) Which was/were used for instruction in elementary school?   | _____          | _____          | _____       | _____                            |
| e) Which was/were used for instruction in high-school?   | _____          | _____          | _____       | _____                            |
| f) Which did you speak with your high-school friends outside of the classroom?   | _____          | _____          | _____       | _____                            |
| g) If you have attended or are attending college, which language is used for instruction?  | _____          | _____          | _____       | _____                            |
| 6) What is your occupation at this time? (Full-time and Part-time).  |                |                |             |                                  |
| <hr/>  |                |                |             |                                  |
| 7) How often are you in situations where bilinguals often switch or mix languages when speaking to you or to others participating in the conversation? |                |                |             |                                  |
| a) Almost daily  | _____          |                |             |                                  |
| b) Mostly on weekends  | _____          |                |             |                                  |
| c) A few times a month   | _____          |                |             |                                  |
| d) A few times a year  | _____          |                |             |                                  |
| e) Never   | _____          |                |             |                                  |

8) Lately, in what environment and with whom do YOU switch from one language to the other? For example, starting a sentence in English and finishing it in Spanish or starting a sentence in Spanish and finishing it in English (mark all that apply).

- a) At home \_\_\_\_\_ With whom? \_\_\_\_\_
- b) At work \_\_\_\_\_ With whom? \_\_\_\_\_
- c) At school \_\_\_\_\_ With whom? \_\_\_\_\_
- d) Social life \_\_\_\_\_ With whom? \_\_\_\_\_
- e) Other places  
(specify) \_\_\_\_\_ With whom? \_\_\_\_\_
- \_\_\_\_\_ With whom? \_\_\_\_\_
- \_\_\_\_\_ With whom? \_\_\_\_\_

- 9) What type of accent(s) do you think you have?  
(mark all that apply):
- a) A noticeable Spanish accent when speaking English \_\_\_\_\_
  - b) A noticeable English accent when speaking Spanish \_\_\_\_\_
  - c) A slight Spanish accent when speaking English \_\_\_\_\_
  - d) A slight English accent when speaking Spanish \_\_\_\_\_
  - e) No foreign accent, or almost no accent, in either language \_\_\_\_\_
- 10) Please add any information that you consider relevant about your learning and use of English and Spanish.
- \_\_\_\_\_
- \_\_\_\_\_

IF YOU ARE INTERESTED IN THE RESULTS OF THIS RESEARCH, PLEASE INDICATE THIS BELOW AND BE SURE THAT YOU HAVE WRITTEN DOWN YOUR ADDRESS ON THE FIRST PAGE OF THIS QUESTIONNAIRE. THANK YOU VERY MUCH FOR YOUR TIME.

I am interested in knowing the results of this study \_\_\_\_\_

I am interested in participating in other studies \_\_\_\_\_

APPENDIX K: Spanish subject questionnaire

ESTE ES UN ESTUDIO DEL LENGUAJE PARA SABER COMO LA GENTE BILINGÜE PROCESA EL LENGUAJE. NO TIENE NADA QUE VER CON EDUCACION BILINGÜE. SU NOMBRE, DIRECCION, Y TELÉFONO SE MANTENDRÁN CONFIDENCIAL. GRACIAS!

NOMBRE: \_\_\_\_\_ FECHA: \_\_\_\_/\_\_\_\_/\_\_\_\_

Por favor complete las siguientes preguntas sobre Ud. lo mejor que pueda:

Fecha de nacimiento: \_\_\_\_\_

Ciudad y País donde nació: \_\_\_\_\_ Sexo: \_\_\_\_\_

Dirección : \_\_\_\_\_

Teléfonos (opcional, pero apreciado): \_\_\_\_\_

1) Si no nació en el continente de los Estados Unidos, a qué edad llegó aquí? \_\_\_\_\_

2) Vive solo(a)?      sí \_\_\_\_\_ no \_\_\_\_\_

3) Si Ud. vive con otras personas por favor indique qué idioma(s) hablan ELLOS en la casa: español e inglés, inglés, o español.

\_\_\_\_\_ Español e Inglés      Español      Inglés \_\_\_\_\_

Adultos

Adolescentes

Niños

- 4) Por favor marque si UD. habla español, inglés, o ambos idiomas separadamente (marque todos los que apliquen):

	<u>Español</u>	<u>Inglés</u>	<u>Ambos</u>
a) En la casa	_____	_____	_____
b) En el trabajo	_____	_____	_____
c) En el colegio	_____	_____	_____
d) En su vida social	_____	_____	_____
e) Otros lugares (especifique)	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

- 5) Marque si uso español, inglés, o ambos idiomas en las siguientes situaciones:

	<u>Español</u>	<u>Inglés</u>	<u>Ambos</u>	<u>Otro</u> <u>(cual)</u>
a) Qué idioma usó cuando niño con los que lo cuidaban (e.g., con sus padres)?	_____	_____	_____	_____
b) Qué idioma usó cuando niño con sus amistades del vecindario (barrio)?	_____	_____	_____	_____
c) Qué idioma usó en el patio de recreo de su escuela elemental?	_____	_____	_____	_____

- |  | <u>Español</u> | <u>Inglés</u> | <u>Ambos</u> | <u>Otro</u><br><u>(cual)</u> |
|--|----------------|---------------|--------------|------------------------------|
| d) Qué idioma de enseñanza usaron en su escuela elemental?   | _____          | _____         | _____        | _____                        |
| e) Qué idioma de enseñanza usaron en sus años de bachillerato (escuela superior)?  | _____          | _____         | _____        | _____                        |
| f) Qué idioma usó con sus amistades de bachillerato (escuela superior) fuera del salón de clase?   | _____          | _____         | _____        | _____                        |
| g) Si está estudiando o ha estudiado a nivel universitario, qué idioma de instrucción fué usado?   | _____          | _____         | _____        | _____                        |
| 6) En qué trabaja actualmente? ("Full-time" o "Part-time").  |                |               |              |                              |
| <hr/>  |                |               |              |                              |
| 7) Con qué frecuencia esta Ud. en situaciones donde gente bilingüe a menudo cambian o mezclan los idiomas cuando le hablan a Ud. o cuando les hablan a otras personas que están presentes? |                |               |              |                              |
| a) Casi diariamente  | _____          |               |              |                              |
| b) Mayormente los fines de semana  | _____          |               |              |                              |
| c) Varias veces al mes   | _____          |               |              |                              |
| d) Varias veces al año   | _____          |               |              |                              |
| e) Nunca   | _____          |               |              |                              |

8) Últimamente, en qué situaciones y con quién cambia UD. de un idioma a otro? Por ejemplo, empezando una oración en inglés y terminándola en español o empezando una oración en español y terminándola en inglés (marque todos los que apliquen).

- a) En la casa \_\_\_\_\_ Con quién? \_\_\_\_\_
- b) En el trabajo \_\_\_\_\_ Con quién? \_\_\_\_\_
- c) En el colegio \_\_\_\_\_ Con quién? \_\_\_\_\_
- d) En su vida social \_\_\_\_\_ Con quién? \_\_\_\_\_
- e) Otros lugares  
(especifique) \_\_\_\_\_ Con quién? \_\_\_\_\_
- \_\_\_\_\_ Con quién? \_\_\_\_\_
- \_\_\_\_\_ Con quién? \_\_\_\_\_

9) Qué clase de acento(s) cree que tiene Usted? (marque todos los que apliquen):

- a) Un acento hispano pesado cuando habla el inglés \_\_\_\_\_
- b) Un acento americano pesado cuando habla el español \_\_\_\_\_
- c) Un acento hispano liviano cuando habla el inglés \_\_\_\_\_
- d) Un acento americano liviano cuando habla el español \_\_\_\_\_
- e) Ningún acento extranjero, o casi ningún acento, en cualquiera de los dos idiomas \_\_\_\_\_

- 10) Por favor añada cualquiera información que considere importante sobre cómo aprendió y cómo usa el inglés y el español.

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SI ESTA INTERESADO(A) EN LOS RESULTADOS DE ESTE ESTUDIO,  
POR FAVOR MARQUE ABAJO Y ASEGÚRESE DE QUE ESCRIBIÓ SU  
DIRECCIÓN EN LA PRIMERA PÁGINA DE ESTE CUESTIONARIO.  
MUCHAS GRACIAS POR SU TIEMPO.

Estoy interesado(a) en los resultados de este estudio \_\_\_\_\_

Estoy interesado(a) en participar en otros estudios \_\_\_\_\_

APPENDIX L: RAW DATA USED FOR THE CALCULATION OF THE ACCURACY SCORES FOR THE BALANCED BILINGUALS. Accuracy score within each condition with sentences beginning in either English or Spanish was calculated as: (control sentences + code-switched sentences)/18. Example: Accuracy score for the Pristine condition with sentences beginning in Spanish is: (9 + 1)/18.

## CONDITIONS

Subj.	PRIST.		PROLONG.		AUD. HESIT.		PHON. ANTIC.									
	Span.	Eng.	Span.	Eng.	Span.	Eng.	Span.	Eng.								
	C S	C S	C S	C S	C S	C S	C S	C S								
1	9	1	7	2	9	4	8	0	7	0	4	5	7	4	9	4
2	9	6	7	3	7	9	9	9	8	9	9	9	8	9	7	9
3	5	4	5	4	6	4	4	3	3	4	6	7	8	3	3	4
4	9	4	6	2	9	5	7	4	9	2	8	7	8	8	9	7
5	9	1	8	3	8	2	9	5	8	4	8	8	6	2	9	5
6	8	4	9	3	8	7	8	6	9	6	6	8	9	7	6	9
7	9	0	8	1	9	0	8	3	9	1	8	4	9	2	7	2
8	9	5	7	5	7	7	7	4	6	7	8	7	9	9	9	4
9	9	4	9	2	6	8	9	1	8	9	9	7	8	9	9	4
10	9	1	9	2	8	4	9	5	8	6	8	9	9	8	8	6
11	9	0	8	1	8	1	9	0	7	1	8	0	8	4	9	4
12	9	4	9	3	8	5	8	2	9	8	9	9	9	5	9	4
13	8	1	8	1	8	5	9	3	9	8	8	8	8	4	9	8
14	9	2	9	0	9	9	8	5	9	9	9	6	9	4	8	2
15	9	5	8	3	8	8	8	3	6	8	6	8	9	7	7	5
16	9	0	8	2	8	4	8	2	7	5	7	8	9	7	6	8
17	8	1	9	1	8	6	9	5	9	7	9	7	9	8	9	2
18	8	3	5	1	7	3	7	3	6	5	5	5	9	5	5	7

Key

- PRIST. - No cues placed before the code-switch.  
 PROLONG. - Sound before the code-switch was extended.  
 AUD. HESIT. - Spanish or English vowel filler placed before the code-switch.  
 PHON. ANTIC. - Word(s) immediately preceding the code-switch were accented with the phonology of the incoming language.  
 Span. - Sentence began in Spanish.  
 Eng. - Sentence began in English.  
 C - Control sentence (same language).  
 S - Switched sentence (moved into other language).  
 Subj. - Number assigned to each subject.

APPENDIX M: RAW DATA USED FOR THE CALCULATION OF THE ACCURACY SCORES FOR THE SPANISH-DOMINANT BILINGUALS. Accuracy score within each condition with sentences beginning in either English or Spanish was calculated as: (control sentences + code-switched sentences)/18. Example: Accuracy score for the Pristine condition with sentences beginning in Spanish is: (8 + 0)/18.

## CONDITIONS

Subj.	PRIST.		PROLONG.		AUD. HESIT.		PHON. ANTIC.									
	Span.	Eng.	Span.	Eng.	Span.	Eng.	Span.	Eng.								
	C S	C S	C S	C S	C S	C S	C S	C S								
19	8	0	9	1	8	5	9	0	8	5	9	7	9	5	9	8
20	9	3	7	3	8	6	9	7	7	9	7	9	8	8	7	9
21	6	5	8	0	3	7	9	5	5	9	9	9	7	8	7	4
22	9	5	9	2	8	1	8	0	9	4	9	6	9	6	9	0
23	9	1	8	0	9	6	9	5	9	9	9	8	8	5	9	7
24	8	0	9	0	7	1	8	3	7	5	9	5	8	5	8	3
25	9	6	9	4	6	7	7	5	7	7	7	6	4	8	7	8
26	6	5	6	4	6	6	3	4	6	5	7	7	5	6	4	4
27	9	7	5	6	4	5	8	7	5	4	9	8	5	7	9	5
28	7	6	9	4	7	2	8	1	6	4	9	5	8	3	8	6
29	8	5	8	1	6	4	8	0	6	7	8	2	8	3	8	1
30	9	1	9	0	8	4	9	2	9	7	9	7	9	3	9	0
31	9	0	9	0	8	1	9	0	9	1	9	0	7	4	9	1
32	7	2	6	3	3	8	9	1	3	6	8	4	4	8	9	3
33	8	2	7	4	8	9	9	8	9	5	9	8	9	0	9	1
34	9	1	9	0	8	4	9	5	9	5	9	6	8	1	8	0
35	8	0	9	1	7	8	9	7	9	9	9	9	6	8	7	7
36	8	4	5	1	5	9	9	8	8	8	8	9	5	8	6	5

Key

- PRIST. - No cues placed before the code-switch.  
 PROLONG. - Sound before the code-switch was extended.  
 AUD. HESIT. - Spanish or English vowel filler placed before the code-switch.  
 PHON. ANTIC. - Word(s) immediately preceding the code-switch were accented with the phonology of the incoming language.  
 Span. - Sentence began in Spanish.  
 Eng. - Sentence began in English.  
 C - Control sentence (same language).  
 S - Switched sentence (moved into other language).  
 Subj. - Number assigned to each subject.

APPENDIX N: RAW DATA USED FOR THE CALCULATION OF THE ACCURACY SCORES FOR THE ENGLISH-DOMINANT BILINGUALS. Accuracy score within each condition with sentences beginning in either English or Spanish was calculated as: (control sentences + code-switched sentences)/18. Example: Accuracy score for the Pristine condition with sentences beginning in Spanish is: (9 + 0)/18.

## CONDITIONS

Subj.	PRIST.		PROLONG.				AUD. HESIT.				PHON. ANTIC.					
	Span.		Eng.		Span.		Eng.		Span.		Eng.		Span.			
	C	S	C	S	C	S	C	S	C	S	C	S	C	S		
37	9	0	8	0	9	4	9	5	9	9	9	9	9	0	8	5
38	9	0	9	1	9	1	9	1	9	4	9	7	9	8	9	4
39	8	0	7	3	9	8	9	8	8	9	7	9	8	8	6	9
40	9	2	7	4	9	4	8	8	8	8	8	9	9	8	7	7
41	9	0	8	2	8	8	9	5	9	8	9	6	9	7	7	7
42	9	2	9	4	8	8	4	6	9	7	6	4	9	4	5	3
43	9	0	9	1	9	3	9	2	9	4	8	5	9	4	8	3
44	9	0	6	5	8	2	8	5	8	2	7	3	9	7	6	7
45	7	3	8	3	8	3	7	3	7	4	8	7	6	6	6	6
46	6	7	3	5	5	5	6	4	6	5	5	7	7	4	9	1
47	9	2	9	5	9	4	8	1	8	5	8	8	8	5	5	2
48	9	1	9	1	9	0	9	5	9	3	9	9	7	6	7	7
49	8	3	9	4	8	9	9	8	9	9	7	7	9	4	6	7
50	6	5	3	6	8	2	3	7	5	4	1	6	6	5	1	7
51	8	2	7	1	7	1	7	5	6	1	4	6	8	4	7	5
52	9	0	8	2	9	1	8	1	9	2	8	6	9	9	9	8
53	9	2	6	4	9	2	8	2	6	2	7	2	9	4	9	8
54	8	5	6	7	8	4	7	7	8	5	3	6	7	7	6	4

Key

- PRIST. - No cues placed before the code-switch.  
 PROLONG. - Sound before the code-switch was extended.  
 AUD. HESIT. - Spanish or English vowel filler placed before the code-switch.  
 PHON. ANTIC. - Word(s) immediately preceding the code-switch were accented with the phonology of the incoming language.  
 Span. - Sentence began in Spanish.  
 Eng. - Sentence began in English.  
 C - Control sentence (same language).  
 S - Switched sentence (moved into other language).  
 Subj. - Number assigned to each subject.

APPENDIX O: DATA TO CALCULATE THE DEGREE OF BIAS FOR BALANCED BILINGUALS. Accuracy proportion scores for control sentences used for each condition to calculate the degree of bias scores for the balanced bilinguals are summarized in the table below.

Subj.	CONDITIONS							
	PRISTINE		PROLONG.		AUD. HESIT.		PHON.ANT.	
	CS	CE	CS	CE	CS	CE	CS	CE
1	1000	778	1000	889	778	444	778	1000
2	1000	778	778	1000	889	1000	889	778
3	556	556	667	444	333	667	889	333
4	1000	667	1000	778	1000	889	889	1000
5	1000	889	889	1000	889	889	667	1000
6	889	1000	889	889	1000	667	1000	667
7	1000	889	1000	889	1000	889	1000	778
8	1000	778	778	778	667	889	1000	1000
9	1000	1000	667	1000	889	1000	889	1000
10	1000	1000	889	1000	889	889	1000	889
11	1000	889	889	1000	778	889	889	1000
12	1000	1000	889	889	1000	1000	1000	1000
13	889	889	889	1000	1000	889	889	1000
14	1000	1000	1000	889	1000	1000	1000	889
15	1000	889	889	889	667	667	1000	778
16	1000	889	889	889	778	778	1000	667
17	889	1000	889	1000	1000	1000	1000	1000
18	889	556	778	778	667	556	1000	556

Each data point is the percent correct score for Spanish and English control sentences used for each condition. The maximum number of correct responses per data point is 9/9. The statistical program read a score of 1000 as 1.000. To convert to percentage scores divide data by 10 (e.g., 1000=100%).

Key

- PRISTINE - No cues placed before the code-switch.  
 PROLONG. - Sound before the code-switch was extended.  
 AUD. HESIT. - Spanish or English vowel filler placed before the code-switch.  
 PHON. ANT. - Word(s) immediately preceding the code-switch were accented with the phonology of the incoming language.  
 CS - Spanish control sentences.  
 CE - English control sentences.  
 Subj. - Number assigned to each subject.

APPENDIX P: DATA TO CALCULATE THE DEGREE OF BIAS FOR SPANISH-DOMINANT BILINGUALS. Accuracy proportion scores for control sentences used for each condition to calculate the degree of bias scores for the Spanish-dominant bilinguals are summarized in the table below.

Subj.	CONDITIONS							
	PRISTINE		PROLONG.		AUD. HESIT.		PHON.ANT.	
	CS	CE	CS	CE	CS	CE	CS	CE
19	889	1000	889	1000	889	1000	1000	1000
20	1000	778	889	1000	778	778	889	778
21	667	889	333	1000	556	1000	778	778
22	1000	1000	889	889	1000	1000	1000	1000
23	1000	889	1000	1000	1000	1000	889	1000
24	889	1000	778	889	778	1000	889	889
25	1000	1000	667	778	778	778	444	778
26	667	667	667	333	667	778	556	444
27	1000	556	444	889	556	1000	556	1000
28	778	1000	778	889	667	1000	339	889
29	889	889	667	889	667	889	889	889
30	1000	1000	889	1000	1000	1000	1000	1000
31	1000	1000	889	1000	1000	1000	778	1000
32	778	667	333	1000	333	889	444	1000
33	889	778	889	1000	1000	1000	1000	1000
34	1000	1000	889	1000	1000	1000	889	889
35	889	1000	778	1000	1000	1000	667	778
36	889	556	556	1000	889	889	556	667

Each data point is the percent correct score for Spanish and English control sentences used for each condition. The maximum number of correct responses per data point is 9/9. The statistical program read a score of 1000 as 1.000. To convert to percentage scores divide data by 10 (e.g., 1000=100%).

Key

- PRISTINE - No cues placed before the code-switch.  
 PROLONG. - Sound before the code-switch was extended.  
 AUD. HESIT. - Spanish or English vowel filler placed before the code-switch.  
 PHON. ANT. - Word(s) immediately preceding the code-switch were accented with the phonology of the incoming language.  
 CS - Spanish control sentences.  
 CE - English control sentences.  
 Subj. - Number assigned to each subject.

APPENDIX Q: DATA TO CALCULATE THE DEGREE OF BIAS FOR ENGLISH-DOMINANT BILINGUALS. Accuracy proportion scores for control sentences used for each condition to calculate the degree of bias scores for the English-dominant bilinguals are summarized in the table below.

Subj.	CONDITIONS							
	PRISTINE		PROLONG.		AUD. HESIT.		PHON. ANT.	
	CS	CE	CS	CE	CS	CE	CS	CE
37	1000	889	1000	1000	1000	1000	1000	889
38	1000	1000	1000	1000	1000	1000	1000	1000
39	889	778	1000	1000	889	778	889	667
40	1000	778	1000	889	889	889	1000	778
41	1000	889	889	1000	1000	1000	1000	778
42	1000	1000	889	444	1000	667	1000	556
43	1000	1000	1000	1000	1000	889	1000	889
44	1000	667	889	889	889	778	1000	667
45	778	889	889	778	778	889	667	667
46	667	333	556	667	667	556	778	1000
47	1000	1000	1000	889	889	889	889	556
48	1000	1000	1000	1000	1000	1000	778	778
49	889	1000	889	1000	1000	778	1000	667
50	667	333	889	333	556	111	667	111
51	889	778	778	778	667	444	889	778
52	1000	889	1000	889	1000	889	1000	1000
53	1000	667	1000	889	667	778	1000	1000
54	889	667	889	778	889	333	778	667

Each data point is the percent correct score for Spanish and English control sentences used for each condition. The maximum number of correct responses per data point is 9/9. The statistical program read a score of 1000 as 1.000. To convert to percentage scores divide data by 10 (e.g., 1000=100%).

Key

- PRISTINE - No cues placed before the code-switch.  
 PROLONG. - Sound before the code-switch was extended.  
 AUD. HESIT. - Spanish or English vowel filler placed before the code-switch.  
 PHON. ANT. - Word(s) immediately preceding the code-switch were accented with the phonology of the incoming language.  
 CS - Spanish control sentences.  
 CE - English control sentences.  
 Subj. - Number assigned to each subject.

APPENDIX R. REGROUPING OF SUBJECTS ACCORDING TO AGE OF SECOND LANGUAGE (L2) ACQUISITION AND THE AMOUNT OF EXPOSURE TO CODE-SWITCHING. Subjects regrouped were those used for the original language dominance groups. All subjects (1-54) were accounted for.

Regrouping	Subject Numbers	Total n
L2 acquired before 9 years of age	2,4,6,7,9,10,12,16, and 37-54	26
L2 acquired after 9 years of age	1,3,5,8,11,13-15, and 17-36	28
L2 acquired before 13 years of age	1-10,12,14,16,17, 26, and 37-54	33
L2 acquired after 13 years of age	11,13,15,18,19-25, and 27-36	21
Exposed to a minimum of code-switching	1,4,5,13,18,21,29, 33,43,48-50,52,54	14
Exposed to a maximum of code-switching	2,3,6-12,14-17,19, 20,22-28,30-32, 34-42,44-47,51,53	40

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