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A PROCESSING STRENGTH ACCOUNT OF LANGUAGE TRANSFER

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ABSTRACT

A PROCESSING STRENGTH ACCOUNT OF LANGUAGE TRANSFER

By

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The processing strength account of language transfer is a performance-based account which predicts the occurrence of errors in the second language (L2) production of closed-class morphemes by speakers whose first language (L1) speech production systems do not process for information required by the L2 production system during the production of those closed-class morphemes. It claims that in L2 development a processing sub-module is added to the existing speech production system in order to process for the information required by the L2. This addition is assumed to create a processing strength inequality between the added sub-module and the preexisting speech production system which results in processing failures and probabilistic error in the L2 speech. The claims of the processing strength account were tested on the L2 marking of GENDER and CASE for English third-person-singular pronouns by native speakers of Chinese. Native speakers of Chinese were chosen for two reasons: (1) Chinese pronouns are marked for neither GENDER nor CASE, AND (2) the Chinese speech production system processes for CASE but not GENDER. Two experimental tasks were conducted on two overlapping groups of undergraduate English majors at South China University of Technology, Guangzhou. The first task was a sentence elicitation task involving pictures and sentential primes. The second task was a story telling task using a story book without words. The tasks were designed to test four hypotheses. The first hypothesis

was that the difference in the Chinese speech production system in terms of processing for CASE and GENDER would result in differences in the accuracy of CASE and GENDER marking in the English. The second hypothesis was that the error in GENDER-marking would be performance-based rather than competence-based. The third and fourth hypotheses were that processing strength would play a role in the error behavior. The Third hypothesis predicted that error rates would be affected by both priming and attentional demands. The fourth hypothesis was that excitatory and inhibitory primes would have differential effects at various levels of processing proficiency. The first two hypotheses were strongly supported by the results. There was substantial support for the third hypothesis and indirect support for the last hypothesis.

Dedicated to Michael Gordon Everett

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CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

Introduction

To the average second language learner, language transfer seems to be an obvious component of second language learning and use, but in second language acquisition (SLA) theory, language transfer has proven to be a difficult concept to define. Within the behaviorist framework, language transfer was defined as the positive or negative effect of first language (L1) habits upon the learning of a second language (L2). Within more recent frameworks, language transfer is represented by a variety of accounts and associated predictive factors which defy any universal definition. Nearly all of these current accounts are based on the assumption that language transfer is the result of interaction between L1 and L2 competences, and thus explain language transfer through reference to the learner's L1 linguistic competence, developing interlanguage linguistic competence, or both. Relatively recently, there has been a call for a more "differentiated approach" to language transfer explanation (Kellerman and Sharwood Smith 1986: 7), in which language transfer is viewed as a diverse rather than unitary phenomenon. Within such a differentiated approach, explanations would focus on a clearly defined domain of language learning or use. The purpose of this dissertation is to contribute to a differentiated approach by presenting an account which deals with a limited set of

language transfer phenomena. The phenomenon examined in this dissertation are believed to result not from the influence of the learner's L1 linguistic competence, but rather the structure of the interlanguage speech production system.

A Brief History of Language Transfer

Language transfer became well known as a metaphor for first language influence during the 1950's and 60's when SLA was dominated by the behaviorist-structuralist approach. According to Selinker (1983: 34), the concept was borrowed from the field of experimental psychology in which it was termed transfer of training. Transfer of training has been defined as "the effect of a *preceding* activity upon the learning of a given task" (Osgood 1953: 520) and as "the fact that the learning or training that has taken place in one task carries over, or transfers, to a second" (Hall 1966: 472).

Lado's book *Linguistics Across Cultures: Applied Linguistics for Language Teachers* (1957) provides a comprehensive outline of the behaviorist-structuralist view of language transfer in SLA. Habit formation is a central feature of the behaviorist framework of language learning and is clearly evident in Lado's statement that "the average childhood speaker has from early childhood reduced practically all the operation of his grammatical system to habit" (Lado 1957: 58). This habit-based view of language learning led to the assumption that an L2 learner's preexisting L1 habits created a fundamental difference between the processes of first and second language acquisition. The logic of the argument was that while both L1 and L2 acquisition shared the basic mechanism of habit formation, L2 acquisition occurred in the context of a previously established set of language habits. According to the framework, these habits would

logically affect the learner's ability to create new habits since preexisting habits are hard to alter or suppress. The effect could surface in two ways. Those first language habits which could be used in the second language--that is, those which were the same for both languages--would lead to positive transfer. The habits which could not be used--that is, those which were different from the habits of the second language--would hinder language learning and thus lead to negative transfer or interference (Littlewood 1984: 17). Lado (1957: 2) expresses this view in his statement that "those elements that are similar to his native language will be simple for him, and those elements that are different will be difficult."

In the late 1960's, paradigm shifts occurred in the fields of linguistics and psychology. In linguistics, the shift was from structural linguistics to generative grammar. In psychology, the shift was from behaviorist to cognitivist psychology. The field of SLA, which relies on both psychology and linguistics, subsequently experienced its own shift from the behaviorist-structuralist view of habit formation to the creative construction view. When this shift occurred in SLA, the concept of language transfer suffered a fall from grace as well. There were two important reasons for that fall. The first was that the concept itself had been born out of the assumptions of the behaviorist approach and was one of the major mechanisms of language learning within that approach. The second reason was the close association between language transfer and the contrastive analysis (CA) hypothesis, which claimed that difficulty or ease of acquisition could be predicted by a surface analysis of the structures of the L1 and L2. CA came under strong criticism along with the behaviorist approach, and it became common opinion that CA was a weak, if not wholly inaccurate, hypothesis. Language

transfer, therefore, suffered from its associations with behaviorist learning theory and CA.

The early 1980's saw a resurgence of interest in language transfer in SLA research. Singleton (1987: 36) cites two examples of this resurgence. The first was the 1981 conference held at the University of Michigan on *Language Transfer in Language Learning*. The second example he cites was a statement made by Gabriele Kasper at the 1984 meeting of the British Association for Applied Linguistics. Addressing the issue of language transfer. Kasper said that

> the question as it puts itself today on both sides of the Atlantic is . . . no more 'is transfer a relevant phenomenon in L2 acquisition and use or is it not?' The generally shared assumption is that it is.

In addition to the examples cited by Singleton, the publication of three books in the 1980's--*Language Transfer in Language Learning* (Gass and Selinker 1983); *Crosslinguistic Influence in Language Acquisition* (Sharwood Smith and Kellerman 1986); and *Transfer* (Odlin 1989)--provides evidence of the revival of interest in language transfer.

The reemergence of language transfer as a respectable aspect of research must be credited in part to the declining threat from behaviorism in the late 1970's whithin the field of SLA. By that time SLA was quite thoroughly cognitivist in its approach, and researchers no longer felt any threat from behaviorism since it was generally considered an unprofitable approach to linguistic and SLA research. The result was that researchers were relatively free to re-examine some of the concepts that made up the behaviorist theory of language learning. Under those circumstances, there was no need to discredit

those concepts. It provided an opportunity to employ a new perspective in reconsiding the language phenomenon the original language transfer theory had been designed to account for. Singleton (1987: 36) described the new atmosphere:

> The fact is of course that to represent the notion of transfer as inextricably bound up with behaviorism is nonsense. The phenomenon was, as we have seen, a familiar one long before behaviorist views on language acquisition became dominant. Behaviorism did provide the current terminology--*interference*, *facilitation*, the word *transfer* itself--but it certainly did not invent the facts.

In his book, *Language Transfer*, Odlin (1989: 23) suggests an additional factor that contributed to the reemergence of language transfer. Like Singleton, he believes that SLA researchers had become aware that language transfer was not inextricably linked to theories of habit formation as was assumed when the behaviorist approach first came under attack. In addition, he claims that researchers began to realize that the studies which had been used to disprove the existence of language transfer contained flawed assumptions about what counted as language transfer. One example is that studies had failed to recognize avoidance as a product of L1 influence (Schachter 1974). Odlin (1989: 24) claims that "much of the empirical research done in the 1970's and 1980's has led to new and ever more persuasive evidence for the importance of transfer in all subsystems." In his opinion, then, it was not only empirical evidence supporting the existence of language transfer in second language acquisition, but also weaknesses in the theoretical assumptions of the studies meant to discount language transfer--such as the assumption that transfer consisted only of overt errors--that contributed to the

reacceptance of language transfer as a valid area of research.

Defining Language Transfer

The fact that language transfer has reemerged in SLA research does not mean that it has been clearly defined. The once generally accepted definition of language transfer as interference or facilitation caused by L1 habits has been replaced by a variety of definitions. Some current definitions are listed in Table 1.1.

Table 1.1. Post-Behaviorist Definitions of Language Transfer.

DEFINITION	SOURCE
The application of native language rules to target language forms.	Selinker, Swain and Dumas (1975: 143)
The imposition of previously learned patterns onto a new learning situation.	Gass (1979: 328)
Falling back on first language knowledge	Krashen (1982: 29)
A constraint on the learner's hypothesis testing process.	Schachter (1992: 32)
A frequency-based statistical trend toward the "same" alternative in a speaker's attempted production of foreign language sentences.	Selinker (1966: 103); Gass (1984: 117)
The organization of data based on previous mother-tongue experience.	Littlewood (1984: 75)
A wrongly activated plan from the speaker's mother-tongue store.	Littlewood (1984: 75)

Odlin's (1989: 25-27) solution to these multiple definitions of language transfer has been to define "what language transfer is *not*" instead of what language transfer is. His list of what language transfer is not includes the following:

1. *"Transfer is not simply a consequence of habit formation."*
2. *"Transfer is not simply interference."*
3. *"Transfer is not simply falling back on the native language."*
4. *"Transfer is not always native language influence."*

Odlin's approach to the problem of defining language transfer is, in effect, to include all definitions as plausible. While this approach may be representative of the facts surrounding language transfer, it fails to bring much organization to this complex issue.

The number and variety of definition of language transfer, as well as Odlin's approach to defining language transfer, provide evidence that a meaningful, universal definition is not currently possible. A more profitable approach to the issue may be to accept the suggestion of Kellerman and Sharwood Smith (1986: 7) that language transfer be treated as a modular phenomenon. A modular approach assumes that the various forms of language transfer actually do not make up a unitary phenomenon but are rather sets of phenomena that are related to the learner's L1 in different ways. A modular approach, therefore, permits the existence of multiple accounts, each relating to a particular set of language transfer phenomena.

The various accounts that currently exist might make up the intial accounts within a modular approach. Each would need to define the set of phenomena that it is intended to account for and be evaluated according to the empirical evidence. Most accounts which currently exist can be categorized as one of three types:
(a) competence-based accounts, (b) comprehension-based accounts and

(c) production-based accounts.

Competence-Based Accounts of Language Transfer

The majority of language transfer accounts can be classified as competence-based. These accounts explain some types of language transfer phenomena as the product of the learner's interlanguage linguistic competence.

The Ignorance Hypothesis

One of the first accounts of language transfer to gain broad acceptance after the move away from the behaviorist view of language transfer was one which essentially denied any involvement of language transfer in the language acquisition process. This account is often called the 'ignorance hypothesis' and is commonly associated with Newmark (1966). It continued as a popular theory of language transfer among language teachers in the 1980's when it was included by Krashen and Terrell (1983b) as part of their natural approach. Krashen (1983a: 141) summarizes Newmark's ignorance hypothesis as follows:

> . . . grammatical interference is not interference at all, not something 'getting in the way', not proactive inhibition, not the result of competing rule systems struggling against each other, but the result of a failure to acquire a rule or to proceed to the 'proper' transitional form. It is the result of substituting previous and often inappropriate knowledge for gaps in the (subconscious) knowledge of the second language.

In Krashen's (1983a: 148) own words, language transfer can be "regarded as padding, or the result of falling back on old knowledge, the L1 rule, when new knowledge (the real

i+1) is lacking." This is the view of language transfer preferred by Corder as well. He refers to the phenomenon as "borrowing", and believes that it is a "performance phenomenon, not a learning process, in other words a communicative strategy" (Corder 1983: 92). Since Corder claims that this view defines language transfer as a performance phenomenon, it might be argued that this is a comprehension-based or production-based account. However, this account of transfer is still a competence-based account since it focuses on gaps in the interlanguage competence of the speaker as the key explanatory factor rather than on the processing mechanisms of the speaker.

The Hypothesis Space Account

Another widely accepted account is Schachter's (1992) Hypothesis Space Account. In contrast to the Ignorance Hypothesis, which views language transfer as an on-line communication strategy, Schachter's account views language transfer as a phenomenon affecting the language acquisition process which ultimately affects the result of that process--the learner's inter-language competence. She claims that language transfer itself is not "a process at all", but rather "a constraint on the learner's hypothesis testing process" (Schachter 1992: 32). Schachter's express purpose in developing this account was to present an explanation of language transfer which related specifically and logically to the creative construction approach to language acquisition. Her means of doing so was to formulate her hypothesis around the primary mechanism in the creative construction approach--hypothesis testing. Schachter's account is adapted from the idea of concept learning associated with Bruner, Goodnow, and Austin (1956); Restle (1962); Estes (1960); Levine (1975). The theory of concept learning is based on four notions: " (1) the notion of hypothesis formulating and testing behavior on the part of the

learner, (2) the notion that there exists a universe of hypotheses, (3) the notion of various domains within the universe, and (4) the notion of inferencing and sampling behavior on the part of the learner" (Schachter 1992: 35). The unique feature of her account is the suggestion that transfer occurs because a learner's perception of the proper domain of hypotheses may be constrained by the structure of his or her L1. The perceptual constraint created by the learner's L1 knowledge results in his or her failure to perceive the full scope of the domain, resulting in a failure to formulate the appropriate L2 hypothesis. The result is an L1-like hypothesis.

The Avoidance Account

The Avoidance Account is another competence-based account associated with Schachter (1974). In her 1974 paper, 'An error in error analysis', Schachter compared the use of relative clauses in writing by Arabic, Persian, Japanese and Chinese learners of English. Because relative clauses are pronominal in Japanese and Chinese while they are postnominal in Persian, Arabic and English, she expected English relative clauses to be more difficult for native speakers of Japanese or Chinese than for native speakers of Persian or Arabic. Looking only at the number of errors in relative clause production, the Persian and Arabic speakers appeared to have more difficulty with English relative clauses. However, a more complete analysis of the data revealed that Japanese and Chinese learners of English tended to avoid the use of relative clauses whereas the Arabic and Persian learners of English did not, thus confirming her hypothesis. The results were important for two reasons. First, they ran counter to the anti-contrastive analysis (CA) view of the times. The results of her study matched the CA prediction that native speakers of Japanese or Chinese would have greater difficulty in learning English

relative clauses than native speakers of Arabic or Persian. The CA prediction was based on the fact that the head NP location for Arabic and Persian matches the location for English while the head NP location for Chinese and Japanese does not match the location for English. The second reason that these results were important was that they also failed to support the pro-Error Analysis (EA) view of the time which assumed that difficulty was always manifested in production errors. Because the difficulty that Japanese and Chinese speakers encounter in learning English relative clauses is manifested through avoidance rather than through error, EA is unable to recognize that English relative clauses are more difficult for native speakers of Japanese or Chinese than for native speakers of Arabic or Persian. In fact, EA analysis leads to the opposite conclusion since the number of errors for the native speakers of Arabic or Persian was greater than the number of errors for the native speakers of Chinese or Japanese.

The UG Account

One of the more recent accounts of language transfer has come out of the universal grammar (UG) perspective on language acquisition. It is unique because it places language transfer phenomena within a clearly defined linguistic framework--Government and Binding. This feature stands in contrast to the fact, pointed out by Gass (1988), that most accounts of language transfer are not strictly dependent upon any theoretical linguistic framework.

Generally, language transfer within the UG framework refers to the transfer of parameters from the L1 to the L2 of the learner. UG related research in SLA has often focused on determining whether or not, or to what degree, UG principles are available to adult L2 learners. Whether UG principles are available or not, transfer may still occur,

but a difference in ultimate attainment would be expected (White 1992: 219). If UG principles are available to adult L2 learners, the transfer of L1 parameters might occur at an intermediate stage in interlanguage development. Those transferred parameters would eventually be replaced by the appropriate L2 parameters once the input has triggered the proper UG principle (White 1992: 219). An alternative view held by Bley-Vroman (1989) is that UG principles are not available to adult L2 learners. The result is that adult knowledge of UG principles is limited solely to what can be reconstructed from the parameters as they exist within the learner's L1 competence. For that reason, the ultimate form of the adult learner's L2 grammar will look substantially different from an L1 learner's grammar. Bley-Vroman's view is particularly interesting because, just as in the behaviorist-structuralist approach, it gives language transfer a prominent role in the L2 acquisition process.

Comprehension-Based Accounts of Language Transfer

The comprehension-based approach to explaining language transfer is relatively recent by comparison to the competence-based approach, and is a framework for investigation and explanation that is quite distinct from the competence-based approach. Instead of explaining language transfer through reference to the linguistic knowledge of the learner, comprehension-based explanations are formulated around the language decoding strategies and processing mechanisms of language learners, and are, therefore, performance-based explanations by nature.

The Competition Model

The best known and most fully developed comprehension-based account of

language transfer is the competition model associated with Bates and MacWhinney (1987). Initially, as introduced in 1987, the competition model was designed to account for "variation between individual learners within a particular language" (Bates and MacWhinney 1987: 249). However, it has since been used by various researchers to account for L2 processing variation that may result from the influence of L1 processing strategies during L2 processing (Gass 1987; Harrington 1987; MacWhinney 1987a; Sasaki 1991). Specifically, this account claims that some language transfer phenomena are the result of competition between L1 and L2 decoding strategies.

The following are aspects of MacWhinney's (1987a: 317) account related to how transfer can occur. The account has five core concepts, which include:

1. two-level mapping;
2. cue strength and competition;
3. cue validity;
4. systematic interactions between cues; and
5. processing limitations.

Processing limitations and two-level mapping are the fundamental constructs in the theory of competition. These two components combine to create competition within the processing system. The concept of processing limitations is foundational to most information-processing approaches, and reflects the broadly held assumption among language researchers that "humans are limited capacity processors" (McLaughlin, Rossman and Mcleod 1983: 135). The concept of two-level mapping is less broadly assumed, and is based on the "functionalist claim that the forms of language are used to express communicative intentions" (MacWhinney 1987a: 318). The two levels are (1) "a *functional* level (where all the meanings and intentions to be expressed in an utterance are represented)" and (2) "a *formal* level (where all the surface forms or

expressive devices available in the language are represented)" (MacWhinney 1987a: 318). Within this account, processing limitations combine with the multiple possibilities for expression at the formal level, and with alternative decoding strategies, to create competition within the system. The implementation of a decoding strategy during processing is dependent upon the cue strength of that strategy. The stronger the cue strength, the more likely it will be implemented. Cue strength is "a function of *both* cue validity and task frequency" (Bates and MacWhinney 1987: 165). Cue validity is in turn a function of two components: "**cue availability** (i.e., how often is this piece of information offered during a decision making process?), and **cue reliability** (i.e., how often does the cue lead to the correct conclusion when it is used?)" (Bates and MacWhinney 1987: 164). MacWhinney (1987b: 271) summarizes the competition model and its core concepts as follows:

> The model assumes that lexical elements and the components to which they are connected can vary in their degree of activation. Activation is passed along connections between nodes. During processing, items are in competition with one another. In auditory processing, the competition may be between candidate lexical items that are attempting to match input data. In allomorphic processing, the competition is between candidate allomorphs. In the processing of role relations, the competition is between candidate items for bindings to argument slots. In polysemy, the competition is between candidate readings of polysemous or homophonous items. In each of these competitions, the item that wins out in a given competition is the one with the greatest activation.

The competition model is theoretically interesting for two reasons. One is that unlike most accounts of language transfer which tend to view language transfer as deriving from linguistic competence, "the competition model is a theory of performance rather than competence . . ." (Kail and Charvillat 1986: 353). The second reason is that since this account views language transfer as deriving from interacting processing cues, language transfer does not have to be viewed as an "all or none affair." It is able to probabilistic error as well as explain the statistical differences between adult speakers (MacWhinney 1987a: 317-20). Bates and MacWhinney (1987: 160) describe this distinct feature in their explanation that their account

> is not offered as a formal model of **linguistic competence** but rather as a model of **linguistic performance**. This concentration on performance has one particularly important implication: in modelling the differences among natural languages, our goal is to provide an explicit account not only for the kinds of discrete "yes or no" phenomena that play a role in traditional linguistic models but also for the probabilistic differences between natural languages that are observed in real-time language use.

Production-Based Accounts of Language Transfer

Like comprehension-based accounts, production-based accounts are distinct from competence-based accounts in that they too are performance-based. In addition, they differ from comprehension-based accounts because they derive language transfer explanations from the structure and processing of the language production system rather than from comprehension strategies and processes. Interestingly, the behaviorist view of

language transfer falls into this category since it explains language transfer through reference to the production system of the speaker--the speaker's set of habits. Language transfer errors are explained as the product of the pre-existing speech habits which are inappropriately involved in L2 speech production.

The IPG -Based Account

One current example of a production-based account is that proposed by Jordens (1986), who claims that "since interlanguage output data are performance data, they can only be accounted for in terms of a model of language production" (Jordens 1986: 91). As part of his account, Jordens adopted Incremental Procedural Grammar (IPG). He demonstrated how the IPG framework can be used to explain the characteristic pattern of transfer errors in subject-verb agreement by Dutch speakers of L2 German. An important feature of production grammars is that the production system is concept driven. Speakers are, therefore, more interested in assuring that their expression represents their intention than in assuring that it is syntactically well-formed. An additional feature of the framework is that "the elements playing a role in the production process do so actively," meaning that all potential units are activated whether they are ultimately selected or not.

Jordens' research sought to demonstrate that some L2 errors result from the use of L1 sentence production procedures during L2 production. His study focused on the incremental divisions that are processed during Dutch sentence production, and how they influence the production of L2 German sentences by native speakers of Dutch. Jordens claims that the Dutch production grammar processes the TOPIC and FOCUS of each sentence independently, and that in most cases the grammatical subject has the TOPIC

function and the finite verb marks the focus portion of the sentence. Because this is the "normal" situation, he argues that there is potential for misidentification of the grammatical subject when the grammatical subject is not the topic. Misidentification, in turn, can lead to AGREEMENT errors in L1 Dutch. He found AGREEMENT errors in the L2 German of native speakers of Dutch as well. Based on this fact, he hypothesized that the transfer of the Dutch production system which creates AGREEMENT errors in L1 Dutch cases, should also create CASE errors in L2 German in specific types of sentences (examples include subjectless sentences or sentences with rhematic subjects) where Dutch increments could result in mis-identification. His hypothesis was verified by the results. From the evidence that there are parallel types of errors in L1 Dutch and L2 German, Jordens concluded that the errors are not due to "an underlying rule system that is termed 'interlanguage'", but rather to the speaker's "'interlanguage production system'".

The On-Line Priming Account

Loebell's (1989) on-line priming account is a production-based account which shares many of the assumptions of Jordens' account, but seeks to explain transfer errors not as the transfer of production rules but as the result of simultaneous availability of multiple syntactic structures during syntactic coding. Her account is based on bilingual research which suggests that both syntactic systems are active during bilingual code-switching. She proposes that both bilingual code-switching and language transfer in second language learners might have a common source--the simultaneous activation of both syntactic systems.

Loebell's account predicts that priming should prove to be an important factor in affecting the outcome of the competition created by simultaneous activation of L1 and

L2 structures since priming would strengthen the activation of one of the two competing alternatives thus leading to the use of the strengthened option. Loebell conducted two studies designed to test for the existence of syntactic priming. The first study is directly relevant to the issue of language transfer. In that study, she examined the effect of inter-language syntactic priming upon the production of German dative sentences. She found that "there was a general tendency for the form of the utterance to match the form of the prime . . ." (Loebell 1989: 29), thus supporting the thesis that inter-language priming does affect the outcome of production. The results are important to language transfer research because they support an account which stands in contrast to accounts like the competition model, which explains transfer by relying on semantic and conceptual properties. Loebell's account explains syntactic transfer as a purely syntactic phenomenon.

Predictive Factors in Language Transfer

In addition to the accounts described above, there are a number of predictive factors associated with the occurrence of language transfer. It is appropriate to consider these factors separately from the accounts described above because rather than attempting to answer the question, "how does language transfer occur?," these factors attempt to answer the question, "when does language transfer occur?" Since these factors are predictive factors, they could potentially play a role within any of the accounts, although they are certainly most theoretically compatible with the competence-based accounts.

Interactive Developmental Factors

Ironically, one of the earliest predictive factors identified in language transfer was the presence of developmental errors. It is ironic because at one time, the two phenomena were viewed as mutually exclusive. Zobl (1980: 470-71) has suggested the three types of interaction exist between developmental errors and language transfer:

1. Structural properties of the L2 which give rise to developmental errors may also activate influence from the learner's L1 when an L1 structure is compatible with the developmental error.

2. General language acquisition principles promote transfer when an L1 structure more closely conforms to the linguistic parameters of the developmental acquisition principle than the L2 structure to be acquired.

3. Although there is a crucial degree of overlap between developmental and transfer errors with respect to the factors involved in their genesis, transfer errors may prolong restructuring of the rule underlying the error. It is hypothesized that this tendency toward fossilization results from the use of a common rule in a mature linguistic system (the L1) and in a developing linguistic system (the L2 developmental stage the learner has attained).

Though they share a common theme of synthesis, each of the preceding interactions presents a unique case in which an L1 structure becomes involved in L2 acquisition as the result of a different trigger. The key words are "compatible," "conforms" and "overlap." In the first case, an L1 structure is compatible with a developmental error that is specific to the L2 being learned. In the second case, the structure of the L1 "conforms" more closely to general developmental processes than the structure of the L2. Since the L1 structure is closer in form than the L2 structure, it is likely to become incorporated in the developing interlanguage grammar. These first two cases comprise predictions of increased likelihood of transfer error occurring. The third case, on the other hand,

predicts an increased difficulty in ridding the interlanguage of the error once it becomes a part of the interlanguage competence. This is predicted to occur when an L1 structure and a developmental error are identical.

Transfer to Somewhere Principle

Andersen (1983), like Zobl, has emphasized the interaction between developmental error and language transfer in his Transfer to Somewhere Principle. He describes the principle in the following way:

> A grammatical form or structure will occur consistently and to a significant extent in interlanguage as a result of transfer *if and only if* there already exists within the L2 input the potential for (mis-) generalization from the input to produce the same form or structure" (Andersen 1983: 178).

In other words, this principle is similar to Zobl's first thesis above. Transfer will occur when there is compatibility between an L1 structure and a potential developmental error in the L2.

Psychological Markedness

Kellerman (1983) has proposed a factor that is quite different in character from those proposed by Zobl and by Andersen. He suggests that learner perceptions can influence the likelihood of language transfer occurring, and proposes a "transferability constraint," which results from the learner's own perceptions of their native language and the language being learned. These perceptions are called the learner's psychotypology, and are categorized as one of two types of constraints. The first is a general constraint on language transfer between two languages, which is dependent upon the learner's

perception of the typological distance between the L1 and L2. The less similar the two languages are perceived to be by the learner, the less likely it is that transfer will occur. The second type of constraint depends upon the perceived markedness of the specific structure that is a candidate for transfer. Markedness in this case refers to the learner's perception of how idiosyncratic a particular structure is to the L1. The more marked-- unique to the L1-- a structure is perceived to be, the less likely it is that it will be transferred. Kellerman is careful to point out that these two factors are interactive and that, as a result, a relatively marked structure may be transferred when the L1 and L2 are perceived to be close typologically. In contrast, a relatively unmarked structure might not be transferred because of the perception that the L1 and L2 are typologically quite distant. A feature that makes Kellerman's psychotypological constraint unique is that it is based on the learner's perceptions of distance and idiosyncrasy. The implication of this feature is the learner's perception of typological closeness may be based on completely non-linguistic sources such as distance between the countries where the two languages are spoken, as well as political or cultural distinctions.

Markedness Differential Hypothesis

In contrast to Kellerman's learner-centric, psychologically determined markedness, Eckman (1977) has proposed that universal, structurally determined markedness conditions affect the occurrence of language transfer. Eckman defines markedness as follows:

> a phenomenon A in some language is more marked than B if the presence of A in a language implies the presence of B; but the presence of B does *not* imply the presence of A (Eckman 1977: 320).

Based on this definition, he proposes the Markedness Differential Hypothesis (MDH), which makes the following claims about language interference (Eckman 1977: 321):

> The areas of difficulty that a language learner will have can be predicted on the basis of a systematic comparison of the grammars of the native language, the target language and the markedness relations stated in universal grammar, such that,
> (a) Those areas of the target language which differ from the native language and are more marked than the native language will be difficult.
> (b) The relative degree of difficulty of the areas of the target language which are more marked than the native language will correspond to the relative degree of markedness;
> (c) Those areas of the target language which are different from the native language, but are not more marked than the native language will not be difficult.

Language Typology

Rutherford (1983) has suggested that it is not isolated syntactic structures that are transferred into a speaker's interlanguage, but rather typological features such as topic-prominence and pragmatic word order. Rutherford investigated the L2 English speech of native speakers of Arabic, Japanese, Korean, Mandarin and Spanish for evidence of typological transfer. One set of typological features that he compared was grammatical word order (GWO) and pragmatic word order (PWO). English is a GWO language; Mandarin, Spanish and Arabic are PWO languages; and Korean and Japanese combine both features. The results revealed an overproduction of dummy subjects by the Japanese and Korean speakers. Rutherford claims that their overproduction suggests a sensitivity to the GWO characteristic of English which derives from the GWO feature in the subjects' L1s. He concludes that this is evidence of "an instance of transfer not of mother tongue surface form but of an aspect of mother tongue typological organization, viz., a comparatively strong predilection for the use of word order to signal grammatical

rather than pragmatic relationships" (Rutherford 1983: 366).

The Coexistence of Multiple Accounts and Predictive Factors

The existence of multiple accounts and predictive factors in language transfer research certainly reflects the diversity of viewpoints that exist within SLA research, and there may be a tendency to view such diversity as chaotic and unproductive. However, there is reason to conclude, as have Kellerman and Sharwood Smith (1986), that such diversity is essential as the field of SLA grows in its understanding of language acquisition and language transfer. In their book, *Crosslinguistic Influence in Second Language Acquisition*, they cite the articles contained within as "a plea for modularity, i.e. a differentiated approach to the various areas of language, given the apparent and hitherto underestimated degree of complexity of crosslinguistic influence" (Kellerman and Sharwood Smith 1986: 7). In addition to Kellerman and Sharwood Smith's call for a modular approach are more specific views of how language research should be subdivided. Sharwood Smith (1982: 33) has called for a distinction in research between "knowledge *what*" and "knowledge *how*", and more recently, Kellerman and he (1986: 3) have called attention to that same view by pointing out that there is a growing consensus "that there is a need to separate the processing dimension from the knowledge dimension". Elsewhere, Sajavaraa (1986), speaking from the comprehension-based perspective, and Bock (1982), speaking from the production-based perspective, both agree that speech processing and speech production should be considered independently from one another as unique areas of research.

If such views are correct, then it follows that this diversity does not represent

chaos in language transfer research but rather a recognition of the complexity of language, language learning and language processing. As such, many of the accounts summarized above could be considered not competing accounts but rather accounts which address differing aspects within the broad domain of language transfer.

Basic Assumptions of the Processing Strength Account

The account proposed in this dissertation is in line with the suggestions of Kellerman and Sharwood Smith (1986); Sajavaraa (1986); and Bock (1982) concerning the need for a modular approach. It is an account that is built upon speech production theory and is intended to account for language transfer phenomena that are problematic for current competence-based and comprehension-based accounts. Prior to outlining the account, it is necessary to first review the important constructs that form its theoretical basis and functional structure.

The Separation of Comprehension and Production in Language Transfer Research

Most language production accounts assume that language comprehension and language production constitute two separate domains of theoretical inquiry, and that "the dissection of . . . [speaking] is a scientific endeavor in its own right" (Levelt 1989: 1) Although not universally accepted, this assumption is both currently and traditionally the dominant viewpoint. MacKay, Allport, Prinz and Scheerer (1987: 1) suggest that this assumption is derived from a tradition of 'separate-and-unequal,' which they trace back as far as the time of Descartes, when processes were categorized as "afferent" or "efferent".

There is reason to believe that this theoretical separation of comprehension and production should exist in language transfer theory as well. Sajavaraa (1986: 67) makes

this point when he said that "crosslanguage influences in speech reception should . . . be considered in a totally different light from such influences in speech production." While there may be a number of reasons for this theoretical separation, Bock (1982: 1) suggests that the asymmetry in the role of syntax in production versus its role in comprehension is a particularly important one. She explains the asymmetry in the following way:

> Successful comprehension yields some representation of the underlying meaning of the sentence. Because of the large influence of our prior semantic and world knowledge on this recovery of meaning, many of the aspects of a sentence's surface form appear to play a relatively minor role in comprehension, in comparison with higher level semantic and knowledge integration processes. As a result many current theories of language comprehension are more concerned with these higher level processes than with syntactic parsing procedures (Lachman & Lachman 1979). In sentence production, on the other hand, it is necessary to create a surface structure (Bock 1982: 1).

This asymmetry in the role of syntax in comprehension and production suggests that a complete understanding of language transfer errors in speech can only be achieved through the inclusion of production-based accounts to the overall theory of language transfer. It is apparent that competence-based theories alone are not capable of fully explaining language transfer errors in speech. A production-based explanation is necessary if all speech errors are to be accounted for.

The Speech Production System

Before a production-based account of language transfer can be presented, a

general understanding of the speech production system is necessary. Figure 1.1 (adapted from Levelt's 1989 "blueprint for the speaker") provides an excellent overview of the components of the speech production system.

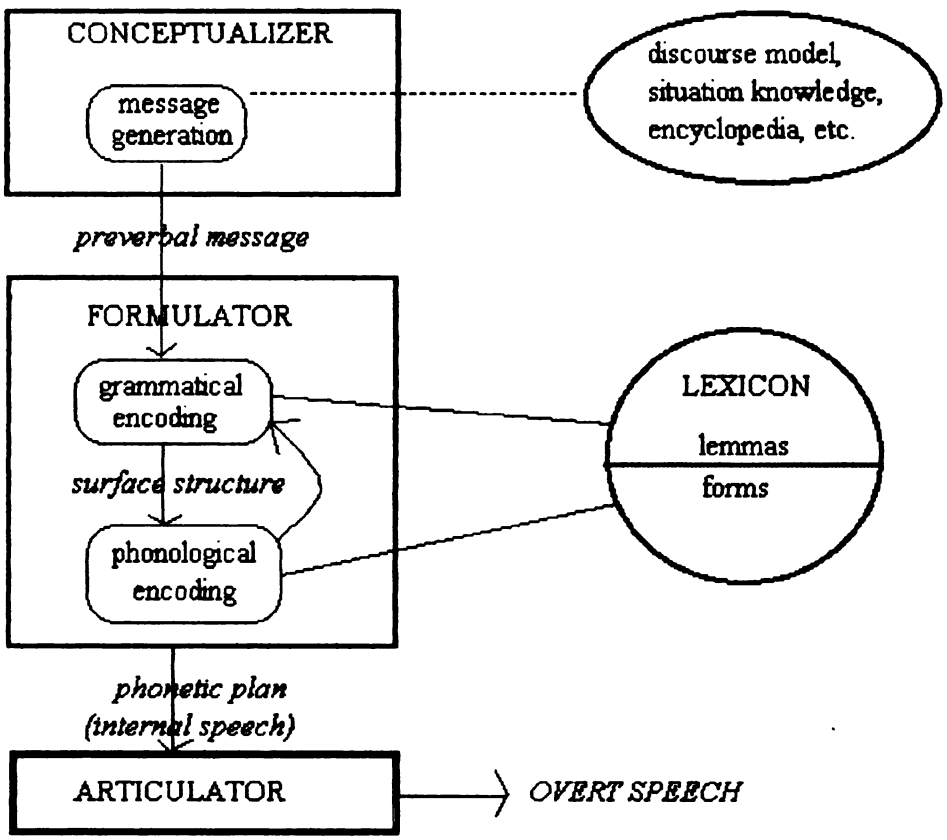


Figure 1.1. Levelt's Blueprint for the Speaker.

Levelt's "blueprint" illustrates the three broad processing components of speech production. Each of the processing components--the CONCEPTUALIZER, the FORMULATOR and the ARTICULATOR--represent groups of processes and access to various knowledge stores which function together to transform the input received from the previous component into an output that can be used by the subsequent component. The

first component, the CONCEPTUALIZER, transforms the intentional activity of the speaker into a preverbal message which serves as input for the FORMULATOR. Levelt's "blueprint" reflects the general assumption that speech production is a top-down process initiated by the intentional activity of the speaker by placing the CONCEPTUALIZER as the initial component. The second component, the FORMULATOR, transforms the preverbal message that is received from the CONCEPTUALIZER into a phonetic plan through its own internal processes. The phonetic plan then serves as the input for the ARTICULATOR which processes it and transforms it into a motor-sensory message, resulting in overt speech.

While Levelt's "blueprint" provides an excellent overview of the speech production system, it leaves the internal components of the FORMULATOR and the relationship of those components relatively unspecified. Bock's 1982 model, shown in Figure 1.2, provides a slightly more detailed description of the relationship between the internal processes of the FORMULATOR, and is based on her identification of the following five "arenas" that make up the "cognitive processes that support sentence production" (Bock 1982: 3-6):

(1) *The Referential Arena* - "The primary responsibility of the referential arena is the translation or coding of the nonlinguistic representations of thought into a format that can be used by the linguistic system."

(2) *The Semantic Arena* - "The semantic arena is responsible for meshing the propositional relations and components formulated in the referential arena with lexical concepts."

(3) *The Phonological Arena* - "The phonological arena is responsible for the mapping of lexical concepts onto phonological representations."

(4) *The Phonetic Arena* - The phonetic arena is responsible for constructing, from the relatively more abstract phonological representation, "the phonetically specified representation that actually guides motor program formulation."

(5) *The Motor Assembly Arena* - "The motor program is constructed from the phonetic code in the motor assembly arena, which is responsible for the actual production of the utterance, including the compiling and running of the motor program."

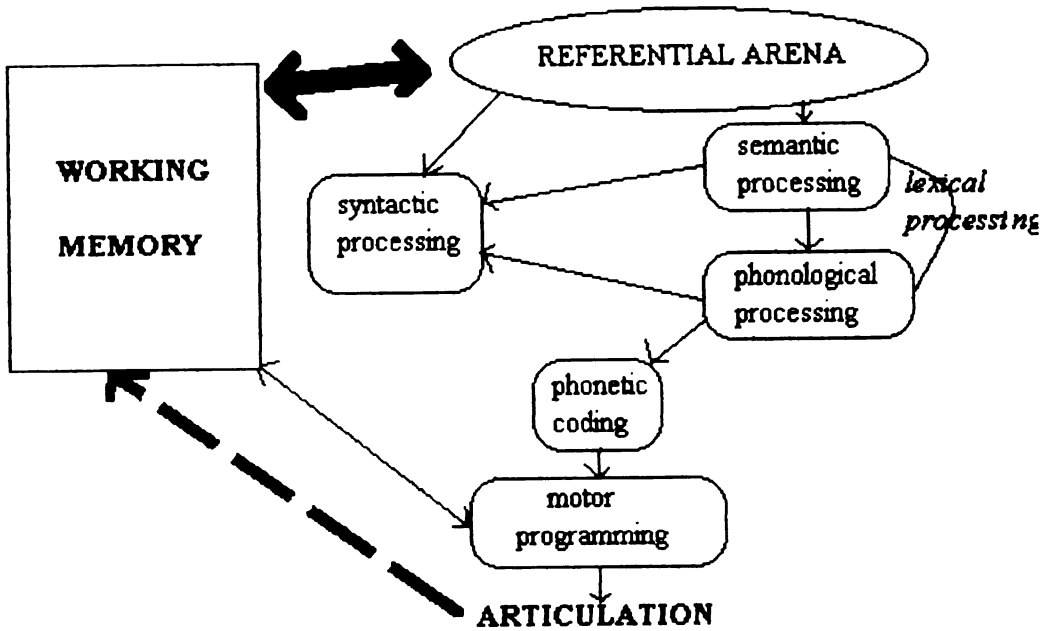


Figure 1.2. Bock's 1982 Speech Production Model.

Bock's model matches the general pattern of Levelt's "blueprint." Her REFERENTIAL ARENA corresponds to Levelt's CONCEPTUALIZER, while her MOTOR PROGRAMMING component corresponds to Levelt's ARTICULATOR. The four remaining components between the REFERENTIAL ARENA and the MOTOR PROGRAMMING comprise the internal structure of the FORMULATOR. The unique feature of Bock's model is that it

attempts to synthesize two very different views of syntactic generation. The first, associated with Chomsky, "regards syntax as originating within an autonomous syntactic component that maps the information to be conveyed by an utterance onto uniquely linguistic structures in an independent linguistic system" (Bock 1982: 2). The other view, related to the assumptions of functional grammar "regards syntax as the product of various cognitive and communicative factors influencing the processing of the intended messages underlying sentences in different communicative contexts" (Bock 1982: 2). Bock's model accommodates the autonomous view by separating syntactic processing from lexical processing. In Figure 1.2, the syntactic processing module and the semantic processing module receive the preverbal message as input independently as it is generated by the REFERENTIAL ARENA. The model also accommodates the view of functional grammar by allowing information to flow from the semantic and phonological processing modules--both subcomponents of the lexical processing module--to the syntactic processing module.

Bock (1991: 142-154) has also identified the following five problems that any production model must be able to account for:

(1) *Getting the Form Right* - 'The production system must get the details of form 'right' in every instance, whether those details are germane to sentence meaning or not' (quote, from Garrett 1980).

(2) *Regulating Information Flow: The Full-Deck-of-Cards Paradox* - "The paradox is that speakers can be simultaneously adept at creating a structure and inept at conveying an interpretation. As a consequence, we get a central fact about speech errors: They obey structural constraints at the same time that they egregiously violate the intended messages."

(3) *Fluency* - "Because of the normal fluency of speech, it is natural to assume that the formulator is organized and operates in a way that meets the demands of creating utterances in time. This has the

potential to conflict with the need to regulate information during production. On one side, the formulator must staunch the flow of information, and on the other, keep it moving."

(4) *Coordination* - "The coordination problem arises because production is, in fact, productive: The utterances we produce are rarely memorized sequences, but rather creative assemblies of elements within structures. Words must be put into place in syntactic structures, and sounds must be put into place within phonological structures."

(5) *Type Transparency* - "The question of *type transparency* (Berwick & Weinberg, 1984), applied to production, is whether the organization of the formulator mirrors the logical organization of rules and structures in the grammar."

In addition to being capable of handling these five production problems, Bock also says that any model of the speech production system must also reflect the types of speech errors that have been identified in speech error research. She claims that Garrett's (1988) production model, shown in Figure 1.3, meets all these requirements (Bock 1991: 146; Garrett 1988: 78).

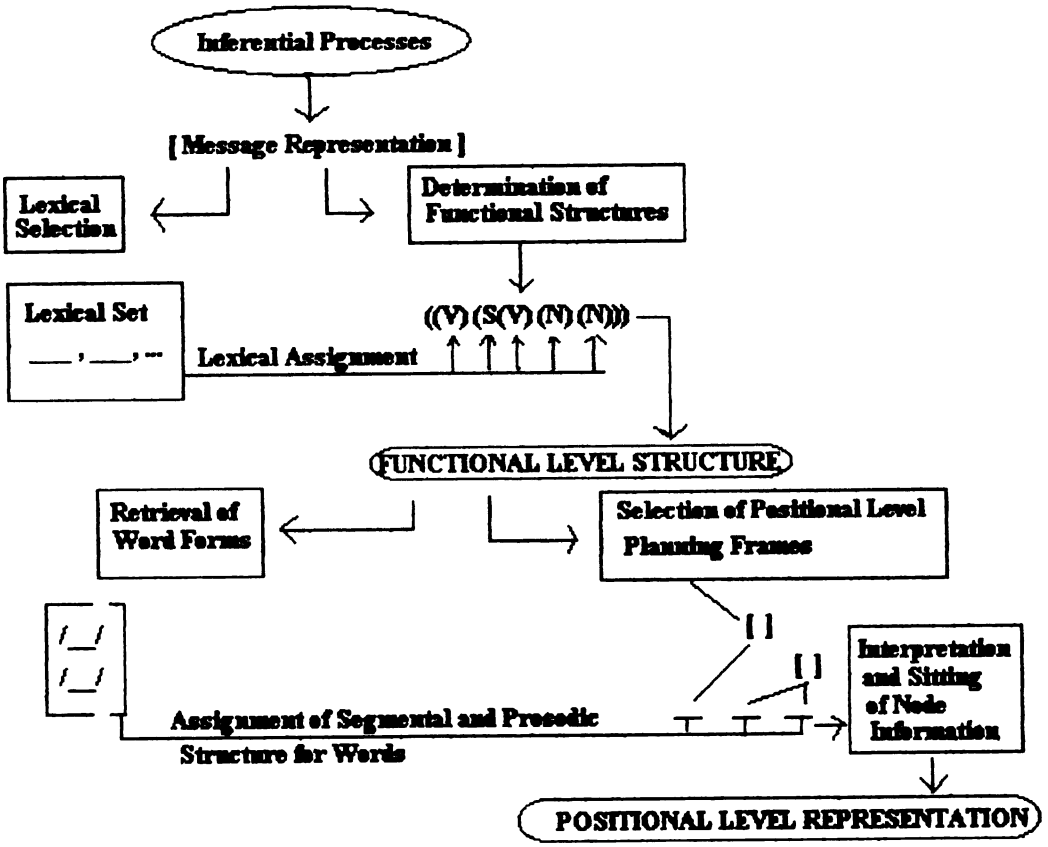


Figure 1.3. Garrett's Speech Production Model.

In Garrett's model, as in the previous two models that have been described, sentence production is initiated by the intentional activity of the speaker. It also maintains the separation of lexical and syntactic processing found in Bock's model. A distinctive feature of this model is that the FORMULATOR has been divided into two distinct processing modules--the functional processing module and the positional processing module. Bock (1991: 145) describes the operation of these two modules as follows:

> The [functional and positional levels of processing] are responsible for putting the linguistic pieces of utterances together. One builds the functional-level representation by assigning selected lexical items from the lexical set to syntactic functions within clauses; these functions are represented as the slots in the functional structure ((V)(S(V)(N)(N))). The phonological forms of words are irrelevant to this assignment, as is the eventual order of the words in the utterance, though the form classes of words are critical. The second level creates the positional-level representation, where both word order and phonological forms are specified within phrases. Word forms are retrieved from the lexicon and their segmental and prosodic features are assigned to the terminal elements of the constituent structure or positional-level planning frame.

The modules and their relationships within Garrett's model are based on the analysis of speech errors. As an example of how the model can account for complex speech errors, Bock (1991: 145) provides the erroneous sentence, *The skreaky gwease gets the wheel*. Based on Garrett's model, the explanation of how this error occurred is that at the

functional level, *wheel* and *grease* are assigned the wrong syntactic functions. As a result, *wheel* becomes the object and *grease* the subject. Because of the mis-assignment of syntactic functions, *grease* and *squeaky* are assigned to the same phrase in the positional-level planning frame, which creates the conditions that permit the sound exchange between the two words. The fact that Garrett's model is designed for the explanation of errors makes it particularly suitable for investigating production-based language transfer errors.

Automaticity and Control

Since the speech production system, as outlined above, is by nature a grouping of processing components, the distinction between automatic and controlled processing is relevant to a complete understanding of its operation. The controlled/automatic dichotomy has traditionally been used to describe what are considered to be two distinct manners of processing. A variety of features have been associated with automatic processes, but the most commonly cited feature is that automatic processes are "cheap or free in terms of processing resources, 'effort', or drain on general-purpose, limited capacity central processing mechanism" (Brown 1985: 14). A second important characteristic of automaticity is speed (Cohen, McClelland and Dunbar 1990: 335). Shiffrin, Dumais and Schneider (1981: 227) have defined an automatic process as "any process that does not use general, nonspecific processing resources and does not decrease the general, nonspecific processing capacity available for other processes." A controlled process according to their definition is a process which is not automatic and which, therefore, uses "general, nonspecific processing resources" and decreases "the general, nonspecific processing capacity available for other processes." McLaughlin, Rossman

and McLeod (1983) explain that the framework of Shiffrin, Dumais and Schneider contains a distinction between two types of memory and two means of activation. The framework views "memory as a large collection of nodes that become 'complexly interassociated' through learning" (McLaughlin, Rossman and McLeod 1983: 139). The system of nodes in its entirety, which is normally in an inactive state, is the long-term store (LTS). Groups of nodes that become temporarily activated are a short-term store (STS). Based on this view of memory, automatic processing is explained as the activation of the same set of nodes in memory each time the appropriate inputs are present, and controlled processing is explained as the activation of nodes in sequence through the application of attentional control.

A more recent theory of automaticity, Logan's (1990) "instance theory" of automaticity, shares the view of Shiffrin and Schneider that automatic and controlled processes are two distinct means of processing. Logan, however, defines the distinction in a somewhat different manner. He proposes that "performance is automatic when it is based on the retrieval of prior events from memory rather than some general algorithmic computation" (Logan 1990: 3). Controlled processing, by this definition then, is processing that is carried out by algorithmic computation.

The views of automaticity expressed by Shiffrin, Dumais and Schneider (1981), McLaughlin, Rossman and McLeod (1983), and Logan (1990) all assume that "automaticity is an all-or-none phenomenon" (Cohen, McClelland and Dunbar 1990: 332). Within their dichotomous view, processing must be either automatic or controlled, but certainly can only be carried out in one of the two distinct processing modes. Cohen, McClelland and Dunbar (1990) suggest that an alternative view is that there is no

dichotomy between automatic and controlled processes but rather a continuum of more or less automatic. The model they propose has been constructed within a parallel distributed processing (PDP) framework. Cohen, McClelland and Dunbar, describe their view of automaticity in their statement that

> a particular process is assumed to occur via a sequence of connected modules that form a *pathway*. . . . The speed and accuracy with which a task is performed depends on the speed and accuracy with which information flows along the appropriate processing pathway. This, in turn, depends on the connections between the units that make up the modules in that pathway. . . . Thus, **the speed and accuracy of performing a task depends on the strength of the pathway** used in that task (Cohen, McClelland and Dunbar 1990: 335). (Emphasis my own.)

According to this view, automaticity is the product of the processing strength of a processing pathway. A task is carried out more or less automatically depending on the strength of the pathway involved. There are no distinctions between types of processing between tasks that are more or less automatic. The only thing that varies is the strength of the processing pathways involved.

The view of automaticity proposed by Cohen, McClelland and Dunbar also provides a relevant explanation for the relationship between attention and automaticity. They describe the relationship in their statement that

> in [this] system, modulation occurs by altering the responsiveness of the processing units in the pathway. In this way, attention can be used to control individual processes. However, this does not necessarily imply

> that attention requires a unique or even distinct component of processing. **Attention can be thought of as an additional source of input** that provides contextual support for the processing of signals within a selected pathway (Cohen, McClelland and Dunbar 1990: 335). (Emphasis my own.)

In other words, attention serves as a source of input which has the effect of increasing processing strength, and thus automaticity, temporarily.

Modularity

The modular view of the mind as proposed by Fodor (1983) is foundational to the account of language transfer proposed in this dissertation. He sees the modular view of the mind as a product of faculty psychology, which he describes in the following manner:

> By faculty psychology I mean, roughly, the view that many fundamentally different kinds of psychological mechanisms must be postulated in order to explain the facts of mental life. Faculty psychology takes seriously the apparent heterogeneity of the mental and is impressed by such prima facie differences as between, say, sensation and perception, volition and cognition, learning and remembering, or language and thought. Since, according to faculty psychologists, the mental causation of behavior typically involves the simultaneous activity of a variety of distinct psychological mechanisms, the best research strategy would seem to be divide and conquer: first study the intrinsic characteristics of each of the presumed faculties, then study the ways in which they interact (Fodor 1983: 1).

In *Modularity of Mind*, Fodor lists nine properties which characterize input systems and which distinguish them from the central cognitive processes of the mind. These nine characteristics are the defining features of a modular system. Fodor claims that the distinction that results from these nine properties stand in support of the modular view of the mind. Those properties include (Fodor 1983: 47-100):

1. Input systems are domain specific.
2. The operation of input systems is mandatory.
3. There is only limited central access to the mental representations that input systems compute.
4. Input systems are fast.
5. Input systems are informationally encapsulated.
6. Input analyzers have 'shallow' outputs.
7. Input systems are associated with fixed neural architecture.
8. Input systems exhibit characteristic and specific breakdown patterns.
9. The ontogeny of input systems exhibits a characteristic pace and sequencing.

Since these nine characteristics define modular systems, Fodor (1983: 47) claims that any psychological systems "which possess most or all of these properties then . . . are modular too."

The speech production system outlined earlier in this chapter possesses most of these characteristics named by Fodor and, thus, can be considered modular as well. First of all, the system is domain specific since it serves the function of speech production only. Secondly, the operation of the speech production system, like the input system, is mandatory. Speech production occurs automatically when initiated by the intentional activity of the speaker in the form of overt speech or what Levelt calls "internal speech" (Levelt 1989: 9). Thirdly, the mental representations of the speech production system are not readily accessible to the central systems. Evidence comes from the fact that retrospection can provide little useful knowledge of the speech production system.

Fourthly, the speech production system is fast. According to Levelt, "Articulation flows automatically, at a rate of about fifteen speech sounds per second . . ." (Levelt 1989: preface). Fifthly, the speech production system is informationally encapsulated. Garrett's speech error example is relevant to this point. The production of the erroneous sentence, *The skreaky gwease gets the wheel* (Bock 1991: 145) is explained as resulting from *wheel* and *grease* being assigned the wrong syntactic functions at the functional level. They, therefore, end up in the wrong syntactic positions in the positional structure. This example illustrates that the FORMULATOR continues sentence production based solely on the information contained within the internal components. Information outside the FORMULATOR--in the central processing system--would recognize that a processing error has occurred, but because the internal components of the FORMULATOR do not have access to that information, processing continues as though there were no error. Finally, speech production systems are also generally "associated with fixed neural architecture," and "exhibit characteristic and specific breakdown patterns."

The general argument that Fodor makes is that all systems that mediate between the external world and the central cognitive systems are modular, but that the central cognitive system itself is not modular. In his book, however, Fodor does not deal with the internal composition of these mediating systems. It is reasonable, however, to assume that the same need for speed and accuracy that presumably makes modularization essential to the proper functioning of the over-all processing system, makes modularization essential to the proper functioning of the system-internal processing components as well. The key feature of modularity is "information encapsulation." Information encapsulation, in effect, assures that processing will be carried out in an

environment in which information is limited. This achieved by isolating the processes within processing sub-modules from information that would significantly decrease processing efficiency. Fodor (1983: 64) refers to the effect of encapsulation in his statement that

> automatic responses are, in a certain sense, deeply unintelligent; of the whole range of computational (and, eventually, behavioral) options available to the organism, only a stereotyped subset is brought into play. But what you save by indulging in this sort of stupidity is *not having to make up your mind*, and making your mind up takes time.

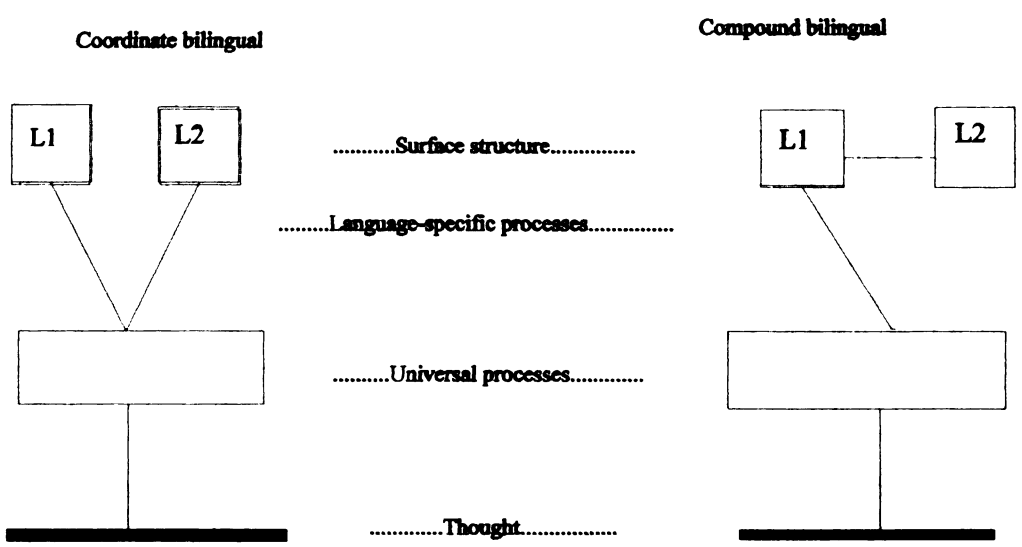
Processing modules are the product of encapsulation. Because of encapsulization, a modular system is efficient, but inflexible.

Modularity is clearly evident in Garrett's model illustrated earlier in Figure 1.3. First of all, the processing component that produces the functional level representation is separate from the processing component that produces the positional level representation. Secondly, the points of interaction between the two components are specified--they are not freely interactive at all points within the system. Finally, modularity is also evident within each of the two representation processing components. In the functional processing component, lexical selection and the selection of the functional structure of the phrase are carried out by two independent components. A similar processing division exists at the positional level, where retrieval of word forms and selection of positional level planning frames are independent from one another.

L1 - L2 Language Production System Overlap

Within bilingual research, there has been an ongoing debate concerning the

independence versus dependence of the two language systems of bilinguals. The debate has centered around the distinction between compound and coordinate bilingualism. Compound bilingualism has been defined as a condition in which a bilingual has "a single language system comprising both languages" (Albert and Obler 1978: 227). Coordinate bilingualism, on the other hand, has been defined as a condition in which a bilingual has "dual noninterfering language systems, mediated only at the level of cognition." Figure 1.4 contains a Kirstein and de Vincenz (1974) diagram reprinted in Albert and Obler (1978: 229) which illustrates the most extreme cases of coordinate and compound bilingualism.



1.4. Compound and Coordinate Bilingualism.

As early as 1978, the dichotomy between compound and coordinate bilingualism was losing meaning. Albert and Obler (1978: 227) point out that already at that time, "few would assert that individuals are **either** compounds or coordinates", and that the more acceptable conclusion is "that individuals lie along a continuum between the two poles, or that parts of systems are coordinate." The same view is represented by Sridhar and Sridhar (1980), who suggest that the most accurate account is an *interactionist* account in which there are overlapping systems. According to this view, the two language systems of the bilingual are independent at some points and dependent (overlapping) at others.

MacWhinney (1987a: 321) agrees with the view of Sridhar and Sridhar, and suggests that the overlapping of the two systems is based on a practical need. He says that "if the bilingual can fully separate his two languages . . . , errors will be kept at a minimum. However, the cost of this organization of two full sets of processing relations is fairly high and the bilingual may attempt to make short cuts." The result of such "short cuts" is the "warping of both L1 and L2 in the interest of the forging of a single processing system." In other words, the development and maintenance of two completely separate processing systems is too costly for the learner/speaker. As a result, he or she will permit the existence of compound components within the system. From a modular perspective, the overlapping or dependence would presumably occur at the level of individual modules, and specifically between modules that serve the same processing function.

The Debate on Variation and Competence

Intra-learner variation in SLA is a topic that, like language transfer, has been accounted for in a variety of ways. Tarone (1988: 25-26) categorizes those various accounts of interlanguage variability as follows:

(1) Inner processing theories -
  (a) Monitor Theory
  (b) Chomskian Model
  (c) Psychological Processing Theories
  (d) Labovian Models
(2) Sociolinguistic and discourse theories -
  (a) Social Psychological Models
  (b) Function-Form Models

As will be explained in greater detail later in this dissertation, inter-learner variation in the marking of GENDER is expected in the production of English third-person-singular pronouns by native speakers of Chinese. The processing strength account's view of variation, outlined in this dissertation, would be categorized generally by Tarone as an inner processing theory since "the cause of variation is traced to inner, psychological processes of one sort or another" (25). It would also be categorized more specifically by Tarone as a psychological processing theory because it "uses research findings and methodologies from experimental psychology and makes a distinction between knowledge and the processes used to implement that knowledge in communicative performance" (33). In the case of the processing strength account, variation is traced to the presumed processing strength inequalities which exist between the pre-existing system and the system being constructed for the second language. In other words, the variation is presumed to be related not to the knowledge of the learner but to the nature of the processes which implement that knowledge during production.

Though it is easy to categorize the processing strength account's view of

variability, the issues surrounding variability within SLA theory are more complex than that. In recent years, the issue of variability in SLA has focused on the debate concerning the nature of linguistic competence and the domain of SLA. This debate attracted a relatively large amount of attention with the public discussion between Gregg (1990), Ellis (1990) and Tarone (1990). The discussion between Gregg on one side and Ellis and Tarone on the other has been critiqued by Eckman (1996). Eckman summarizes Gregg's position with the following three statements (5):

a. The domain of a theory of SLA must be the linguistic competence of the learner.

b. The study of linguistic competence necessarily excludes the type of within-speaker variability that is important to variationist models.

c. Theories of SLA that attempt to account for this variability blur the competence/performance distinction, which, in turn, prevents such models from forming the basis for a successful theory of SLA.

Gregg's position is basically one in which he desires to limit the domain of SLA to the study of a learner's competence, which, he claims, must be homogeneous for theoretical reasons. Ellis and Tarone, on the other hand, argue that variation (what Gregg considers performance and therefore outside the domain of SLA) must be included within the domain of SLA theory and that variation is actually a part of the learner's competence (Eckman 1996: 6).

In his critique, Eckman (1996) pointed out that the domain of SLA, as well as the nature of a learner's competence, cannot be established on an a priori basis, as Gregg is attempting to do. It can only be established through empirical evidence. However, because the tradition within linguistics and first language acquisition research has been to assume a homogeneous competence, the burden of proof rests upon variationists to

demonstrate that variability should be included within a theory of competence. At the same time, he concedes that there are two ways to argue that variability should be included within a theory of SLA. Those two arguments are:

1. First, if one could show that variability data could be readily accounted for without unduly complicating SLA theory (i.e., a theory of the linguistic competence of the learner), then such data should be included as a part of the theory's domain (11).

2. The second way to present such an argument would be to demonstrate that, by taking variability into account, one could explain some previously unexplained fact, F (12).

This dissertation agrees with Eckman's position. The processing strength account of language transfer, which will be outlined in chapter 2, maintains the traditional assumption that the competence of the learner is homogeneous. Yet at the same time, it is an account which views variation as important. Eckman states that an account need only satisfy one of his two reasons for including it into a theory of SLA, but the processing strength account satisfies both. First, it includes variation without complicating the theory of competence. Within this account, the homogeneity of competence is protected by relegating variation to processing strength inequalities. Processing strength inequalities explain why and how variable output can result from a homgenous competence. It is also an assumption of the processing strength account that transfer related to processing strength inequalities must be variable since processing strength by nature varies during processing. The research reported in this dissertation seeks to demonstrate that the language transfer phenomenon investigated is related to processing strength by establishing a link between error rates and priming which affects processing rather than competence. The processing strength account satisfies the second reason for inclusion into the theory of SLA as well because it explains facts about

language transfer that are otherwise left unexplained. On one hand it explains the specific facts surrounding the acquisition and use of GENDER and CASE in English by native speakers of Chinese. In addition, it provides a general explanation for what Adjemian (1976) calls the permeability of a learner's interlanguage in which his or her interlanguage is "penetrated by rules 'foreign to its internal systematicy'" (Tarone 1988: 30). The processing strength account suggests that the interlanguage competence of the learner is not permeable at all but rather that during processing incomplete accessing of the lerner's competence occurs which in turn leads to production errors.

In summary, the processing strength account of language transfer is orthodox in its acceptance of the homogeneous competence view. In addition, it protects the orthodox position in face of variability by relagating variation to processing characteristics of the system. It is somewhat untraditional, however, in that it not only relegates variation to production features but also specifies what those features are and what the source of the variation is. The result is a statement that lends itself to empirical testing. The purpose of this dissertation is to investigate the assumption that the probabilistic transfer errors that are expected in the use of GENDER in English by native speakers of Chinese are related to processing mechanisms rather than to features of the learner' competence.

Competence-based Accounts of Language Transfer and Probabilistic Error

MacWhinney pointed out when he discussed the uniqueness of his competition model that his model is able to account for probabilistic data, a characteristic that stands in contrast to competence-based accounts. The processing strength account proposed in

this dissertation is also such that it is able to account for probabilistic error. Probabilistic error refers to random error--error which cannot be predicted. The processing strength account is able to make the statement that language transfer exists and that it is manifest in probabilistic error. The competence-based accounts described in this chapter are not able to do so while maintaining a homogeneous competence view.

According to the accounts outlined in this chapter, language transfer arises from (1) gaps in knowledge, (2) an inappropriate hypothesis space or (3) improperly set parameters. If competence can be assumed to be homogeneous, then language transfer should be an all-or-none phenomenon according to these three accounts. The logic is fairly straightforward. A gap in a speaker's competence should always result in productions that are consistent with that gap. If a speaker were to produce sentences that were sometimes accurate--showing that no gap existed--and sometimes produced sentences that were L1-like--showing that a gap does exist--then an account which relates both types of production to competence becomes a variable competence account since there must then be two types of competence. The same would be true of the hypothesis space account or an account based on UG parameters. If two types of production are thought to arise from the competence, then homogeneous competence does not exist. There would have to be two different hypothesis spaces or two different parameter settings at the same time.

The case studied in this dissertation provides an interesting example. If it is true that language transfer can be accounted for only by the structure of a learner's competence then the conclusion for Chinese speakers of English would have to be that there is no language transfer in the use of GENDER during their productions of third-

person-singular pronouns in English since they will frequently produce the correct forms. The L1-like errors would be left over as undefined performance errors. This type of solution is problematic, however, because it fails to explain why the marking of GENDER on third-person-singular pronouns in English proves to be a uniquely difficult problem for native speakers of Chinese both in terms of frequency of error and length of time it persists in a speaker's production. It also raises the question of why CASE marking does not prove to be a problem in the same way that GENDER does since performance errors of the same type would be expected for CASE as well if the error is not L1 related.

The research found in this dissertation uses priming as a means of determining whether the errors in the marking of GENDER during the production of third-person-singular pronouns in English by native speakers of Chinese are competence-based or processing-based. The importance of priming is that it affects processing rather than competence. Therefore, if the error rates of the subjects in this study can be influenced by priming, then the error can be assumed to be processing-related. If they cannot be influenced, then it must be competence-related.

Summary

This completes an overview of the history and current status of language transfer as well as an outline of the basic theoretical concepts relevant to the processing strength account of language transfer. In the following chapter, the underlying assumptions and framework of the processing strength account of language transfer will be explained in greater detail. In addition, a specific case will be proposed for the testing of the claims of the processing strength account along with the general hypotheses that will be the

focus of the research study that will be outlined in the subsequent chapter.

CHAPTER 2

THE PROCESSING STRENGTH ACCOUNT OF LANGUAGE TRANSFER

Introduction

The processing strength account of language transfer is distinct from competence-based and comprehension-based accounts of transfer because it links language transfer to the processing mechanisms and developmental structure of the interlanguage speech production system. Like the competition model, the processing strength account relies on processing features of the system, but unlike the competition model, the focus is on the encoding processes rather than the decoding processes.

In line with the modular approach to language transfer, this account is only intended to explain only a limited set of transfer phenomena. The specific transfer errors that this account is designed to explain are errors in the production of closed-class morphemes such as English pronouns, plural *-s*, past tense, modals, and articles. There is an obvious asymmetry in the occurrence of error in the production of these closed-class morphemes by native speakers in comparison to some non-native speakers of English. In the speech of native speakers, production of closed-class morphemes is highly accurate. For non-native speakers of English from some first language backgrounds, however, the production of some closed-class morphemes in English is marked by L1-like patterns of inaccuracy. Despite this difference in accuracy, there is a

similarity that exists between these two groups in terms of processing, as well. Both the accuracy of the native speakers and the L1-like patterns of some non-native speakers appear to be highly automatic in character. The automaticity of closed-class processing is apparent in native speakers when a slip of the tongue occurs and the correct closed-class morphemes are selected to make the sentence grammatical. Despite the breakdown in production, the production of closed-class elements continues accurately and efficiently. On the other hand, automaticity is evident in the L1-like productions of some non-native speakers by the fact that even when attention is applied to producing the correct form, errors persist. In other words, the L1-like patterns are difficult to alter or suppress. That the processing of closed-class morphemes appears to be highly automatic is an observation that coincides with the expectations of the speech production system as outlined in this work. Because closed-class morphemes are processed at the positional level of the FORMULATOR based solely on the information communicated from the functional level, they are in effect encapsulated. It is this encapsulization that makes their production highly automatic--efficient and accurate (grammatically). It is also this feature that makes them particularly relevant to the processing strength account of language transfer because, as will be explained more fully in the following sections, the processing strength account is designed around the assumption that it is information encapsulization of the processing sub-modules which combines with processing strength inequalities in the developing L2 speech production system to create the potential for processing errors.

Interlanguage Speech Production System Development

The processing strength account assumes that as the interlanguage speech production system develops, warping of the L1 and L2 processing systems can create an environment that leads to processing errors. Because adult learners are typically under pressure to speak from the earliest developmental stages of L2 acquisition, they initially rely largely on their L1 speech production system, or some slight modification of that system. As L2 learning takes place, however, the speech production system is modified to meet the specific processing needs of the L2. From some initial stage, the interlanguage speech production system, ($ISPS_{initial}$) moves toward a more accurate, efficient and complete system. The stages of development can be represented as $ISPS_{(1,2,3,...i)}$. Theoretically, there also exists a final stage ($ISPS_{potential}$), which represents the most accurate, efficient and complete system possible. $ISPS_{potential}$, however, is not identical to the speech production system of a monolingual speaker of the L2 since a bilingual speech production system will always involve some degree of integration. The pattern of interlanguage speech production system development is illustrated in Figure 2.1.

$$\mathbf{ISPS_{initial}} \longrightarrow \mathbf{ISPS_{(1,2,3\ldots)}} \longrightarrow \mathbf{ISPS_{potential}}$$

Figure 2.1. Interlanguage Speech Production System Development.

As the interlanguage speech production system develops, there are two possible situations that might arise within the functional level, which differ in terms of

availability and applicability of similar L1 processing sub-modules. Each leads to a different type of development within the interlanguage speech production system. The first possible situation arises in cases where there is already an L1 sub-module which serves the same processing function as that required by the L2. In a case such as this, no additions or modifications are necessary at the functional level since the L1 processing sub-module can be used during L2 speech production. The second situation arises when there is no functionally equivalent L1 processing sub-module within the functional level of the L1 FORMULATOR that can be used to carry out the necessary L2 processing. In this case, a new sub-module will be built into the functional level for L2 processing.

From the perspective of the processing strength account of language transfer, these two developmental situations result in differing potentials for processing error. The difference in the error potential is presumably due to a predicted difference in processing strength between the L1 processing sub-modules and added L2 processing sub-modules. The first case, in which the L1 processing sub-module is adopted for L2 speech production, no processing strength difference is expected between the overall speech processing system and the sub-module since the relevant sub-module is an original component of the L1 speech production system. In the second case, however, the added sub-module is expected to have a lower processing strength than the overall processing system since it is an addition rather than an original component of the L1 speech production system. The processing inequality that results creates the potential for processing error during speech production.

Processing Strength Inequalities within the Interlanguage Speech Production System

Structurally, the processing strength account of language transfer is based on Garrett's (1988: 78) model of the speech production system (illustrated in Figure 1.3). Garrett's model details the internal structure of what is typically called the FORMULATOR. As part of the speech production system, the FORMULATOR receives a message representation from the inferential processes of the speaker, which it then transforms into a phonetic representation through its own internal processes. Within Garrett's model, the FORMULATOR is divided into two serially ordered processing components, called the functional level and the positional level. When a message arrives from the inferential processes of the speaker, it is first processed at the functional level where the two independent but parallel processes of lexical selection and functional structure determination take place. The final processing step within the functional level is the assignment of the selected lemmas to the argument structure. The eventual output is called the functional level representation, and it serves as the input to the positional level. At the positional level, there are also two independent, parallel processes. One is the retrieval of phonological forms and the other is the determination of syntactic structure. After the retrieved phonological forms are assigned to the syntactic structure, the product--called the positional level representation--then serves as input to the ARTICULATOR.

Figure 2.2 contains a simplified illustration of Garrett's model, in which the independence of the four primary processing modules of the FORMULATOR are more clearly illustrated. Each processing module is enclosed by a box to represent its independence from the other processing modules. The independence of each module is

also illustrated by the arrows which reveal that information flow between modules is strictly one-way.

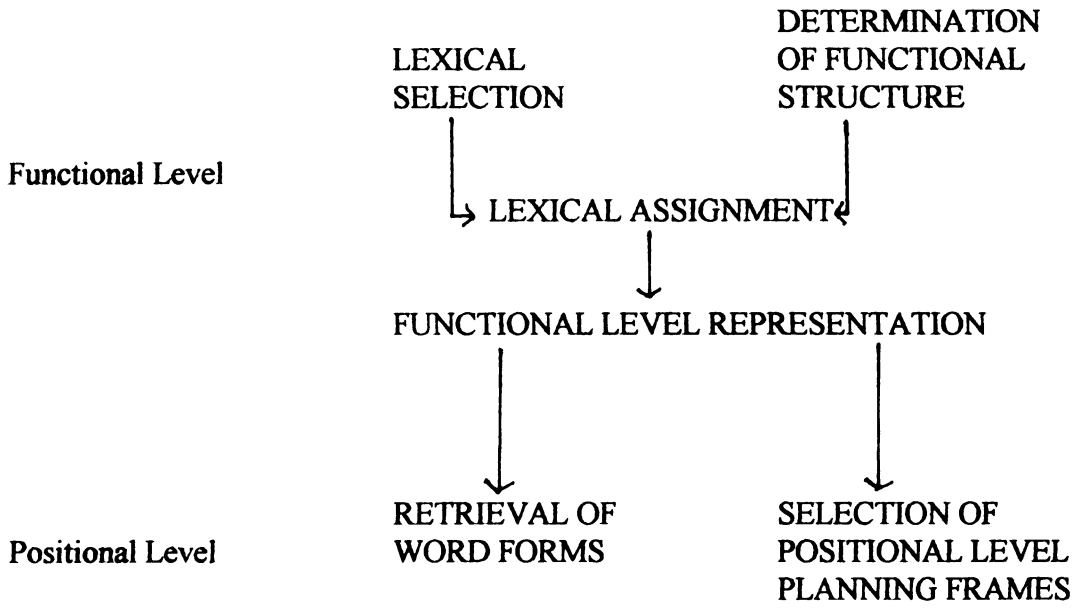


Figure 2.2. A Simplified Illustration of Garrett's Model.

The processing strength account of language transfer hypothesizes that some types of probabilistic, L1-like error in L2 speech production result from processing strength inequalities between a processing sub-module which has been added to the FORMULATOR as part of interlanguage speech production system development and the other sub-modules that composed the original structure of the FORMULATOR as it was constructed for L1 speech production. Processing strength inequalities are relevant to the accurate operation of the system since, as explained in chapter 1, processing strength has been proposed as an explanation for automaticity (Cohen, McClelland and Dunbar

1990). The processing strength explanation of automaticity views automatic processes as existing along a continuum of more or less automatic depending upon the processing strength of intra and inter module connections. In the processing strength account of language transfer, there are two types of connections that can vary in terms of processing strength. The first type of connection are those within the added L2 related processing sub-module--those that make up the internal structure of the added sub-module. The strength of these connections is a function of the amount of use they experience. The second type of connection are those which mediate between the added sub-module and the other sub-modules within the FORMULATOR. The strength of these connections is a function of two things. The first is the amount of use they experience. The second is the degree of integration--unitization--of the added processing sub-module into the overall structure of the FORMULATOR. Unitization has been defined as "the formation and strengthening of direct interassociations among goals in a goal structure" (Brown 1985: 21).

Specifically, the processing strength account of language transfer assumes that processing strength inequalities come about during the development of the interlanguage speech production system as processing sub-modules are added to the L1 FORMULATOR (L1F) in order to modify it for the processing needs of the L2. The added processing sub-modules would be expected to have a lower processing strength by comparison to the sub-modules which were part of the original L1F structure for two reasons. The first is that the added sub-modules have not undergone the same amount of use as the original L1 related sub-modules, particularly initially. The second reason is that since the new sub-modules are additions to the over-all system, they are not as efficiently

unitized into the interlanguage speech production system as they would have been if they were built into the original processing structure during L1 speech production system development. Because the newly added processing sub-module is, in effect, a retrofit, there are compromises made in its structure because it is being fit into an already existing system that would not be made were the system design initially to include it.

The processing strength account of language transfer claims that processing strength inequalities occur at the functional level when an L2 requires information for positional level processing which is not processed at the functional level and passed on to the positional level during the L1 speech production. When this situation arises, a processing sub-module must be added to the functional level as part of the interlanguage speech production system development. Because the added sub-module has a weaker processing strength than the rest of the sub-modules in the functional level, a processing strength inequality exists which leads to the potential for error. The result of this processing strength inequality is that the functional representation--the output from the functional level processes--is sometimes sent to the positional level before the L2-relevant information arrives. Subsequently, the information is lost and processing at the positional level takes place without it. Errors appear probabilistically, as a result. In addition, these errors have L1-like characteristics.

A Case for Examining the Role of Relative Processing Strength in Language Transfer

In order to examine the claims of the processing strength account of language transfer, it is necessary to find cases of L2 speech production in which the L2 requires

the processing and communication of information at the functional level that is not processed for in the speaker's L1. The processing strength account of language transfer predicts that processing inequalities will arise within the functional level of the FORMULATOR in such cases. In addition to finding a case in which processing inequalities are expected to arise, it is important to find a comparable case in which processing inequalities are predicted not to exist. The production of English third-person-singular pronouns by native speakers of Chinese provides just such a case, and is, therefore, an ideal case for investigating the claims of the processing strength account of language transfer.

A comparison of relevant pronouns of English and some Chinese languages (Table 2.1) illustrates that while CASE marking and GENDER marking of third-person-singular pronouns both occur in English, neither occurs in Chinese (Hashimoto 1973; Ball 1888).

Table 2.1. Relevant Mandarin, Cantonese, Hakka and English Pronouns.

PERSON/NUMBER/GENDER/CASE	MANDARIN	CANTONESE	HAKKA	ENGLISH
1st/singular/neutral/subject	*wo*	*ngo*	*ngai*	*I*
1st/singular/neutral/object	*wo*	*ngo*	*ngai*	*me*
1st/plural/neutral/subject	*women*	*ngodei*	*ngaidenngin*	*we*
1st/plural/neutral/object	*women*	*ngodei*	*ngaidenngin*	*us*
2nd/singular/neutral/subject	*ni*	*nei*	*ng*	*you*
2nd/singular/neutral/object	*ni*	*nei*	*ng*	*you*
2nd/plural/neutral/subject	*nimen*	*neidei*	*ndenngin*	*you*
2nd/plural/neutral/object	*nimen*	*neidei*	*ndenngin*	*you*
3rd/singular/masculine/subject	***ta***	***koey***	***gi***	***he***
3rd/singular/masculine/object	***ta***	***koey***	***gi***	***him***
3rd/singular/feminine/subject	***ta***	***koey***	***gi***	***she***
3rd/singular/feminine/object	***ta***	***koey***	***gi***	***her***
3rd/plural/neutral/subject	*tamen*	*koey dei*	*gidenngin*	*they*
3rd/plural/neutral/object	*tamen*	*koey dei*	*gidenngin*	*them*

The surface differences between the pronoun systems of Chinese languages and English suggests that the same type of processing additions would have to be made to the interlanguage speech production system of a native speaker of Chinese in order to process for CASE in English as would have to be made to process for GENDER in English since Chinese pronouns are marked for neither of the two. A more careful consideration of the Chinese speech production system, however, reveals a processing asymmetry between CASE and GENDER. The asymmetry exists because Chinese does not require GENDER information at the positional level of the FORMULATOR, which leads to a system in which it is not required at the positional level and thus would not be processed for at the functional level. On the other hand, CASE information is required at the positional level in Chinese speech production in order to assign arguments to their syntactic positions. Therefore, the functional level within the Chinese speech production system does process for this information and communicate it to the positional level.

The symmetry between CASE and GENDER marking in the surface structure of Chinese combine with the asymmetry in processing for GENDER and CASE within the Chinese FORMULATOR to provide the ideal conditions for investigating the processing strength account of language transfer. As the Chinese L1 FORMULATOR is modified for English speech production during the acquisition of English, a sub-module must be added to the functional level to process for GENDER and communicate it to the functional structure, thus leading to a processing inequality between the original components of the FORMULATOR and the added sub-module. On the other hand, because a Chinese speaker's L1 FORMULATOR already contains a processing sub-module at the functional level which processes for CASE and communicates it to the positional

structure, the L1 sub-module will be used during L2 production resulting in no processing strength inequality between the sub-module and the overall system. The processing strength account of language transfer predicts differences in accuracy as well as speed of development in the production of these two morphological features of English by native speakers of Chinese.

The comparison of CASE and GENDER marking of first-person-singular pronouns in English has an advantage over a comparison of other closed-class morphemes that fit the criteria for this investigation because of the fact that they are conceptually, distributionally and structurally non-complex. For that reason, they would appear to be relatively easy to learn from both a competence and processing perspective, making them particularly suitable for comparing the various perspectives.

General Hypotheses

The research reported in this dissertation will focus on four hypotheses concerning the L2 production of CASE and GENDER forms of third-person-singular pronouns in English by native speakers of Chinese. These four hypotheses are derived directly from the processing strength account of language transfer, and each relates to a distinctly different issue. The first hypothesis is a statement of what is expected if it is true that the functional level structure of the L1 FORMULATOR does affect L2 processing as predicted by the account. The second hypothesis is a prediction of the nature of error pattern if the error rates are due to performance features rather than differing developmental leaps within competence development. The third and fourth hypotheses are statements of the expected results if processing strength is involved in the error

behavior. Each of these hypotheses is explained individually below.

Hypothesis #1

The first hypothesis is the most foundational of the four. It is based on the assumption of the processing strength account that if a processing sub-module must be added to the functional level of the FORMULATOR in order to process information required for the production of L2 closed-class forms at the positional level, then those forms will be marked by probabilistic error. The comparison between the accuracy of CASE marking versus the accuracy of GENDER marking of pronouns will provide evidence relevant to this hypothesis. The processing strength account predicts that all subjects who participate in the study will mark CASE on third-person-singular pronouns very accurately--at a rate of error exceeding one standard deviation from the actual mean rate of error--independent of the rate of error in marking GENDER. This is expected because the functional level of the L1 FORMULATOR for native speakers of Chinese processes for CASE information and communicates it to the positional level. Therefore, there is expected ot be no processing strength inequality in the interlanguage speech production system in this case since no processing sub-module is added. On the other hand, the processing strength account predicts that a substantial number--more than 16 percent (within one standard deviation of the mean for a normal population)--of the subjects in the study will exhibit a high rate of error--at a rate within one standard deviation from the actual mean rate of error--in marking GENDER on third-person-singular pronouns in English. This is expected because the functional level of the L1 FORMULATOR for native speakers of Chinese does not process for GENDER and communicate it to the positional level. Consequently, a processing sub-module must be

added to the FORMULATOR to handle the requirements of English speech production. The result is a processing inequality between the added sub-module and the overall production system.

Hypothesis #2

The second hypothesis is based on the assumption that the expected error in the marking GENDER on English third-person-singular pronouns in English by native speakers of Chinese is a processing problem, rather than a problem of inaccurate or incomplete linguistic competence. This hypothesis makes two predictions about the error behavior expected by the subjects in this study. The first prediction is that a substantial number--more than 16 percent (within one standard deviation of the mean for a normal population) --of the subjects will exhibit error behavior that is probabilistic rather than all-or-none in nature. Error rates within one standard deviation from the actual mean rate of error will be considered probabilistic. The second prediction is that the rates of GENDER error among subjects will fall along a continuum of relatively higher and lower rates of error, which would be indicative of incremental developmental changes that occur in performance development, rather than fall in groups or at the ends of the continuum as would be expected if restructuring of linguistic competence were occurring with its associated developmental leaps.

Hypothesis #3

The third hypothesis relates specifically to the involvement of processing strength in the expected error behavior. It is based on the assumption that the expected error is due to processing strength inequalities between an added sub-module and the overall speech production system. As discussed previously, processing strength can be

affected by previous activation in two ways. One is through priming and the other is through selective attention. For this reason, this investigation contains two different tasks intended to provide evidence about the affects of priming and attention on error rates. In the first task, pronouns are produced in a sentence generation task under 3 different priming conditions--a zero priming condition (no third-person-singular pronoun in the priming sentence), an inhibitory priming condition (the priming sentence contains a third-person-singular pronoun of the alternative GENDER) and an excitatory priming condition (the priming sentence contains a third-person-singular pronoun of the same GENDER). When mutually exclusive options exist within a processing system, inhibitory primes and excitatory primes have differential effects on the alternative processing pathways. An excitatory prime involves the previous activation of the pathway that will be used in subsequent production. Because it is activated, its processing strength has been temporarily increased. On the other hand, an inhibitory prime is the activation of the alternative pathway rather than the one to be used in subsequent production. In this case, the pathway to be used has been inhibited during the activation of the alternative pathway, thus leading to a temporary decrease in processing strength. The hypothesis, then, is that if processing strength is involved, then the inhibitory priming condition should increase the rate of error relative to the zero priming condition, and the excitatory priming condition should decrease the rate of error in comparison to the zero priming condition. The expected pattern then is that the error rate associated with the inhibitory priming condition will be highest, the error rate associated with the excitatory priming condition will be lowest and the error rate associated with the zero priming condition will fall between the other two.

In the second task relevant to this hypothesis, subjects tell a story from a picture book. Task II is intended to affect processing strength through attention. Because story telling requires the storing and coordination of information, this task is presumed to be more attentionally demanding than the production of individual sentences. It is assumed therefore that subjects have more attention available to direct toward the accurate production of GENDER-marked pronoun forms in the sentence production task than in the story telling task. The hypothesis predicts a higher rate of error when telling the story than when doing the sentence generation task.

Hypothesis #4

The fourth hypothesis also relates to the processing strength dimension of the account although somewhat less directly. It is based on the assumption that the relative processing strength of the added sub-module is directly related to the rate of error that will be observed in the production of third-person-singular pronouns of a given speaker. Not only is it expected to relate to the overall rate of error, but to the type of effect that the inhibitory priming condition and the excitatory priming condition have upon the error rates. At lower levels of processing proficiency, the inequality between the added sub-module and the overall system is greater. The excitatory priming condition in this situation should have less effect because an increase in processing strength would still fail to increase processing strength sufficiently to cause consistently accurate production. The inhibitory priming condition should have a greater effect, however, because the likelihood of the sub-module keeping up with the overall system when inhibited becomes extremely small. At a higher level of processing proficiency, the opposite situation is expected. Because the speed of the sub-module is nearly equal to

the overall system at the highest levels of proficiency, then the excitatory priming condition should have a relatively large effect. A small increase in processing strength would normally assure that the sub-module will keep up. On the other hand, the inhibitory priming condition would not inhibit a sub-module with an internally high processing strength sufficiently to have a substantial effect. This hypothesis would be confirmed if the effect of the primes varied with the degree of processing proficiency the speaker has achieved. The processing strength account predicts that inhibitory primes will have a greater effect at lower levels of processing proficiency and a smaller effect at higher levels of processing proficiency. In contrast, the excitatory primes will have a greater effect at higher levels of processing proficiency and a smaller effect at lower levels of processing proficiency.

CHAPTER 3

RESEARCH DESIGN AND EXPERIMENTAL PROCEDURES

Introduction

Two experimental tasks were selected to test the claims of the processing strength account of language transfer. These tasks were designed to focus specifically on the marking of CASE and GENDER on third-person singular pronouns in the L2 English of native speakers of Chinese.

Experimental Task I

Method

The first experimental task was patterned after a method that has been used to investigate the structure and processes of the speech production systems of both native speakers of English (Bock and Loebell 1990; Bock, Loebell and Morey 1992) and German-English bilingual speakers (Loebell 1989). The method is based on the use of a sentence elicitation procedure and sentential primes. The method used for Task I involved the use of pictures designed to elicit the production of both the masculine and feminine forms as well as the subject and object forms of English third-person singular pronouns. Each of the pictures used to elicit the production of these pronoun forms had a priming sentence associated with it. The priming sentences created one of the three

priming conditions in the task. The three priming conditions were:

Inhibitory priming: an inhibitory priming condition existed when the associated priming sentence contained a third-person-singular pronoun of GENDER or CASE which was different from that of the singular human image in the picture. For example, a priming sentence intended to inhibit GENDER would contain a masculine third-person-singular pronoun if the picture had the image of a woman. If the picture had an image of a man then the inhibitory priming sentence would contain a feminine third-person-singular pronoun. If, on the other hand, the inhibitory priming sentence was intended to inhibit CASE, then the priming sentence would contain a third-person-singular pronoun in the subject position if the picture contained a human image in the object position--the right side of the picture-- and a third-person-singular pronoun in the object position if the picture contained a human image in the subject position--the left side of the picture.

Excitatory priming: an excitatory priming condition existed when the associated priming sentence contained a third-person-singular pronoun of GENDER or CASE which was the same as that of the singular human image in the picture. For example, a priming sentence intended to excite GENDER would contain a feminine third-person-singular pronoun if the picture contained the image of a woman. If the picture contained the image of a man, then an excitatory priming sentence would contain a masculine third-person-singular pronoun. On the other hand, if the priming sentence was intended to excite CASE, then the priming sentence would contain a third-person-singular pronoun in the subject position if

the picture had a single human figure on the left side of the picture and a third-person-singular pronoun in the object position is the picture had a single human figure on the right side of the picture.

Zero priming: a zero priming condition existed when the associated priming sentence contained no third-person-singular pronoun. In this case, it was assumed that no priming would occur.

Appendix A contains a sample of the pictures used for sentence elicitation, along with examples of the various types of priming conditions that could exist for that picture.

The elicitation task was embedded within a picture memory task in order to conceal the actual focus of the experiment. The subjects were given a set of pictures which contained images of people, various business signs, and types of buildings. They were then told to examine these pictures in order to remember them well enough to recognize them if they appeared later in the sentence elicitation pictures. As can be seen in example B, which contains samples of the pictures given to each subject to remember, these were single images of people, buildings and business signs. The sentence elicitation pictures were built from pictures like these memory pictures. This aspect of the task served two purposes. The first was to distract the subjects from the actual purpose of the task, which was to evaluate the accuracy of their production of third-person-singular pronouns in terms of CASE and GENDER marking. The second purpose was to increase the attentional demand of the task with the assumption that it would reduce the amount of attention that subjects could focus on grammaticality. This was particularly important because there was no time limit placed upon subjects as they proceeded through the task.

Subjects

The 44 subjects were native speakers of various dialects of Chinese who were undergraduate students studying English at South China University of Technology in Guangzhou, The People's Republic of China. Their median age was 20 years (range 17-23 years) old and their median length of English study was 8 years (range 5-14 years). Eight first-year students, eleven second-year students, thirteen third-year students and twelve fourth-year students participated in Task I. The age, length of English study, gender and native dialect of each subject are listed in Appendix C. All subjects were volunteers and did not receive compensation for their participation.

Materials

As mentioned, Task I was designed to look like a memory task. However, its actual purpose was to elicit each of the GENDER and CASE forms (*he, him, she, her*) investigated in this study under each of the three possible priming conditions (zero priming, inhibitory priming and excitatory priming). The full test consisted of 120 pictures and their associated priming sentences. Each of the pictures had the same general structure. Each picture contained two images (only one singular human image), a written verb and a written time phrase. The components of each picture were ordered so that the subject was on the left side of the page, the verb was below the subject, the object was to the right of the verb and the time phrase was on the right side of the page. An example of the type of picture used in this task can be found in Appendix A. There were twelve possible combinations between the forms (subject/masculine, subject/feminine, object/masculine and object/feminine) and the types of priming conditions. For the full test, each of the twelve combinations was represented by ten

pairs which matched a priming sentence and an elicitation picture. In addition to the sentence elicitation pictures, there was a set of pictures which served as the focus of the memory task component. During actual testing, it became apparent that lower level students could not complete the entire 120 sentence elicitation task because they were too slow. Therefore, the number of sentences was reduced as class levels became lower. Appendix D lists the length of the test given to each student.

Procedure

For Task I, subjects were told that they were participating in a psycholinguistic experiment, but were not told the specific purpose of the experiment. Each subject was shown a set of pictures containing images of people, business signs and buildings and told to look at them until they could remember them well enough to recognize them in a large picture. Specifically, they were told that they would be shown a series of pictures which might contain one of the images within it, and that they would have to say whether or not the picture contained one of those images by saying either "yes" or "no". The subjects were given as much time as they needed to feel confident that they had sufficiently remembered the set of pictures.

Following those initial instructions and the opportunity to remember the initial set of images, subjects were instructed in the procedural pattern for the task itself. They were told that they would hear a sentence read by the investigator which they were to recite out loud exactly as they had heard it. Following their recitation, they would be shown a picture which they were to observe, determine whether or not any of the images from the initial set of pictures appeared in the picture and then compose a sentence based on the picture. Subjects were specifically instructed how to compose a sentence from the

picture. They were told to use the image on the left of the page as the subject and the image on the right side of the page as the object of the sentence they were to form. They were instructed to use the verb which was written at the bottom of the picture and to use an appropriate tense based on the time phrase written on the picture. They were also told to use pronouns for all human images in order to simplify the task and promote consistency from picture to picture. Finally, they were instructed that when they had finished looking at the picture they should nod their heads. Subjects were told that at that time the picture would be removed and they should say "yes" or "no" to indicate whether or not any of the images from the initial set of memory pictures had appeared in the picture they had just viewed. The last step in the procedure was to say their sentence for the picture they had just viewed. This procedure was repeated for every sentential prime/picture pair. After receiving these instructions and before conducting task I, the subjects were trained with four examples each to assure that they understood the procedure. During the performance of the task, each subject wore a lapel microphone for the purpose of audio-recording their sentences. Subjects were given as much time as they needed to observe each picture, decide on whether or not any of the initial images were present, form a sentence for the picture and say the sentence. If subjects failed to follow the procedure, they were corrected before the next priming sentence was given. In general, there was no other correction given except under the condition that a subject forgot the picture interpretation procedure and produced subject or object forms in the unintended argument positions over a number of pictures.

The following is a sample narrative of what a typical subject might have heard and said during Task I:

Examiner: In a little while I will show you a number of pictures. Each one represents a sentence that I would like you to say. Some of those pictures will contain pictures from this set (subject is shown the memory set). You will need to be able to tell me whether any of these pictures appears the the pictures you will see later. I want you to take as much time as you need to be able to remember these pictures if you see them again.
(After several minutes have passed.)
Are you finished?

Subject: Yes.

Examiner: For this task, I will first read a sentence that I want you to listen to and then repeat out loud exactly as you heard it. After you repeat the sentence, I will show you a picture like this (subject was shown a sample picture) that represents a sentence. I want you to look at it and see if any of the memory pictures appears in this picture or not. I also want you to form a sentence from the picture that I show you. You should use the image on the left [pointing] as the subject of your sentence and the image on the right [pointing] as the object of your sentence. Use the verb that is written at the bottom of each picture and use a tense that fits the time phrase that is written on the picture. When you see a person or a group of people in the picture, then just use a pronoun like "he" or "she" or "they". This will make it consistent from picture to picture and easier for you. When you have finished looking at the picture, nod your head like this [demonstrating] and I will take the picture away. At that time, I want you to say either "yes" or "no" to indicate whether the picture contained one of the pictures from the memory set or not. After you say "yes" or "no" I want you to say your sentence out loud. Is that clear?

Subject: Yes.

Examiner: Then let's try some examples.
The truck hit him yesterday.

Subject: The truck hit him yesterday.

Examiner: (Shows the subject the first practice picture).
(Subject nods).
Was there a picture from the memory set?

Subject: No.
She cooked pizza last night.
(The practice was repeated three more times).

Examiner: Ok. Let's begin the actual test.

Experimental Task II

Method

Task II was a story telling task in which subjects told the story of a little girl from a picture book. This task was intended to provide a more attentionally demanding task for comparison with the sentence elicitation task in Task I. The need for this comparison was based on the common assumption within cognitive science that the human processing system is characterized by its limited processing capacity (Carr and Curran 1994; Tomlin and Villa 1994: 189). Because story telling should require the use of more processing resources than simply producing sentences from a picture, it was expected that processing resources would be spread out more thinly during production. The observable effect of spreading processing resources more thinly by introducing a more demanding task is typically a deterioration in performance (Carr and Curran 1994: 219). The processing strength account of language transfer specifies that in the case examined in this dissertation, the deterioration will occur in the production of third-person-singular pronouns because the processing strength inequality for the processing of GENDER will become magnified. This is predicted because under a situation where more processing resources are available to the speaker, he/she would presumably allocate some of those resources to the strengthening of the weaker pathways. The result would be the increased efficiency of the GENDER related pathways. When those processing resources are not available, as should be the case in Task II, efficiency should decrease resulting in higher rates of error.

While Tasks I and II were selected because of their differing processing demands, they were intended to differ as little as possible in terms of focus on form (as defined

within the Labovian paradigm). Within the Labovian paradigm, attention to form is caused by a speaker's concern with whether his or her social status is being assessed by the listener (Ellis 1989: 29). For Tasks I and II, there should be little difference in the subject's concern with social status for two reasons. The first is that the context remains the same in a number of ways. Both tasks are part of a research task. In addition, the two tasks occurred during the same meeting and in the same place, the investigator was the same, and both tasks were tape recorded. The second reason is that there is a great deal of overlap in the basic form of the two tasks since both tasks involve the production of language from pictures. Tarone (1988: 77) has pointed out that some studies have compared tasks that would vary in rates of error because of the degree of attention to form that they encourage from the subject. As an example, she mentions four tasks used in a Bialystok study. Those tasks ranged from "(1) a multiple-choice grammar test where the most attention to form might be expected, through (2) a written discourse-completion task and (3) an oral interview, to (4) an unstructured oral discourse." By selecting tasks that are more similar in context and design than those mentioned by Tarone, it was intended that available attentional resources would differ between Tasks I and II but that attention to form itself would not differ between the two tasks.

Subjects

51 native speakers of various dialects of Chinese participated in Task II. 41 of the 51 subjects who participated in Task II had also participated in Task I. All of the subjects were undergraduate students studying English at South China University of Technology in Guangzhou, The People's Republic of China. Their median age was 20 years (range 17-23 years) and their median length of English study was 8 years (range 5-

14 years). Eleven first-year students, thirteen second-year students, fourteen third-year students and thirteen fourth-year students participated in Task II. The age, length of English study, gender and native dialect of each subject is listed in Appendix E. All subjects were volunteers and received no compensation for their participation.

Materials

The materials used for this task were two story books, *Sunshine* (1981) and *Moonlight* (1982) by Jan Ormerod. The entire story found in each book is related solely through a series of pictures. The books contain no words. Both of the stories revolve around the activities of a little girl and her parents one morning and one evening, respectively.

Procedure

For Task II, each subject was given one of the story books and told to go through the book page by page and tell the story about the little girl. They were specifically instructed not to describe each picture, but to tell a story. Subjects were also instructed not to give the girl a name but rather to simply call her "little girl." In addition, subjects were told that the adult characters were the little girl's mother and father. During the telling of the story, if a subject needed help with a specific vocabulary word, the researcher provided it for the subject. Subjects were permitted to tell the story at their own pace, and just as with Task I, the story was audio-recorded.

Summary of the Specific Hypotheses

Four general hypotheses and their justifications were described in general at the end of Chapter 2. For the purpose of evaluation, those hypotheses are now stated as follows:

Hypothesis #1 -

All subjects will mark CASE on English third-person-singular pronouns very accurately--at a rate of error exceeding one standard deviation from the actual mean rate of error--while a substantial number--more than 16 percent (within one standard deviation of the mean for a normal population)--will mark GENDER on English third-person-singular pronouns at a low rate of accuracy--at a rate within one standard deviation from the actual mean rate of error.

Hypothesis #2a -

A substantial number--more than 16 percent (within one standard deviation of the mean for a normal population)--of the subjects will exhibit error behavior in the marking of GENDER on English third-person-singular pronouns that is probabilistic--defined as error rates within one standard deviation from the actual mean rate of error--rather than either/or in nature.

Hypothesis #2b -

Individual rates of error in marking GENDER on English third-person-singular pronouns will fall along a continuum of higher and lower rates of error rather than be grouped into sets or fall at the ends of the continuum.

Hypothesis #3a -

The inhibitory priming condition will be associated with a greater rate of error in the marking of GENDER on English third-person-singular pronouns in comparison to the zero priming condition, and the excitatory priming condition will be associated with a lower rate of error in comparison to the zero priming condition.

Hypothesis 3b -

The rate of error in marking GENDER for English third-person-singular pronouns will be greater for Task II than for Task I.

Hypothesis #4 -

The inhibitory priming condition will have a greater effect upon error rates at lower levels of processing proficiency and a lesser effect upon error rates at higher rates of processing proficiency. In contrast, the excitatory priming condition will have a greater effect at higher rates of processing proficiency and a lesser effect at lower levels of processing proficiency.

CHAPTER 4

DESCRIPTION OF RESULTS

Overview of analysis

For purposes of statistical analysis, subjects were grouped in three different manners. Initially, statistical analysis was conducted on the data from the total subject group. Analysis was also conducted on the results of each of the four class years. Finally, subjects were ranked according to their over-all rates of accuracy on GENDER marking of pronouns and divided into three groups representing high, mid and low processing proficiency. This last grouping is assumed to reflect the relative proficiency processing of subjects better than class-year membership since within this account accuracy is assumed to be a measure of processing proficiency. This third grouping was necessary in order to provide additional information for the final hypothesis that the relative effecst of inhibitory and excitatory priming would differ at differing levels of processing proficiency.

Two statistical tests were conducted on the data from Task I. One test was the Kruskal-Wallis (KW) test, which is a non-parametric analysis of variance. This test was used to determine whether differences in error rates associated with each of the three priming conditions were statistically significant or not. A second test was the Mann-Whitney (MW) test, which is a non-parametric t- test. It was used to compare pairs of

priming conditions in an attempt to determine specific sources of significance within the data. For example, it was performed on the zero prime condition and each of the other two sets of priming conditions to determine whether the differences in error rates were significant or not.

For the Task II data, only the KW test was used. It was performed on two types of data. The first was on the error rates of masculine and feminine pronouns following masculine and feminine referents (both pronominal and non-pronominal) to determine whether the difference in the rates was significant or not. The purpose was to examine the potential effect of referential priming of GENDER. The second type of data on which it was performed was on the error rates of the two types of pronoun priming conditions that arose in the story. Pronoun priming is defined as the production of a pronoun that was preceded by the utterance of a pronoun in the previous sentence. This kind of priming is equivalent to the type of priming that occurred in Task I. In the story there was no equivalent of the zero priming condition in Task I, but there were inhibitory and excitatory priming conditions in cases where a referent was preceded by a pronoun of the same or different GENDER. In other words, a referent preceded by a pronoun of the same GENDER constituted a case of excitatory priming and a referent preceded by a pronoun of the other GENDER constituted a case of inhibitory priming.

The results of Tasks I and II are described in the following two sections. The results of each task are organized in order of the specific hypotheses listed at the end of Chapter 3.

Task I Results

CASE and GENDER Error Rates

The first and most basic hypothesis in this study concerned whether or not the processing strength account of language transfer is accurate in its claim that differences in the L1 FORMULATOR of native speakers of Chinese would result in differences in production of CASE and GENDER forms of third-person-singular pronouns in English. The hypothesis was stated as follows:

> ***Hypothesis #1 -***
>
> *All subjects will mark CASE on English third-person-singular pronouns very accurately--at a rate of error exceeding one standard deviation from the actual mean rate of error--while a substantial number--more than 16 percent (within one standard deviation of the mean for a normal population)--will mark GENDER on English third-person-singular pronouns at a low rate of accuracy--at a rate within one standard deviation from the actual mean rate of error.*

This first hypothesis was supported because the rate of CASE error for all subjects exceeded one standard deviation from the mean rate of error, while 35 subjects (79%) had GENDER error rates within one standard deviation of the actual mean. Among the 44 subjects who participated in Task I, only one subject (2%) produced a CASE error (subject #2-4). In this case, she used a subject-marked feminine pronoun in the object position of the sentence and immediately corrected it. This error resulted in an error rate for CASE marking by this subject of 1.7 percent. In contrast to this lack of CASE errors in production of third-person-singular pronouns, 41 out of the 44 subjects (93%) who

participated in Task I produced GENDER errors. The rates of GENDER error for those 41 subjects ranged from 2 percent to 26 percent, and averaged 8.4 percent overall.

The Developmental Pattern

The second hypothesis was concerned with the question of whether or not the expected error behavior was performance-based, as expected by the processing strength account, rather than competence-based. This hypothesis entailed two different predictions. The first was stated as follows:

> ***Hypothesis #2a -***
>
> *A substantial number--more than 16 percent (within one standard deviation of the mean for a normal population)--of the subjects will exhibit error behavior in the marking of GENDER on English third-person-singular pronouns that is probabilistic--defined as error rates within one standard deviation from the actual mean rate of error--rather than either/or in nature.*

The second prediction was stated as follows:

> ***Hypothesis #2b -***
>
> *Individual rates of error in marking GENDER on English third-person-singular pronouns will fall along a continuum of higher and lower rates of error rather than be grouped into sets or fall at the ends of the continuum.*

Both predictions were supported by the results. Hypothesis #2a was supported by the fact that a substantial number of subjects--30 out of 44 (68%)--exhibited error patterns in marking GENDER that were probabilistic--between 2 percent and 14 percent. Hypothesis #2b was supported by the fact that the error rates of the 44 subjects were spread quite

evenly across a broad range. Analysis showed that the difference between adjacent subjects on the error rate curve ranged from 0 to 3 percent, and that the average difference between adjacent subjects was 0.6 percent. The error rate curve for Task I, in Figure 4.1, illustrates the evenly-spaced character of the individual error rates. Clearly, error rates did not fall at the ends of the error-rate spectrum or in groups, but are spread over the whole range.

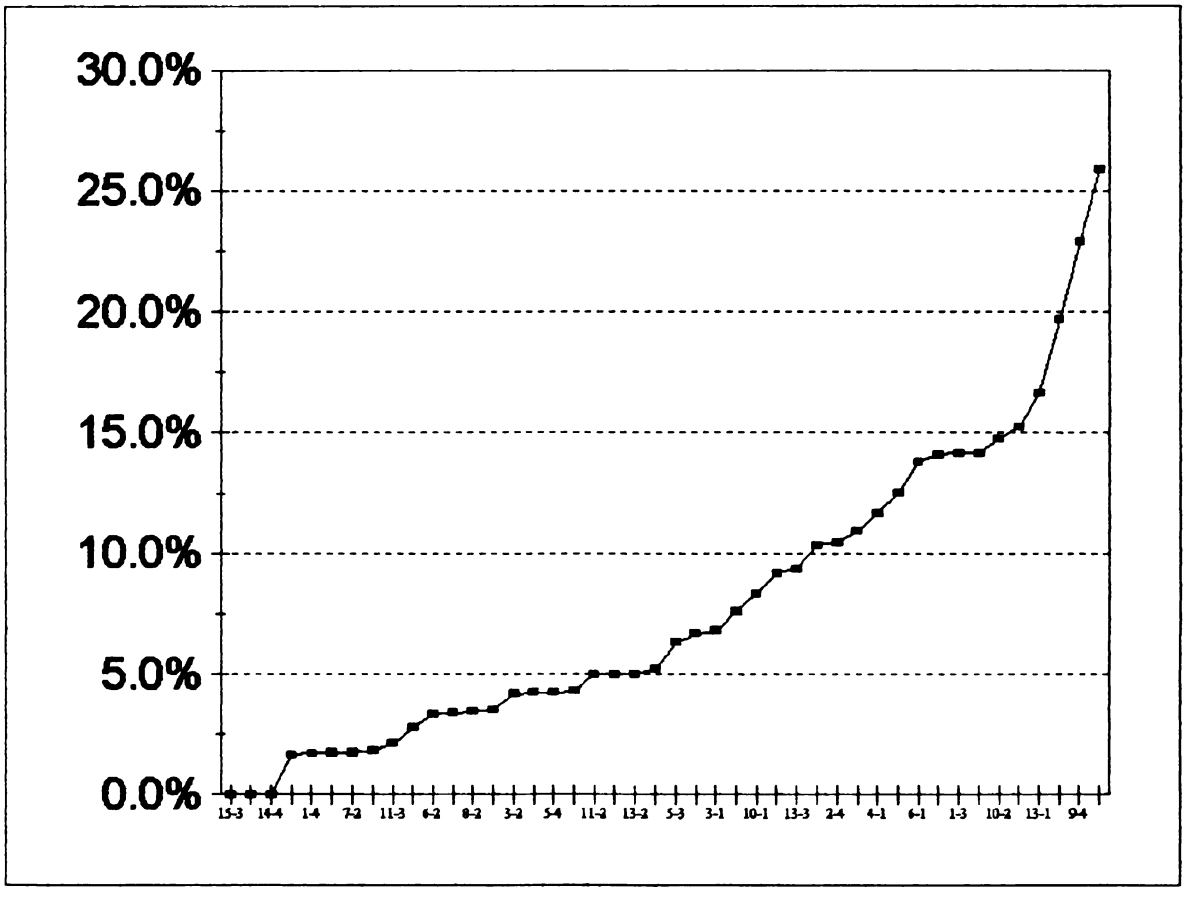


Figure 4.1. Individual Rates of GENDER Error on Task I.

The Effect of the Three Priming Conditions upon Error Rates

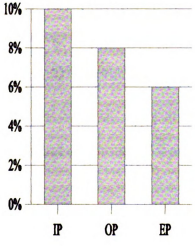
The third hypothesis also entailed two predictions, but only the first one was relevant to Task I. It predicted differential effects for the three different priming conditions upon rates of error in marking GENDER on English third-person-singular pronouns. This first prediction was stated as follows:

> ***Hypothesis #3a -***
>
> *The inhibitory priming condition will be associated with a greater rate of error in the marking of GENDER on English third-person-singular pronouns in comparison to the zero priming condition, and the excitatory priming condition will be associated with a lower rate of error in comparison to the zero priming condition.*

The hypothesis did not hold for each individual, but there was an overall pattern among the subjects supporting the hypothesis which proved to be statistically significant. Of the 41 out of the 44 subjects who produced GENDER errors in their pronoun production, 26 (63%) had greater rates of error associated with the inhibitory priming condition than associated with the zero priming condition. 12 subjects (29%) had a lower rate of error associated with the inhibitory priming condition than associated with the zero priming condition, and 3 (8%) had the same error rates associated with these two conditions. Of those same 41 subjects, 22 (54%) had lower rates of error associated with the excitatory priming condition than associated with the zero priming condition, 14 (34%) had higher error rates and 5 (12%) had the same error rates under both conditions.

A comparison of the average rates of error associated with each of the three priming conditions for the entire group reveals conformity to the pattern predicted by the

hypothesis. The average rate of error associated with the inhibitory priming condition was 2 percent greater than the average rate of error associated with the zero priming condition, and the average rate of error associated with the excitatory priming condition was 2 percent smaller than rate of error associated with the zero priming condition. The Kruskal-Wallis analysis of variance found that the differences between the rates of error associated with each priming condition were significantly different ($p = 0.04$). Figure 4.2 illustrates the average rates of error associated with each of the priming conditions as well as the results of the KW analysis of variance.



KRUSKAL-WALLIS

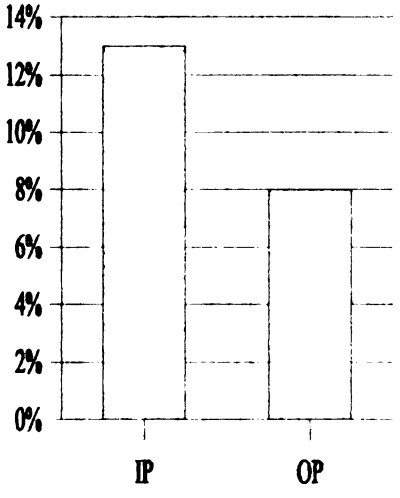
TYPE OF PRIME	*MEDIAN RATE OF EROR*	*AVERAGE RATE OF ERROR*	*COMBINED RATE OF ERROR*
Inhibitory	0.09	0.10	0.10
Zero	0.07	0.08	0.08
Excitatory	0.05	0.06	0.06

$p = 0.04$

Figure 4.2. Average Rates of GENDER Error for the Three Priming Conditions.

In order to isolate the source of the significance, Mann-Whitney tests were performed on the various pairs of priming conditions within the overall data. For the feminine referents, the rate of error associated with the inhibitory priming condition was 5 percent greater than the rate of error associated with the zero priming condition while

the rate of error associated with the excitatory priming condition was 1 percent greater than the rate of error associated with the zero priming condition. MW tests revealed that the difference between the inhibitory priming and zero priming conditions was statistically significant ($p = 0.03$) while the difference between the excitatory priming and zero priming conditions was not significant ($p = 0.92$) for feminine referents. For masculine referents, the rate of error associated with the inhibitory priming condition was the same as the rate of error associated with the zero priming condition, and the rate of error associated with the excitatory priming condition was one percent smaller than the rate of error associated with the zero priming condition. MW tests revealed that in these cases, the non-difference between the inhibitory priming and zero priming conditions was non-significant ($p = 0.57$) while the difference between the zero priming and excitatory priming conditions was narrowly significant ($p = 0.056$; $p = 0.04$, *adjusted for ties*). The average rates of error for these different conditions are illustrated in Figures 4.3 through 4.6 along with the results of the MW tests.

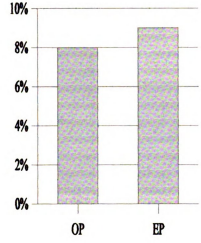


MANN-WHITNEY

TYPE OF PRIME	*MEDIAN RATE OF ERROR*	*AVERAGE RATE OF ERROR*	*COMBINED RATE OF ERROR*
Inhibitory	0.105	0.13	0.13
Zero	0.05	0.08	0.09

$p = 0.03$

Figure 4.3. Average Rates of GENDER Error for Feminine Referents Associated with the Zero Priming and Inhibitory Priming Conditions for the Total Group.

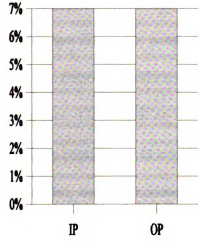


MANN-WHITNEY

TYPE OF PRIME	*MEDIAN RATE OF ERROR*	*AVERAGE RATE OF ERROR*	*COMBINED RATE OF ERROR*
Zero	0.050	0.08	0.09
Excitatory	0.057	0.09	0.09

p = 0.92

Figure 4.4. Average Rates of GENDER Error for Feminine Referents Associated with the Zero Priming and Excitatory Priming Conditions for the Total Group.

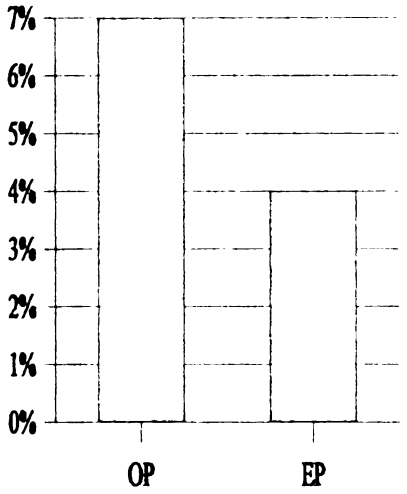


MANN-WHITNEY

TYPE OF PRIME	*MEDIAN RATE OF ERROR*	*AVERAGE RATE OF ERROR*	*COMBINED ATE OF ERROR*
Inhibitory	0.00	0.07	0.06
Zero	0.05	0.07	0.06

p = 0.59

Figure 4.5. Average Rates of GENDER Error for Masculine Referents Associated with the Inhibitory and Zero Priming Conditions for the Total Group.



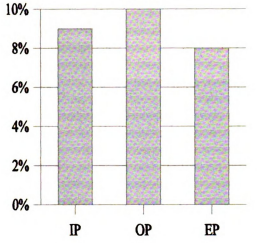
MANN-WHITNEY

TYPE OF PRIME	*MEDIAN RATE OF ERROR*	*AVERAGE RATE OF ERROR*	*COMBINED RATE OF ERROR*
Zero	0.05	0.07	0.06
Excitatory	0.00	0.04	0.03

p = 0.056; 0.04 (adjusted for ties)

Figure 4.6. Average Rates of GENDER Error for Masculine Referents Associated with the Zero Priming and Excitatory Priming conditions for the Total Group.

Because of the small size of each class, it was not expected that a statistically significant difference would be found between the three different priming conditions. For this reason, hypothesis #3a was not stated in terms of individual class results. However, it is interesting to note that the predicted pattern in which the inhibitory priming condition was associated with a higher rate of error than the zero priming condition, and the excitatory priming condition was associated with a lower rate of error was generally evident within each class. Figures 4.7 through 4.10 contain graphic comparisons of the average rates of error associated with each of the three priming conditions for each class level.

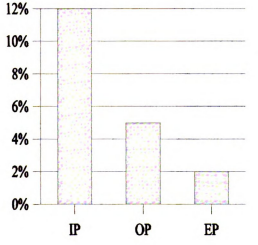


KRUSKAL-WALLIS

TYPE OF PRIME	*MEDIAN RATE OF ERROR*	*AVERAGE RATE OF ERROR*
Inhibitory	0.10	0.09
Zero	0.09	0.10
Excitatory	0.07	0.08

p = 0.824

Figure 4.7. Average Rates of GENDER Error Associated with the Three Priming Conditions for First-Year Students .

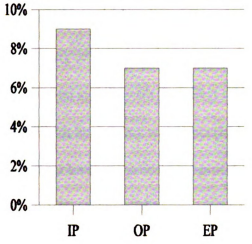


KRUSKAL-WALLIS

TYPE OF PRIME	*MEDIAN RATE OF ERROR*	*AVERAGE RATE OF ERROR*
Inhibitory	0.09	012
Zero	0.04	0.05
Excitatory	0.00	0.02

p = 0.003

Figure 4.8 Average Rates of GENDER Error Associated with the Three Priming Conditions for Second-Year Students .

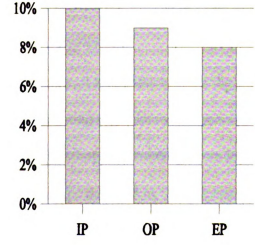


KRUSKAL-WALLIS

TYPE OF PRIME	*MEDIAN RATE OF ERROR*	*AVERAGE RATE OF ERROR*
Inhibitory	0.09	0.09
Zero	0.07	0.07
Excitatory	0.07	0.07

p = 0.911

Figure 4.9. Average Rates of GENDER Error Associated with the Three Priming Conditions for Third-Year Students .



KRUSKAL-WALLIS

TYPE OF PRIME	*MEDIAN RATE OF ERROR*	*AVERAGE RATE OF ERROR*
Inhibitory	0.09	0.10
Zero	0.08	0.09
Excitatory	0.05	0.08

p = 0.723

Figure 4.10. Average Rates of GENDER Error Associated with the Three Priming Conditions for Fourth-Year Students .

Relationship Between Priming Condition Effects and Processing Proficiency

The fourth hypothesis was also concerned with the effect of the inhibitory and excitatory priming conditions upon error rates, but unlike the third hypothesis which was concerned simply with the effect of the priming conditions upon error rates in general, the fourth hypothesis was concerned with the relative effect of the priming conditions at different levels of processing proficiency. The fourth hypothesis was stated as follows:

Hypothesis #4 -

The inhibitory priming condition will have a greater effect upon error rates at lower levels of processing proficiency and a lesser effect upon error rates at higher rates of processing proficiency. In contrast, the excitatory priming condition will have a greater effect at higher rates of processing proficiency and a lessereffect at lower levels of processing proficiency.

Originally, it was expected that the 4 class levels would represent different levels of processing proficiency. However, the results for the four class levels revealed no overall pattern in error rates from level to level and no significant difference between the four groups themselves. These results imply that there is no reliable relationship between class membership and processing proficiency of GENDER marking. Figure 4.11 contains a graphic comparison of the average error rates of the four classes.

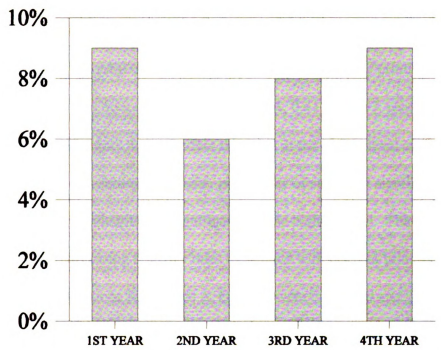


Figure 4.11. Average Rate of GENDER Error for Each of the Four Class Levels.

Because class level participation was not a predictor of processing proficiency (as measured by accuracy), subjects were ranked by overall rate of GENDER error on pronoun use and then divided into three groups according to that ranking. Group A was composed of the 14 most accurate subjects, Group B was composed of the 16 intermediate subjects, and Group C was composed of the 14 least accurate subjects. Overall rates of error in GENDER marking were assumed to reflect the relative processing proficiency of individuals. Therefore, these groups were assumed to provide a more effective means of evaluating the relative effects of the various priming conditions at various levels of processing proficiency than class levels could.

There was no statistical support for hypothesis four on an individual basis.

However, a comparison of probabilities from the MW test performed on Groups A, B and C provide some general support. The probabilities of significance from the MW tests comparing the rates of error associated with the inhibitory priming and zero priming conditions for Groups A, B and C were 0.58, 0.41 and 0.03, respectively. The probabilities imply that the effect is greater at the lowest level of proficiency than at the highest level resulting in a higher probability of statistical significance at the lowest level and a lower probability of significance at the highest level. The probabilities from the MW test comparing the error rates associated with the zero priming and excitatory priming conditions for Groups A, B and C were 0.37, 0.19 and 0.7, respectively. Though the pattern isn't as neat as for the inhibitory priming and zero priming conditions, the pattern predicted by the hypothesis was evident between the highest and lowest levels of processing proficiency. The probability of significance was greater at the highest level than at the lowest level. Figure 4.12 illustrates the probabilities of significance at the highest level of processing proficiency and Figure 4.13 illustrates the probabilities of significance at the lowest level of processing proficiency.

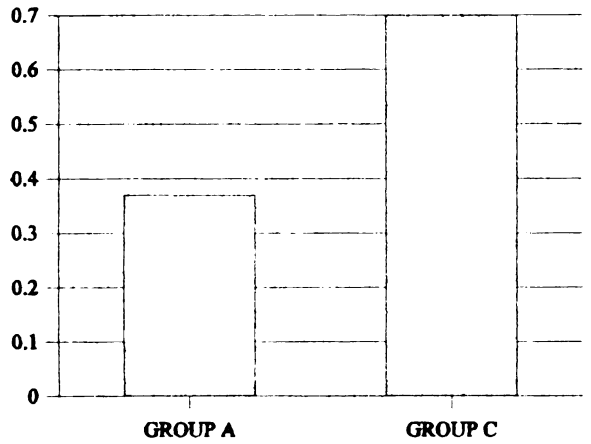


Figure 4.12. Probabilities of Significance for the Excitatory Priming Condition at the Highest and Lowest Levels of Processing Proficiency.

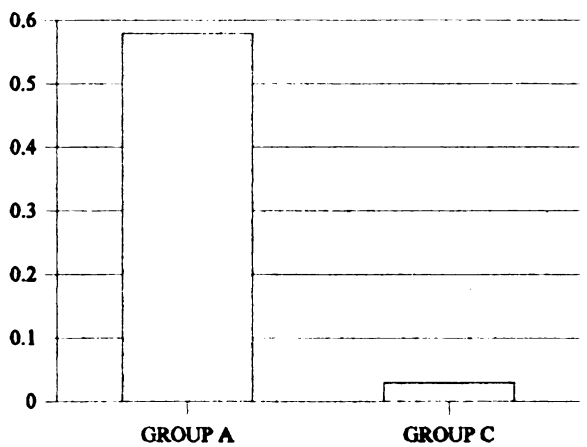


Figure 4.13. Probabilities of Significance for the Inhibitory Priming Condition at the Highest and Lowest Levels of Processing Proficiency.

Task II Results

CASE and GENDER Error Rates

Just as for Task I, hypothesis #1 was generally supported by the results of Task II. The hypothesis was stated as follows:

> *All subjects will mark CASE on English third-person-singular pronouns very accurately--at a rate of error exceeding one standard deviation from the actual mean rate of error--while a substantial number--more than 16 percent (within one standard deviation of the mean for a normal population)--will mark GENDER on English third-person-singular pronouns at a low rate of accuracy--at a rate within one standard deviation from the actual mean rate of error.*

Among the 51 subjects who participated in Task II, four subjects (8%) produced CASE errors (subjects #5-1, #12-1, #4-2 and #1-3). Each of the four subjects produced one CASE error, and in each situation the error occurred as the use of *her* in subject position. The rates of error for those 4 subjects were 3 percent, 7 percent, 3 percent and 3 percent , respectively. The average rate of CASE error was 4 percent for these 4 subjects. In contrast, 49 of the 51 subjects (96%) who participated in Task II produced GENDER errors, and 45 of the 51 subjects (88%), a substantial number as defined in the hypothesis, produced errors of 7 percent or greater, which is one standard deviation from the mean rate of error. The rates of error for the 49 subjects who produced errors ranged from 2.5 percent to 69 percent, and averaged 25 percent overall. Subject #12-1 had a 7 percent rate of error, above that predicted by the hypothesis, but this may be a feature of the small number of subject pronouns produced by this subject--approximately half as

many as the other 3 subjects. In addition, the occurrence of CASE errors seemed to be unrelated to individual rates of error on GENDER since CASE errors were made by subjects whose rankings based on GENDER error rates were third, sixteenth, thirty-eighth and fortieth most accurate in terms of GENDER error rates.

The Developmental Pattern

The predictions made by the second hypothesis were also supported by the results of Task II. The second hypothesis contained two parts. The first part was stated as follows:

> ***Hypothesis #2a -***
>
> *A substantial number--more than 16 percent (within one standard deviation of the mean for a normal population)--of the subjects will exhibit error behavior in the marking of GENDER on English third-person-singular pronouns that is probabilistic--defined as error rates within one standard deviation from the actual mean rate of error--rather than either/or in nature.*

The second part was stated as follows:

> ***Hypothesis #2b -***
>
> *Individual rates of error in marking GENDER on English third-person-singular pronouns will fall along a continuum of higher and lower rates of error rather than be grouped into sets or fall at the ends of the continuum.*

The results of Task II showed that a substantial number of subjects (72%) exhibited error patterns in the marking of GENDER that were probabilistic--defined as error rates within one standard deviation from the actual mean rate of error (between 7 and 42

percent for this population)--rather than either/or in nature. In addition, the error rates of the 51 subjects were spread quite evenly across a broad range, just as they were in Task I. The analysis revealed that the difference between adjacent subjects on the error rate curve ranged from 0.0 to 7 percent, and that the average rate of difference between adjacent subjects was 1.3 percent. Figure 4.14 provides an illustration of the evenly spaced character of the individual error rates.

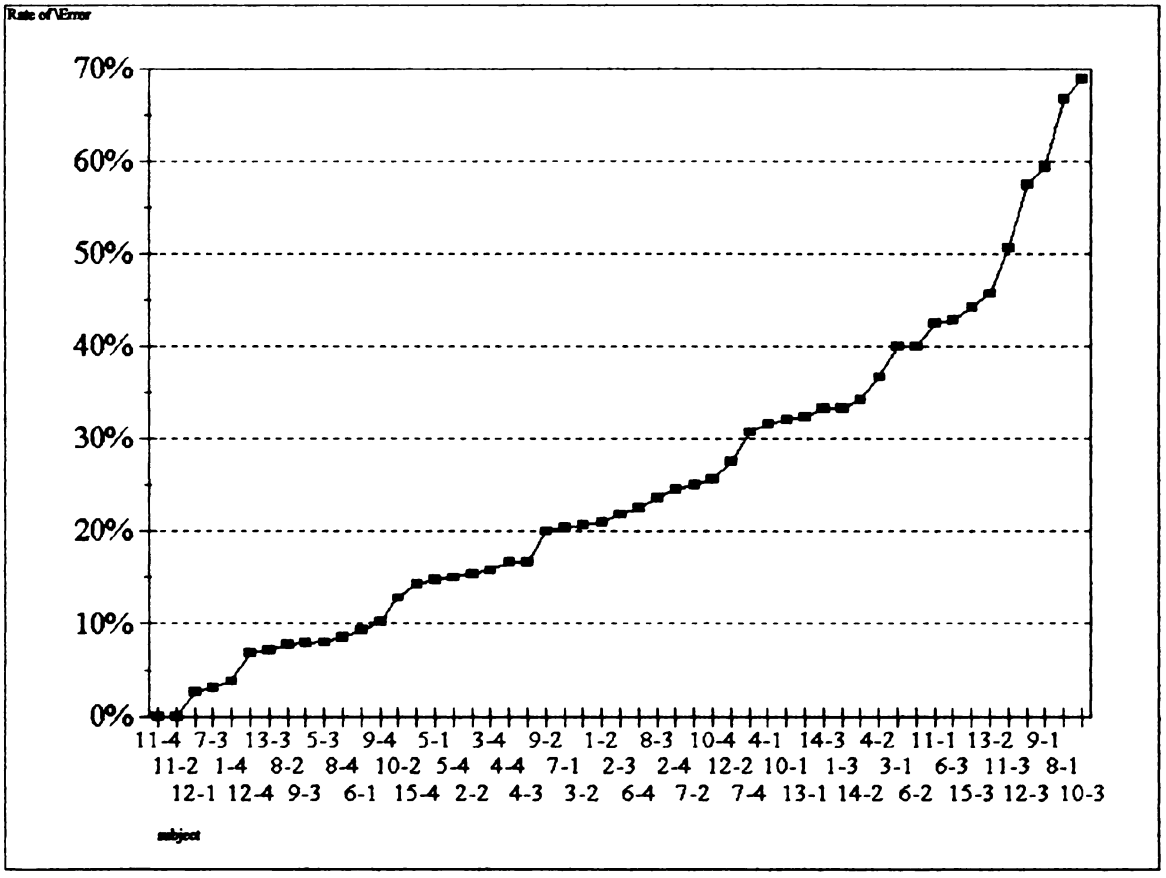


Figure 4.14. Individual Rates of GENDER Error on Task II.

The General Effect of the Three Priming Conditions upon Error Rates

In Task II, there was no equivalent to the zero priming condition found in Task I, but there were equivalents to the inhibitory priming and excitatory priming conditions. In Task II, the production of a third-person-singular pronoun following the production of a third-person-singular pronoun was considered the equivalent of the type of priming condition found in Task I. In Task II, an excitatory priming condition was considered to have existed when a third-person-singular pronoun was followed by a pronoun whose referent was of the same GENDER. An inhibitory priming condition existed when a third-person-singular pronoun was followed by a pronoun whose referent was of the other GENDER. Because of the difference in possible priming conditions between Task I and Task II, the hypothesis which was stated as follows for Task I:

> ***Hypothesis #3a -***
>
> *The inhibitory priming condition will be associated with a greater rate of error in the marking of GENDER on English third-person-singular pronouns in comparison to the zero priming condition, and the excitatory priming condition will be associated with a lower rate of error in comparison to the zero priming condition.*

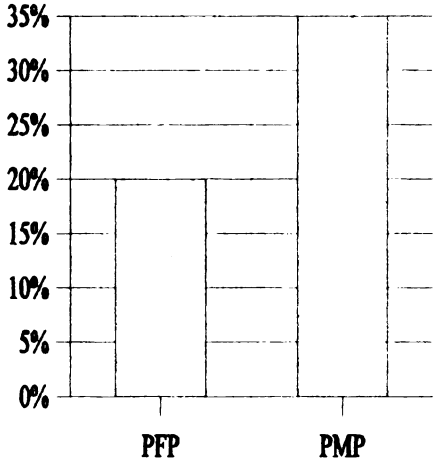
was restated as follows for Task II:

> ***Hypothesis #3a (modified) -***
>
> *The inhibitory priming condition will be associated with a greater rate of error in the marking of GENDER on English third-person-singular pronouns in comparison to the excitatory priming condition.*

Just as in the Task I data, hypothesis 3a was not borne out in the productions of each

individual. However, there was a statistically significant difference between the two priming conditions among the subjects as a whole which matched the pattern predicted by the hypothesis. Of the 51 subjects, 45 produced GENDER errors on feminine referents. Of those 45, 31 (69%) had higher rates of error associated with the inhibitory priming condition than associated with the excitatory priming condition, while 13 (29%) had lower rates of error associated with the inhibitory priming condition than associated with the excitatory priming condition.

A comparison of the average rates of error associated with the two priming conditions that existed in Task II revealed conformity to the pattern predicted by the hypothesis. For feminine referents, the average rate of error following feminine pronouns was 20 percent while the average rate of error following masculine pronouns was 35 percent. The KW analysis of variance revealed the difference in error rates was significant ($p = 0.03$). The number of cases in which a masculine referent occurred after feminine and masculine pronouns was too small for statistical analysis. Figure 4.15 illustrates the difference in the averages under the two conditions as well as the results of the KW analysis of variance.



KRUSKAL-WALLIS

TYPE OF PRIME	*MEDIAN RATE OF ERROR*	*AVERAGE RATE OF ERROR*
Post-Feminine Pronoun	0.17	0.20
Post-Masculine Pronoun	0.37	0.35

$p = 0.031$

Figure 4.15. Average Rates of GENDER Error for Feminine Referents Following Masculine and Feminine Pronouns for the Total Group.

Just as for Task I, it was not expected that a significant difference between priming conditions could be established with each class level because of the small size of the population. However, it is interesting to not that the pattern predicted by hypothesis 3a was generally found. Figures 4.16 through 4.19 illustrate the average rates of error associated with each of the two priming conditions for each class level.

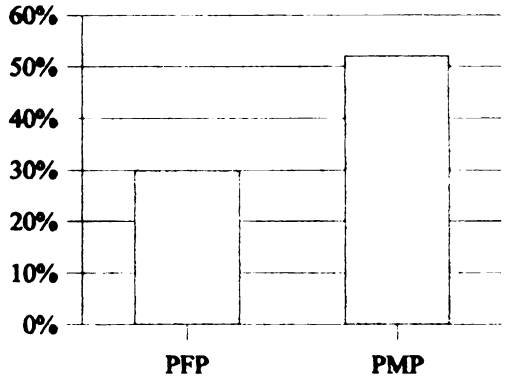


Figure 4.16. Average Rates of GENDER Error on Task II Associated with the Two Priming Conditions for First-Year Students.

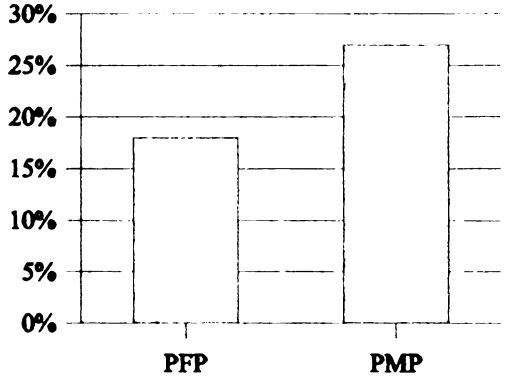


Figure 4.17. Average Rates of gender Error on Task II Associated with the Two Priming Conditions for Second Year Students.

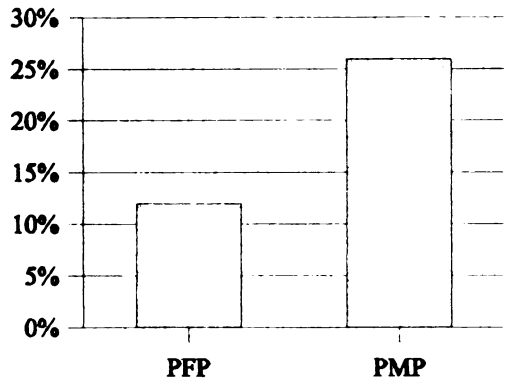


Figure 4.18. Average Rates of GENDER Error on Task II Associated with the Two Priming Conditions for Third-Year Students.

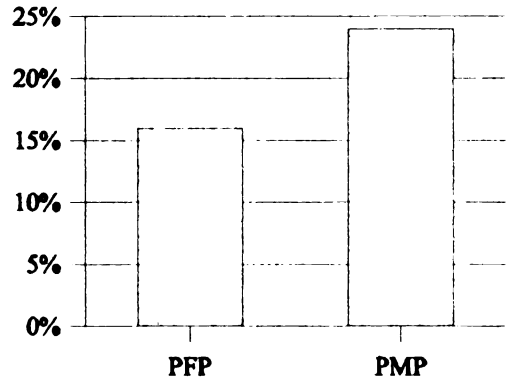


Figure 4.19. Average Rates of GENDER Error on Task II Associated with the Two Priming Conditions for Fourth-Year Students.

The third hypothesis contained a second statement which a predicted a differential rate of error for the two tasks based on the assumption that the Task II makes greater attentional demands upon the speaker than Task I. The second part of the hypothesis was stated as follows:

Hypothesis 3b -

The rate of error in marking GENDER for English third-person-singular pronouns will be greater for Task II than for Task I.

Hypothesis 3b predicted greater rate of error for Task II than for Task I because the amount of processing resources available for allocation to the production of GENDER-marked forms should be lower on Task II. The reduction in the amount of processing resources allocated to the production of gender-marked forms was expected to lower the processing strength of the relevant pathways. This prediction was confirmed by the results in two ways. The first confirmation came from a comparison of the average overall rates of GENDER error for Task I and Task II. The average rate of error for Task I was 8 percent, while the average rate of error for Task II was 25 percent. The second confirmation came from the fact that individually, of the 40 subjects who participated in both Task I and Task II, 32 (80%) had higher rates of error on Task II than on Task I, thus providing a second source of general support for the hypothesis.

Relationship Between Priming Condition Effects and Processing Proficiency

The fourth hypothesis related to the relationship between the effects of excitatory priming and inhibitory priming conditions at differing levels of processing proficiency. It was stated as follows:

Hypothesis #4 -

The inhibitory priming condition will have a greater effect upon error rates at lower levels of processing proficiency and a smaller effect upon error rates at higher rates of processing proficiency. In contrast, the excitatory priming condition will have a greater effect at higher rates of

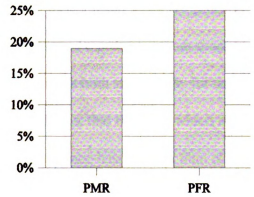
processing proficiency and a lower effect at lower levels of processing proficiency.

In Task I, the measurement of effect was made by using the zero priming condition as a baseline and measuring the effect of the inhibitory priming and excitatory priming conditions in relation to it. Since there was no equivalent of the zero priming condition in Task II, the data of Task II cannot provide evidence relevant to this hypothesis.

Referent Priming Condition

While one of the primary purposes of Tasks I and II was to examine the effect of pronoun priming on the error rates of marking GENDER, the data revealed an interesting pattern associated with the referent primed of pronouns. Referent priming differs from pronoun priming in that it refers to situations in which the GENDER of the preceding referent (whether it is pronominal or non-pronominal) is considered as the prime rather than the actual utterance of a pronoun. The data for the subjects as a group, revealed a significant difference in rates of error in marking GENDER for English third-person-singular pronouns following a referent of the same GENDER. For feminine referents, the average rate of error following a feminine referent was 25 percent while the average rate of error following a masculine referent was 19 percent. The KW analysis of variance revealed that this difference was significant ($p = 0.03$). A similar pattern was found for the error rates of masculine referents following masculine and feminine referents. For masculine referents, the average rate of error following masculine referents was 35 percent while the average rate of error following feminine referents was 30 percent. The KW analysis of variance revealed that this difference was not significant ($p = .75$), but that was likely due to the small number of cases. Figures 4.20 and 4.21 illustrate the

differences in the average rates of error associated with the two conditions for the two different referents, as well as the results of the KW analyses of variance.

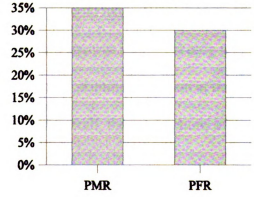


KRUSKAL-WALLIS

TYPE OF PRIME	*MEDIAN RATE OF ERROR*	*AVERAGE RATE OF ERROR*
Post-Masculine Referent	0.15	0.19
Post-Feminine Referent	0.21	0.25

$p = 0.03$

Figure 4.20. Average Rates of GENDER Error for Feminine Referents Following Masculine and Feminine Referents for the Total Group.



KRUSKAL-WALLIS

TYPE OF PRIME	*MEDIAN RATE OF ERROR*	*AVERAGE RATE OF ERROR*
Post-Masculine Referent	0.00	0.35
Post-Feminine Referent	0.00	0.30

$p = 0.75$

Figure 4.21. Average Rates of GENDER Error for Masculine Referents Following Masculine and Feminine Referents for the Total Group.

Summary of Results

The four hypotheses that were the focus of this study were all supported to various degrees by the results of Tasks I and II. The first hypothesis, that probabilistic error would result when the processing of an L2 closed-class morpheme requires the addition of a processing sub-module at the functional level, was strongly confirmed by the results both statistically for the group and for the individuals themselves. The second hypothesis, that the error which results from the structure of the FORMULATOR are performance-based rather than competence-based, was also strongly confirmed by the results as well in both the overall group statistics and the individual results. The third hypothesis, that error rates would be affected differently by excitatory and inhibitory primes, was also confirmed. The hypothesis was not borne out in the result of each individual subject. The fourth hypothesis, that the effect of excitatory and inhibitory primes would have relatively different effects at higher and lower levels of processing proficiency, was supported only indirectly in the probabilities of significance associated with each priming condition at the highest and lowest levels of processing proficiency. Taken overall, the assumptions of the PS account of language transfer found support in the results.

CHAPTER 5

DISCUSSION

Overview

In review, the purpose of this dissertation has been to present and test an account of language transfer that relies on the structural features of the speech production system as well as upon the internal processing characteristics of that system. This account, the processing strength account, was proposed to account for a specific type of persistent, probabilistic L1-like error in the L2 production of closed-class morphemes. The set of errors that the processing strength account is intended to account for are not defined solely by the structural characteristics of the morphemes themselves, but also by the developing structure of the L2 speech production system. Specifically, the account explains errors that occur when a processing sub-module must be added to the functional level of a learner's L2 FORMULATOR because the production of an L2 closed-class morpheme requires information at the positional level that is not processed for in the learner's L1 FORMULATOR. Probabilistic error occurs in such a case because of the resultant processing inequality between the added sub-module and the overall system. This situation leads to periodic failure of the sub-module to keep up with the overall system, and results in a processinig failure. When that occurs, the necessary information fails to arrive at the positional level and the closed-class morpheme is processed based

only on the information that the speaker has available when processing his or her L1..

The evidence for the processing strength account reported in this dissertation comes from two different tasks that were designed to elicit the oral production of English third-person-singular pronouns by native speakers of Chinese. The L2 English production of native speakers of Chinese provided an ideal context for testing the claims of the processing strength account of language transfer because Chinese pronouns are not marked for either CASE or GENDER while English third-person-singular pronouns are marked for both. The surface similarity in Chinese suggests that the marking of CASE and GENDER should be equally difficult or easy for native Chinese speakers. However, the processing strength account predicts a difference in the ease of achieving processing accuracy for the two since the Chinese L1 FORMULATOR processes for CASE information while it does not process for GENDER information. The result is a processing inequality within the L2 FORMULATOR between the added sub-module that processes for GENDER and the overall system. That processing inequality was expected to lead to probabilistic error during L2 production.

Evidence for the Processing Strength Account of Language Transfer

The tasks used in this research were designed to provide evidence relating to the following three basic assumptions of the processing strength account of language transfer:

(1) The structure of the learner's speech production system can be a source of language transfer when a processing sub-module must be added to the functional level of the FORMULATOR to process for information that is

required in L2 speech production.

(2) Language transfer errors of the type described in (1) are performance-based rather than competence-based.

(3) Processing strength is the primary mechanism in the occurrence of these types of performance-based errors.

Four hypotheses were derived from these three assumptions. They have been summarized in Chapter 3 and reported with the results in Chapter 4. The following sections contain discussions of the evidence pertaining to these three assumptions and the hypotheses associated with each.

Language Transfer and the Interlanguage Speech Production System

The most basic assumption of the processing strength account is that language transfer errors can result from the structure of the interlanguage speech production system. The processing strength account claims that if a speaker's L1 FORMULATOR does not process information at the functional level that is necessary for L2 speech production, then persistent probabilistic errors will occur in the L2 production of closed-class morphemes that rely upon that information at the positional level of the FORMULATOR. Hypothesis #1 follows directly from this assumption. It was evaluated by comparing the error rates of native speakers of Chinese in their marking of GENDER and CASE on English third-person-singular pronouns. Because the Chinese L1 speech processing system processes for CASE information but not GENDER information, the account predicted a high level of accuracy in the marking of CASE but not GENDER. This hypothesis was strongly supported by the results of both Task I and Task II, thus confirming the most basic assumption of the account.

The Nature of Speech Production Error Behavior

The second assumption of the processing strength account is that language transfer errors that result from the interlanguage structure of the speech processing system are performance-based rather than competence-based. Hypothesis #2 was derived from this assumption, and it entailed two different predictions. The first was that the error pattern would be probabilistic rather than all-or-none in nature. As pointed out by MacWhinney, probabilistic occurrence is a central feature of performance-based error. The second prediction was based on a distinction between the pattern associated with competence development versus that which can be associated with performance development. The development of linguistic competence is typically characterized by developmental leaps that result from restructuring of the system while performance development can be characterized by small incremental changes. The hypothesis, therefore, predicted that the error rates of the subjects in the study would be spread out in an even pattern rather than fall at the ends of the error-rate spectrum or in a few groups along the spectrum. The results of both Task I and Task II confirmed these predictions.

The Involvement of Processing Strength in the Error Behavior

This third assumption of the processing strength account, that processing strength is the primary mechanism in the occurrence of error, was the focus of hypothesis #3 and #4. Because processing strength can be affected in two different manners--by previous activation and by selective attention--hypothesis #3 had two components. The first related to evaluating the effect of previous activation by testing the effect of priming upon error rates. This component of hypothesis #3 was relevant only to Task I. The specific prediction was that inhibitory priming would reduce processing strength thus

leading to an increase in error rate relative to the zero priming condition while excitatory priming would increase processing strength thus leading to a decrease in the error rate relative to the zero priming condition. The second prediction of hypothesis #3 was based on the different attentional demands of Task I and II. Since Task II placed a greater attentional demand upon the speaker, the relative amount of selective attention available for the marking of GENDER would be lower, leading to potentially lower processing strengths in Task II. The prediction was that error rates would be higher for Task II than for Task I. Both of the sub-components of hypothesis #3 found statistical support.

Hypothesis #4, which also related to the assumption that processing strength is the major mechanism in the observed error, focused on processing strength from a different perspective. Hypothesis #4 made claims about the relationship between the development of the processing pathways and the relative effect of the two priming conditions. This hypothesis predicted that there would be differential effects for the inhibitory priming condition and the excitatory priming condition at lower and higher levels of processing proficiency. Initially, it was hoped that the 4 class levels that participated in the study would serve as examples of processing proficiency, but it was apparent that class level membership and processing proficiency, as measured by accuracy, were not directly related. Therefore, the analysis was conducted on three groups ordered by their overall accuracy in GENDER-marking of third-person-singular pronouns. While there was no support for the hypothesis based upon individuals, there was some weak statistical support for this hypothesis.

For both hypothesis #3 and #4 determining statistical significance between groups proved difficult because of the small sizes of the groups: 14 to 16 subjects.

Evidence for Pro-Drop Related Inhibiting Mechanism

In addition to the support for the claims of the four hypotheses in the study, there was a pattern of error observable in the data of Task II that lends support to the processing strength account of language transfer in an unexpected way. The pattern was observable in cases of referent priming, which refers to a case in which the production of a pronoun is preceded by a either a pronominal or non-pronominal referent. In cases of referent priming, the rate of error for the marking of feminine pronouns was higher following a feminine referent than following masculine referent, and the rate of error for the marking of masculine pronouns was higher following masculine referents than following feminine referents. This is contrary to the effect generally observed in the study in cases of pronoun priming, which refers to cases in which the production of a pronoun is preceded by the production of a pronoun. The rate of error for the marking of feminine pronouns was lower following a feminine pronoun than following a masculine pronoun, and the rate of error for the marking of masculine pronouns was lower following masculine pronouns than feminine pronouns.

Initially these findings seem hard to reconcile, but when the pro-drop feature of Chinese languages is taken into account, the processing strength account framework suggests a ready explanation. The relevant feature of pro-drop languages is that they permit null subjects. In *Speaking*, Levelt (1989: 271) suggests that pronominalization (including complete elision) occurs in speech production when arguments are marked as "+ accessible." Because null subjects occur probabilistically in speech production, it may be that accessibility is better characterized not simply as a dichotomous feature (+ or - accessible) but rather as a mechanism that becomes more or less weighted as a

referent becomes more or less accessible within a discourse context. As accessibility increases, the weighting increases, leading first to pronominalization and later to complete elision. From a processing perspective, once the weighting increases to a certain level it could function as an inhibitory mechanism. The more accessible a referent, the stronger the inhibition leading to greater elision.

An inhibitory mechanism would explain the increase in GENDER errors in English production of third-person-singular pronouns by Chinese speakers in cases of referent priming. In a context where the referent has already been determined, accessibility would increase leading to an increase in the inhibitory mechanism. That inhibitory mechanism, which would lead to complete elision of the referent in Chinese, would lead to a failure to process for GENDER at the functional level of the FORMULATOR in English and concomitant probabilistic error. This explanation is compatible with the processing strength account framework which would explain the inhibitory mechanism as a mechanism which reduces the processing strength of the relevant processing sub-module.

The effect of referent priming upon the GENDER-marking of third-person-singular pronouns in English by native speakers of Chinese is even more interesting in light of the fact that GENDER errors in the production of these English pronouns have been observed by the author among languages as diverse as Spanish, Japanese and Thai. Loschly (1992) has examined the difficulty that Japanese speakers have in achieving accuracy in marking GENDER for these pronouns in English. Explanation for the difficulty faced by speakers of these languages cannot be found in their speech production systems because these languages all mark GENDER on third-person-singular pronouns and, therefore, process for GENDER within the functional level of their FORMULATORs. For native

speakers of these languages there would be no processing strength inequality at the functional level like that expected for native speakers of Chinese languages2. While it is true that the errors observed in the English of native speakers of Thai, Japanese and Spanish cannot be explained by the existence of a processing strength inequality, the fact that these languages are also pro-drop languages suggests that the errors in GENDER-marking might also be the result of an inhibitory mechanism that results in the occurrence of null subjects in these languages.

That the processing strength account is able to account for errors caused by pronoun priming and referent priming within the same framework and also provide an explanation for the difficulty that speakers of Thai, Japanese and Spanish have in GENDER-marking of English pronouns, is a feature that provides additional, though indirect, support for the account itself.

The Processing Strength Account of Language Transfer and Hierarchies of Difficulty

In addition to the its ability to explain the otherwise unexplained difficulty of native speakers of Thai, Japanese and Spanish in marking GENDER on English pronouns, there is another source of indirect support for the processing strength account that comes from the fact that it is able to provide an explanation for a characteristic of language transfer identified by Stockwell, Bowen and Martin (1965) in their book titled *Grammatical Structures of English and Spanish.* Based on a study of native speakers of English learning Spanish, they proposed a hierarchy of difficulty for L2 learners. Of relevance to the processing strength account of language transfer is that the most difficult case on their hierarchy is a case in which the speaker's L1 does not make a grammatical

distinction that is obligatory in the L2 (Stockwell, Bown and Martin: 283). Stockwell, Bowen and Martin do not explain why this case is the most difficult, but only claim that it is so based on their research.

The processing strength account of language transfer is able to provide an explanation for the difficulty a learner faces in such cases. The situation described by Stockwell, Bowen and Martin is parallel to the situation faced by native speakers of Chinese learning English because while English third-person-singular pronouns present an obligatory choice regarding GENDER, their L1s present no choice in terms of GENDER. The processing strength account is able to provide a general explanation for Stockwell, Bowen and Martin's most difficult case by claiming that the production of the L2 obligatory choice requires the addition of a processing sub-module at the functional level of the learner's FORMULATOR which will lead to processing strength inequalities and thus probabilistic error during speech production.

Implications for Language Transfer Theory

The support for the processing strength account of language transfer found in the results of this study and in its ability to provide a framework for explaining other previously unexplained language transfer phenomena demonstrates the value of non-competence-based explanations in SLA, and in language transfer theory specifically. More generally, it suggests that Kellerman and Sharwood Smith (1986) are correct in their assertion that a modular approach is essential to a comprehensive understanding of language transfer phenomena. Without a modular approach and its acceptance of performance-based explanations, the type of language transfer phenomenon examined in

this study would remain unexplained.

Directly related to supporting a modular view of language transfer theory, this research suggests that it is important within language transfer research to define the set of error types that a particular account is intended to explain. The behaviorist theory of language transfer failed to do this because it viewed all language transfer phenomenon as resulting from the same source--first language habits. Many competence-based accounts of language transfer have followed this same pattern by presenting their hypotheses as general statements of how all language transfer phenomenon occur. The variety of types of language transfer phenomena, as well as the variety of accounts necessary to account for them, make it obvious that it is impossible to talk about language transfer as a unitary phenomenon. It is rather a broad set comprised of very different types of phenomena with very different causes.

Future Research

The study reported here and its results suggest a number of directions for future research. The most obvious direction is continued research of the claims of the processing strength account of language transfer. The English speech production of native speakers of Chinese provides other sources of data which could be used to test the processing strength account. TENSE and NUMBER are other types of grammatical information that are not processed for at the functional level in Chinese but which are required at the positional level for the processing of some closed-class morphemes in English.

A second direction for research that is suggested by the results of this study is the

relationship between errors in the marking of GENDER on third-person-singular pronouns in English by native speakers of Thai, Japanese and Spanish and the pro-drop feature of those languages. Specifically, this study suggests a possible causal relationship between the mechanism which leads to elision of arguments in pro-drop languages and errors GENDER-marking in English.

Finally, the account proposed by Jordens (1986), the account proposed by Loebell (1989) and the processing strength account suggest the structure of the interlanguage speech production system and its processing mechanisms might be a fruitful source of explanation in language transfer theory. Other phenomena that are currently unexplained may find an explanation in this area.

APPENDICES

APPENDIX A

Sample Pictures and Example Priming Sentences

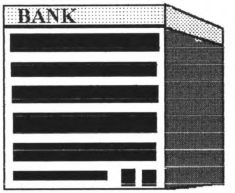
YESTERDAY

BUY

Excitatory Priming (GENDER):	She ate pizza yesterday
Excitatory Priming (CASE):	She washed the car this morning
Inhibitory Priming (GENDER):	He mailed a package last week.
Inhibitory Priming (CASE):	The car hit her.
Zero Priming:	The car hit the bank.

APPENDIX B

Sample Memory Pictures



APPENDIX C

Age, Gender, Length of English Study and Native Chinese Dialect of Subjects who Participated in Task I

Subject	Age	Gender	Length of English Study	Native Chinese Dialect
3-1	18	M	7 years	Mandarin
4-1	17	F	6 years	Mandarin
6-1	18	F	8 years	Cantonese
7-1	18	M	6 years	Shanghainese
9-1	18	M	6 years	Mandarin
10-1	19	M	6 years	Mandarin
12-1	20	M	8 years	Cantonese
13-1	20	F	8 years	Cantonese
1-2	20	F	8 years	Cantonese
2-2	21	M	7 years	Chaozhou Dialect
3-2	20	F	9 years	Cantonese
6-2	20	F	10 years	Cantonese
7-2	20	M	8 years	Mandarin
8-2	20	M	8 years	Mandarin
9-2	18	F	7 years	Mandarin
10-2	19	F	7 years	Mandarin
11-2	19	M	7 years	Jiangxi Dialect
12-2	20	M	8 years	Cantonese
13-2	18	M	7 years	Hunanese
1-3	20	F	6 years	Nan Chang Dialect
2-3	20	F	9 years	Mandarin
3-3	21	M	7 years	Cantonese
4-3	21	F	10 years	Cantonese
5-3	21	M	8 years	Cantonese
6-3	21	M	10 years	Cantonese
8-3	21	F	11 years	Cantonese
9-3	20	F	10 years	Cantonese
11-3	20	F	5 years	Nanjing Dialect
12-3	21	F	10 years	Hakka
13-3	20	F	9 years	Hainanese
14-3	21	M	8 years	Cantonese
15-3	21	F	10 years	Cantonese
1-4	21	F	10 years	Shanghainese
2-4	20	F	9 years	Hunanese

4-4	21	M	11 years	Cantonese
5-4	22	F	10 years	Cantonese
7-4	22	F	10 years	Mandarin
9-4	23	F	10 years	Mandarin
10-4	21	F	10 years	Cantonese
11-4	21	M	11 years	Min Nan Dialect
12-4	21	F	10 years	Mandarin
13-4	21	F	10 years	Hunanese
14-4	22	F	10 years	Cantonese
15-4	22	M	11 years	Shanghainese

APPENDIX D

List of Number of Sentence Elicitation Sentences for Each Student.

Student	Number of Sentences	Student	Number of Sentences
3-1	60	13-3	96
4-1	60	14-3	96
6-1	60	15-3	96
7-1	60	1-4	120
9-1	60	2-4	120
10-1	60	4-4	120
12-1	60	5-4	120
13-1	60	7-4	120
1-2	72	9-4	48
2-2	72	10-4	120
3-2	72	11-4	120
6-2	60	12-4	120
7-2	60	13-4	120
8-2	60	14-4	99
9-2	60	15-4	120
10-2	60		
11-2	60		
12-2	60		
13-2	60		
1-3	120		
2-3	120		
3-3	120		
4-3	120		
5-3	120		
6-3	120		
8-3	114		
9-3	110		
11-3	96		
12-3	96		

APPENDIX E

Age, Gender, Length of English Study and Native Chinese Dialect of Subjects who Participated in Task II

Subject	Age	Gender	English Study	Chinese Dialect
3-1	18	M	7 years	Mandarin
4-1	17	F	6 years	Mandarin
5-1	20	M	7 years	Zhejiang Dialect
6-1	18	F	8 years	Cantonese
7-1	18	M	6 years	Shanghainese
8-1	19	F	8 years	Cantonese
9-1	18	M	6 years	Mandarin
10-1	19	M	6 years	Mandarin
11-1	19	M	6 years	Mandarin
12-1	20	M	8 years	Cantonese
13-1	20	F	8 years	Cantonese
1-2	20	F	8 years	Cantonese
2-2	21	M	7 years	Chaozhou Dialect
3-2	20	F	9 years	Cantonese
4-2	20	F	8 years	Cantonese
6-2	20	F	10 years	Cantonese
7-2	20	M	8 years	Mandarin
8-2	20	M	8 years	Mandarin
9-2	18	F	7 years	Mandarin
10-2	19	F	7 years	Mandarin
11-2	19	M	7 years	Jiangxi Dialect
12-2	20	M	8 years	Cantonese
13-2	18	M	7 years	Hunanese
14-2	20	F	7 years	Zhejiang Dialect
1-3	20	F	6 years	Nan Chang Dialect
2-3	20	F	9 years	Mandarin
4-3	21	F	10 years	Cantonese
5-3	21	M	8 years	Cantonese
6-3	21	M	10 years	Cantonese
7-3	21	F	11 years	Hakka
8-3	21	F	11 years	Cantonese
9-3	20	F	10 years	Cantonese
10-3	20	F	8 years	Cantonese
11-3	20	F	5 years	Nanjing Dialect
12-3	21	F	10 years	Hakka
13-3	20	F	9 years	Hainanese

14-3	21	M	8 years	Cantonese
15-3	21	F	10 years	Cantonese
1-4	21	F	10 years	Shanghainese
2-4	20	F	9 years	Hunanese
3-4	19	F	10 years	Cantonese
4-4	21	M	11 years	Cantonese
5-4	22	F	10 years	Cantonese
6-4	21	F	13 years	Mandarin
7-4	22	F	10 years	Mandarin
8-4	21	F	10 years	Cantonese
9-4	23	F	10 years	Mandarin
10-4	21	F	10 years	Cantonese
11-4	21	M	11 years	Min Nan Dialect
12-4	21	F	10 years	Mandarin
15-4	22	M	11 years	Shanghainese

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