LA IS BETTER THAN EL: THE ROLE OF REGULARITY AND LEXICAL
FAMILIARITY IN NOUN PHRASE PRODUCTION BY YOUNG
SPANISH-SPEAKING CHILDREN

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As members of the Dissertation Committee, we certify that we have read the dissertation

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ABSTRACT

Language production involves two stages of lexical retrieval with a word's *lemma* (meaning, syntax) accessed before its *lexeme* (form). Adult speakers of gendered languages are said to access gender via the lemma (Vigliocco, Antonini and Garrett, 1997). However, presenting gender incongruous distractors during picture naming does not produce interference for Spanish speakers (Costa, Sebastián-Gallés, Miozzo & Caramazza, 1999; O'Rourke, 2007). Spanish demonstrates predictability between determiner gender and noun form: 96.3% of nouns ending in /a/ are feminine, taking the definite determiner *la*, and 99.87% of nouns ending in /o/ are masculine, preceded by *el* (Teschner & Russell 1984). Morphophonological regularity might allow Spanish-speakers to bypass lemma-level gender.

This dissertation addressed the question of whether young children learning Spanish access gender with the lemma of individual words, utilize language-specific morphophonological regularities alone, or use a combination of lexical familiarity and morphophonological regularity.

This was tested in an elicited imitation task manipulating lexical status, congruity and gender. Spanish-English bilingual children (2;0-4;0) and Spanish-speaking adults repeated Spanish words and non-words preceded by gender congruous and incongruous definite articles. If children access gender with lemmas, children should omit fewer articles for words vs. non-words in congruous (el libro-the$_m$ book$_m$) versus incongruous conditions (la libro-the$_f$ book$_m$). If children use morphophonological patterns, words should show no advantage; however, children should omit fewer feminine than masculine

articles in congruous (la $_f$ fupa $_f$) versus incongruous conditions (el$_m$ fupa $_f$) since feminine

is more regular than masculine. Alternately, if lexical familiarity and

morphophonological regularity play a role, children should omit fewer articles for words

than non-words and fewer feminine than masculine articles in congruous versus

incongruous conditions.

The results suggest that children, like adults, use both lexical familiarity and

morphophonological regularity to produce determiner-stem sequences. Words exerted an

influence, but only in processing efficiency while regularity affected patterns for both

words and non-words. Unlike adults, for children regularity was preferred over

distributional frequency and lexical familiarity was only advantageous if familiar words

demonstrated regular feminine morphology. The data suggest that children use language-

specific input statistics from early in language production and, additionally, provide

evidence for developmental processing strategies.

CHAPTER 1   INTRODUCTION

1.1 The issues at hand

This dissertation concerns how children learning to speak Spanish store, access and retrieve grammatical gender for the production of simple noun phrases. Traditionally, the child's early utterance, often characterized by missing or misused elements, has been taken as a direct reflection of the development of underlying linguistic competence (e.g. Hyams, 1986; Antinucci and Miller, 1976; Mariscal, 2008); however, there is evidence to suggest that what the child intends to say is not always reflected in what the child actually produces (e.g. Gerken, 1991, 1992; McKee and Iwasaki, 2001; Gershkoff-Stowe and Smith, 1997). This gap between the state of the child's linguistic knowledge and the form taken by the child's actual utterance provides an opportunity to not merely test linguistic competence but to investigate the development of the processing system that allows the child to express this knowledge. The elicited imitation task involved in this study seeks to do just that by tapping online processing requiring the coordination of a gendered noun with the appropriate gender congruent definite article, thereby offering insight into the architecture of the developing production mechanism itself.

With respect to acquiring his or her native language, we know that the monolingual child faces the task of parsing the speech stream of the ambient language, learning the phonology and phonotactics of his/her language, as well as detecting information useful for delineating word boundaries. Additionally, the child must map such sound strings to meaning and syntactic category while unraveling the syntactic

relations that define the interdependence of these individual words in language-specific syntactic phrasal geometry. The level of complexity and well-formedness of the child's utterance has traditionally defined the child's progress toward linguistic grammatical competence in the abovementioned areas of language learning. However, there is evidence to suggest that in addition to learning words, the child develops the ability to access and retrieve such words (Dapretto and Bjork, 2000; Gershkoff-Stowe and Smith, 1997). There is also evidence to suggest that the monolingual child must also develop the processes necessary to coordinate retrieval of stored syntactic and semantic information regarding newly-learned words with the construction of syntactic phrasal frames and the retrieval of associated closed-class elements that are then linearized and interpreted phonologically via retrieval of word-form information (Wijnen, 1990; Wijnen, 2007; Rispoli and Hadley, 2001; McKee and Iwasaki, 2001).

This dissertation seeks to explore the developing architecture of the production system, and particularly the intersection of lexical retrieval and morpho-syntax. The particular linguistic domain chosen is Spanish grammatical gender, because research with adults suggests that gender indeed inhabits this intersection. The proposed research examines the early production of young children using an elicited imitation task requiring children to repeat simple Spanish words and non-words preceded by either a gender congruous or a gender incongruous definite article.

In all, this dissertation considers three accounts for how children process grammatical gender for production: (1) Children store gender with the semantic and syntactic information of individual words and must access this information via lexical

retrieval processes which in turn drive phrasal construction. (2) Children, like adult Spanish speakers, store gender with individual words but are able to exploit the surface morphophonological information present in the predictable co-occurrence patterns of determiner-noun combinations, bypassing the lemma by using morphophonological "frames" as production templates. (3) Children use a combination of lexical, distributional and sublexical information extracted from a fine-grained analysis of the input they receive. The mechanism is driven by morphophonological regularities across the gender systems that in turn affect the organization, access and production of familiar lexical items as well as the production of unknown words. Below, the existing evidence for each account will be reviewed in turn.

1.1.1 Gender is stored in the lexicon

The first account is consistent with lexically driven variants of adult production models in which a word's syntactic specification guides procedures for phrasal construction. A noun's grammatical gender specification is necessary for grammatical encoding processes requiring the selection of gender congruent agreement targets such as determiners, adjectives and pronouns. If this model holds across languages and more specifically for Romance languages like Spanish, the child's task is then to learn and store gender with individual words that the child subsequently learns to retrieve for the production of simple noun phrases. The type and distribution of naturally-occurring speech errors motivates the distinction between syntactic multiphrasal planning and the generation of phonological phrases as well as the separation of lemma and lexeme at the word level for lexical retrieval processes. This distinction in levels of planning and

retrieval processes is based on the dissociation between errors involving meaning and form (Garrett, 1982). If the planning levels in the proposed model are correct, the Spanish-learning child would be expected to show patterns consistent with the coordination of lexico-semantic information and lexico-syntactic information regarding grammatical gender with the construction of morpho-syntactic gender- inflected phrasal planning frames for sentence production. It is fitting at this time, then, to begin by reviewing the literature relevant to the basic organization of the adult production system with a focus on storage, access and production of grammatical gender. The issue will be revisited in greater detail in Chapter 2.

Grammatical gender can be situated within models of adult production detailing the architecture and timing of message generation, selection of lexical items, and retrieval of lexico-syntactic information for construction of syntactic phrasal planning frames that are phonologically encoded with respect to segmental and suprasegmental information for articulation (Garrett, 1984; Dell, 1986; Fromkin, 1971; Levelt, 1989). Language production can be modeled with two stages of lexical retrieval in which a word's *lemma* (semantic and syntactic information) is accessed before its *lexeme* (phonological information). Vigliocco, Antonini and Garrett (1997) showed that for monolingual speakers of a gendered language a word's gender status is available before its form, evidence that language-specific syntactic information such as gender is also stored at the lemma level. Tip-of-the-tongue states reflect successful retrieval of lexico-syntactic and semantic information with failure to retrieve a word's form or lexeme. In a TOT state a person is able to report detailed information regarding meaning and often certain aspects

of the word's form. In both Italian aphasic patients as well as normal controls, subjects demonstrated the ability to report a word's meaning as well as syntactic information regarding a word's grammatical gender even when they could not report any information regarding a word's form (Vigliocco et al, 1997; Badecker, Miozzo and Zanuttini, 1995).

Grammatical gender, stored at the lemma level along with categorial procedures (NP, VP etc.), is the interface between lexical retrieval processes and grammatical encoding processes at the sentence level. With respect to lexical access and retrieval for production processes, all nouns of the same gender are proposed to be connected to the same gender node. The Levelt, Roelofs and Meyer (1999) model specifies that gender nodes, in turn, are connected to all agreement targets of the corresponding gender such as pronouns and determiners. Evidence from picture-word interference research corroborates the notion that grammatical gender is crucial for processes of grammatical encoding. For example, utterance onset latencies for picture description were greater when Dutch speakers describing colored line drawings were presented a distractor whose gender was incongruous to that of the target than when the distractor was gender congruous to the target (Schriefers, 1993). Using the same paradigm, LaHeij, Mak, Sander, and Willeboordse (1998) replicated the gender distraction effect for NPs requiring the gender marking of adjectives and determiners but crucially not for the production of bare nouns.

1.1.2 Morphonologically regular gender is predictable from surface forms

The gender congruency effect has been interpreted as evidence of competition at the gender selection level during lemma access and retrieval; however, crosslinguistic

differences suggest that this may not be the case for Romance languages such as Spanish

(Schriefers, 1993; Costa, Sebastían-Gallés, Miozzo and Caramazza, 1999). In fact, the

evidence that Spanish gender is stored exclusively with the lemma is considerably

weaker. The second account of how children use grammatical gender for production

considered in this dissertation is based on such evidence. For example, presenting a

picture whose label is of the opposite gender than a to-be-produced target word does not

result in interference for adult Spanish speakers (Costa, Sebastián-Gallés, Miozzo and

Caramazza, 1999; O'Rourke, 2007). One possible explanation involves re-interpretation

of the gender congruency effect with consideration of crosslinguistic differences with

respect to the variable degrees of interaction between syntactic and phonological

processes. In languages like Dutch the form of the determiner can be specified upon

accessing syntactic information at the lemma level; however, in Spanish, as in other

Romance languages like Italian, the form of the determiner is sometimes dependent upon

the phonological instantiation of the first phoneme of the noun it precedes. This is the

case for a small group of feminine nouns that begin with a stressed /a/ that take the

masculine determiner. For example, the noun *water* "agua" is grammatically feminine

and agreement dictates that modifying adjectives be marked for feminine morphology

(agu**a** frí**a** / water-fem cold-fem); however, the phonology of the language dictates that

when preceded by a singular definite determiner, it must take the form of the masculine

determiner *el* rather than the feminine determiner *la* (el agua fría/ the-masc water-f cold-

f). As a result, selection of the appropriate determiner form is dependent upon the

availability of phonological information of the content word and is thus posited to occur

later in the process of noun phrase production with languages like Spanish versus

languages like Dutch (Caramazza, Miozzo, Costa, Schiller and Alario, 2001). A similar

situation is shown for Italian. In fact, Miozzo and Caramazza (1999) showed that

discordant phonological information within the noun phrase significantly slows naming

times relative to naming times for noun phrases containing phonologically consistent

gender marking. The relative contribution of phonological information posited as an

explanation for the lack of a gender congruency effect for Spanish gives rise to yet

another possibility based on the regularity and predictability of structure and form of the

Spanish gender system. Another possible reason for the exceptional status of Spanish is

the very high level of predictability between determiner gender and noun form. For

example, 96.3% of nouns ending in –a are feminine and therefore preceded by the

definite determiner *la*, and 99.87% of nouns ending in –o are masculine and preceded by

el (Teschner & Russell, 1984). This pattern holds for some 78% of Spanish nouns

(Moreno-Sandoval & Goñi-Mendoyo 2000). The high predictability of Spanish noun

endings and determiner gender means that Spanish-speaking adults might be able to

produce the correct gender for a noun without needing to access gender information

specified in the lemma. That is, gender may be stored in the lemma for adult Spanish

speakers, just as it is for speakers of other languages, but the lemma-level information

may not be required for the production of simple noun phrases. Given this proposal about

the production of gender by Spanish-speaking adults, an interesting question concerns the

development of gender production by Spanish-learning children. One possibility

consistent with the lemma-based account is that Spanish-learning children initially

associate gender with individual nouns, storing gender information in the lemma and accessing it from the lemma during production. Only later do they, like Spanish-speaking adults, produce gender based on the predictable relation of noun form and determiner. Another alternative, however, is that both child and adult Spanish-speakers employ the predictable noun form / determiner relation. Given that in comprehension, children clearly demonstrate the ability to track and utilize distributional regularities in the input as cues to the syntactic structure of language, it is possible that the production system also exploits such information in the initial stages of development when the system is less robust in nature and processing capacity is particularly limited.

To explore this possibility the relevant data regarding what is known about the child's use of syntactic structure and morphology for comprehension, establishing reference as well as discerning gender categories will now be reviewed. For example, young children have been shown to be sensitive to morphosyntactic regularities such as determiners that facilitate identification of content words (Gerken and McIntosh, 1993; Zangl and Fernald, 2007; Fernald and Hurtado, 2006; Williams and Fernald, 2007). In fact, 18-month olds were slower and less accurate in identifying familiar nouns preceded by a nonce determiner (po car) than nouns preceded by a grammatical determiner (the car) (Zangl and Fernald, 2007). Gains in efficiency in processing in comprehension have been shown to be correlated with gains in efficiency in other areas such as production. For example, not only are Spanish-learning children quick to make use of gender-marked articles to establish reference in comprehension, but those children who are quickest in exploiting grammatical gender cues are also those with larger productive

vocabularies who also produce more grammatically complex utterances (Williams and Fernald, 2007). Children are not only sensitive to syntactic positional cues to structure but also to the morphosyntactic features of such frames. For example, child gender acquisition data suggest that gender can be acquired via surface morphophonology without knowing the meaning of a word. In a preferential looking paradigm, English-speaking 17-month-olds trained on a subset of a Russian gender paradigm were able to utilize morphosyntactic gender and case marking to discriminate between grammatical and ungrammatical items they were not exposed to in familiarization (Gerken, Wilson and Lewis, 2005). English-speaking adults, like children, are also able to detect cues to syntactic categories and utilize these cues to learn a Russian gender paradigm system (Richardson, Harris, Plante and Gerken, 2006). This ability for both adults and young children breaks down as the number of available cues to syntactic structure decreases (Gerken et al, 2005; Richardson et al, 2006). These studies show that children use a variety of overlapping cues to syntactic structure (i.e. phonological, morphological, positional and referential) reflected in comprehension as well as for gender category formation; however, the data are scare supporting the possibility that the developing production system also exploits surface regularities and distributional patterns that allow the child to produce simple noun phrases. McKee and Iwasaki (2001) suggest such a possibility noting that a Japanese child's use of the genitive marker "no" with an adjectival noun rather than the appropriate marker "na" could be interpreted as the application of a default developed by the system based on distributional information of the language for the purpose of avoiding a crash when timing and retrieval processes

break down. In fact, the particle "no" is reported to be overused by both L1 child and L2 adult learners of Japanese (McKee and Iwasaki, 2001; Murasugi, 1991; Sekiguchi, 1995). The research outlined in this dissertation addresses this question in an experimental design, allowing for comparison of performance on real Spanish words to performance on phonologically legal non-words, testing the possibility that the production system utilizes distributional patterns in the input with respect to morphophonological and positional cues available in the syntactic frame of a noun phrase as cues to gender for productivity. If this is indeed the case, the child's performance should show patterns consistent with the predictability of distributional patterns across the nominal gender system as well as the regularity of morphophonological patterns present in the form of sublexical information   /o/ = masculine and /a/ = feminine. Extraction of these patterns should result in generalizations that allow the child to produce a noun phrase without accessing information stored with specific lexical entries as evidenced by similar patterns of performance on words and non-words.

1.1.3   Feminine morphophonology is better than masculine morphophonology

The third alternative account proposed in this dissertation is that the child's system is input driven, operating off of a fine-grained analysis of the lexical input it receives, extracting regularities of distributional patterns as well as those found in surface morphophonological properties of the language. The production mechanism exploits the regularity of these input statistics as evidenced by differential performance for feminine versus masculine morphophonology with greater accuracy shown for feminine morphophonological patterns that demonstrate regularity versus masculine

morphophonological patterns that reflect greater variability. Accessing gender stored with specific lexical entries is not required for successful production of a noun phrase; however, morphophonological regularities do affect processes involved in access and retrieval of familiar words in the child's lexicon in coordinating production of the determiner / stem combination. On this hypothesis, the child's production mechanism looks much like that of the adult Spanish speaker; however, the child system is less robust in nature and thus more readily demonstrates effects that reflect regularities in distributional patterns provided by input statistics. This account predicts greater accuracy in performance wherever the child encounters the combination of regularity and familiarity; thus an asymmetry should be found between performance on feminine versus masculine words with greater accuracy for feminine words versus masculine words. When the child encounters a real word, lexical retrieval is initiated. Performance on non-words should nonetheless reflect a similar pattern as that shown for real words; however, in the absence of familiarity, the child's mechanism demonstrates more clearly the influence of input statistics, operating solely off of regular morphophonological sequences. Evidence that morphophonological regularity is a priority should be seen for both words and non-words; thus, across the board, *la* should be easier than *el* since feminine determiners are engaged in more regular patterns than are masculine determiners.

A major component of this input-based account is based upon research showing the child's ability to perform statistical analysis of the data he/she is exposed to, extracting regularities that form the basis for generalizations. In addition to the data

presented in support of the frame-based account, evidence for a data-driven account of determiner production is also found within the framework of connectionist models. The words that a child learns form networks of associations built up as the child acquires the vocabulary and structure of his/her language. Within such a model, token and type frequencies in the input received by the child determine the strength and productivity of lexical schemas. The words a child knows are connected via semantic relations as well as phonological similarity. From the patterns of associative connections among various sets of words that share features, morphological patterns emerge as generalizations (Bybee, 1995; 1998). Computer simulation of statistical learning provides evidence that children are, in fact, able to use distributional information and surface features of the language to extract such generalizations and use them for productivity. For example, Smith, Nix, Davey, López-Ornat and Messer (2003) extracted all of the determiner-noun combinations present in the parental speech directed to a Spanish-speaking child, María, in a longitudinal study of her linguistic development between ages 1;7 and 2;11 (López-Ornat, Fernandez, Gallo and Mariscal, 1994). Analysis of the noun phrases present in this parental speech revealed a distributional pattern mirroring the structure of the Spanish nominal gender system with slightly more feminine regular nouns relative to masculine regular nouns and masculine irregular nouns outnumbering irregular feminine nouns by approximately 2 to 1. The associative network was trained incrementally on sets of noun phrases extracted from the parental speech and was then tested at each stage with success determined by the network's ability to produce the correct phonemic sequence of the intended determiner. When tested on the four highest frequency

masculine and feminine regular and irregular words, the network demonstrated slightly better performance on feminine versus masculine determiners in the initial stage between ages 1;7 and 2;1. After this point, the feminine advantage was lost and children's accuracy on both regular and irregular masculine determiners exceeded that of performance on feminine determiners. A closer look at the data reveals that the poor performance on feminine determiners is largely due to the introduction of feminine items with irregular endings as well as the fact that masculine irregular items begin to outnumber feminine irregular items in the input fed into the network. When tested on novel words, the network showed evidence of generalization in its ability to produce determiners with novel word strings. With novel masculine regular words, the network consistently assigned masculine determiners to the majority of the items from an early increment whereas with novel feminine regular words the network showed some inconsistency in gender assignment from the very beginning. With irregular items, the network was more likely to assign masculine than feminine gender. When the output produced by the network was compared to the actual recorded speech of María, a similar pattern of development was found, important evidence to support the notion that children indeed are capable of tracking the distributional patterns of the input they are exposed to. The combination of results is taken to suggest that the system demonstrates a masculine bias or default; however, upon careful inspection of the distribution of word-final phonemes in Spanish across genders, it becomes clear that children are not only detecting distributional patterns and capitalizing on regularity, but they are also "assigning" gender on the basis of the structure of the nominal gender system. For example, the net's

decreased consistency on feminine non-words compared to masculine non-words can also be interpreted in terms of the distribution of Spanish nouns across genders. While there are over 500 feminine words that can take the masculine determiner, there are only approximately 16 masculine words that can take the feminine determiner (Teschner and Russel, 1984). While performance of the associative network clearly models the ability of a statistical learner tracking patterns in the input, it crucially lacks the ability to accurately reflect the complexity of online processing of a system that has at it's disposal not only the ability to detect regularities but also the ability to use this information to access and use stored lexical information in a manner that reflects the efficiency of regular feminine morphophonology and likewise the difficulty of variable masculine morphophonology. Associative network computer modeling offers insight into the learning process; however, the design of this dissertation goes a step beyond this by (a) minimizing learning effects in asking the child to repeat a stimulus given in the complete determiner / stem form (b) comparing performance on words that children are likely to know and represent in their system to phonologically legal non-words and (c) comparing performance on masculine versus feminine stems based on the most regular pattern that represents the majority of words in the Spanish language. Such a design not only allows for the possibility of comparing the child's utterance to a specific stimulus presented but also of comparing the ways in which the child modifies the utterance to structural and distributional patterns found in the nominal gender system of Spanish. Where the child's pattern differs from the distributional structure of the language, much insight can be gained regarding the structure and processing strategies of the production system itself.

In order to evaluate the relative contribution of the structure of the language, the structure of the nominal gender system in Spanish will now be briefly reviewed and will be discussed in greater detail in Chapter 2. The Spanish nominal gender system falls somewhere in between on the continuum of languages such as Zande in which semantics reliably predict gender assignment with no correspondence between gender and word form and languages such as Russian and German (Corbett and Fraser, 2000). With the exception of nouns referring to natural biological sex, gender assignment in these latter two languages is governed by inflectional patterns. In Spanish semantic gender assignment is restricted to those nouns reflecting the biological sex of the referent. Grammatical gender is arbitrarily assigned and can be dissociated from a word's meaning and form class. For example, both *silla* and *asiento* mean "chair" in Spanish, yet with respect to grammatical gender, the former is feminine while the latter is masculine (Harris, 1991). The phonological realization of a particular gender, or the word's form class, is dissociable from its assigned gender as is evidenced by the fact that *mano* "hand" ends in /o/ yet is feminine while *sintagma* "phrase" ends in /a/ and is masculine.

While it is true that gender assignment in Spanish is arbitrary in nature, regularities emerge that would allow a statistical learner to make use of the predictability of determiner form and the regularity of stem morphology as well as the distribution of degrees of variability within the nominal gender system. Corpus data analysis is informative with respect to a structural analysis of the nominal gender system of Spanish. Table 1 is based on an inverse dictionary analysis of Spanish nouns (Teschner and

Russell, 1984) and shows the distribution of regular and irregular patterns across the

Spanish lexicon.

Table 1.1: Distributional analysis of regular and irregular nouns for both masculine and feminine genders based on Teschner and Russell (1984).

	Masculine	Feminine	M-F Difference
Regular	12,536 (30%)	15,400 (37%)	- 2,864
Irregular	9,501 (23%)	4,470 (10%)	5,032
R-I Difference	3,035	10,930	
Total	22,037 (53%)	19,870 (47%)	

As Table 1.1 shows, there are slightly more masculine nouns than feminine nouns

overall. There are more feminine regular nouns than regular masculine nouns and this

pattern reverses for irregular nouns such that masculine irregular nouns outnumber

feminine irregular nouns. The ratio of regular to irregular nouns is of particular interest

when considering the distributional patterns present in the data that children are exposed

to. Note that there is a much smaller difference between the quantity of regular versus

irregular masculine nouns compared to the more sizeable gap between the feminine

regular versus irregular nouns.

If children are sensitive to the distributional patterns of both surface features and

lexical regularities, we would expect to find a pattern similar to that described above for

adults reflected in the speech of young children. The MacArthur Communicative

Development parental checklist, developmentally normed for both Spanish and English

provides an excellent means of examining the structure of the Spanish-speaking child's

lexicon. Analysis of the nouns understood and produced by Spanish-speaking children

between 16 and 30 months indeed reveals a pattern similar to that of the adult

distribution. Table 2 shows the resulting analysis of the CDI developmentally- normed

vocabulary checklist based on a total of 353 nouns.

Table 1.2: Distributional analysis of nouns included on the Spanish CDI

	Masculine	Feminine	M-F Difference
Regular	101 (28%)	151 (41%)	-49
Irregular	83 (23%)	18 (5%)	64
R-I Difference	18	133	
Totals	184 (54%)	169 (46%)	15

As can be seen in Table 1.2, children, like adults, produce slightly more

masculine nouns than feminine nouns. The difference between regular and irregular

nouns is greater for feminine versus masculine with children producing more regular

nouns overall than irregular nouns. For masculine nouns, this difference is very small.

The distribution of the majority of nouns produced by both the child and adult Spanish

speaker demonstrates a regular pattern whereby *el* corresponds with word-final phoneme

/o/ and *la* corresponds with word-final phoneme /a/.

Upon closer examination of the distribution of variability and regularity within

the Spanish nominal gender system, it becomes clear that the feminine gender system of

Spanish shows greater regularity than does the masculine system. In addition to the fact

that *la* more reliably predicts the gender of the upcoming stem than does *el*, the advantage

of the feminine gender system is further bolstered by the phonetic quality of the vowel /a/ as well as the syllable structure of the language. In Spanish, the more sonorant the vowel, the better candidate it is for forming the nucleus of a vowel. The vowel /a/ is the most sonorant of the vowels in Spanish and is the only vowel produced in the low central position. Coupled with the fact that consonant vowel (CV) is the most frequent syllable structure in the language, the feminine definite determiner should be (a) potentially easier to perceive for the child and crucially (b) easier to produce. In fact, there is evidence to suggest both an overall advantage of feminine morphology over masculine morphology as well as a specific advantage for production of the feminine determiner over the masculine determiner. For example, Pizzuto and Caselli (1992) recorded the speech of three Italian children between the ages of 1;4 and 3;0 and found that the feminine singular determiner *la* both appeared earlier than the masculine article *il* as well as achieved acquisition criteria sooner than the masculine determiners. Mariscal (1996, 1997) and López-Ornat (1997) demonstrated similar findings in a longitudinal study of one Spanish-speaking child's noun phrase development. The analysis showed that the child consistently produced a gender congruent article or vowel form with feminine words than she did with masculine words. In addition to an increased number of article omissions with masculine words, the child also produced more variable vocalic forms with masculine words when she produced an element in the determiner position than with feminine words. In a gender categorization task, 144 French children were asked to categorize masculine and feminine non-words with both typical and non-typical endings as either *un* (a/an-masc) nouns or *une* (a/an-fem) nouns. Overall, there were more

ending-consistent responses given to gender-biased non-words than to unbiased non-words. The data also showed that 3 and 4 year olds performed above chance on determiner selection with feminine-biased non-words but not with masculine-biased non-words (Seigneuric, Zagar, Meunier and Spinelli, 2007). In a longitudinal study of 4 Spanish-speaking children, Mariscal (2009) analyzed noun phrase development via structured play sessions and noted that half of the children produced more complex noun phrases including various determiner forms with feminine nouns compared to their performance with masculine nouns. Frequency, saliency, reliability in predicting the gender of the upcoming noun as well as consistency and regularity across feminine forms are all posited to explain the asymmetry in performance between masculine and feminine nouns. Spanish-speaking children with specific language impairment (SLI) who demonstrate comprehension of both masculine and feminine articles nevertheless show difficulty in producing them. Patterns of performance suggest that the locus of the disorder is the result of a production processing deficit rather than insufficient linguistic knowledge. When performance on various types of articles is compared, children make the majority of errors in gender with the masculine definite article substituting *la* with masculine nouns. Additionally, Spanish-speaking children with SLI were found to omit *el* with greater frequency than any of the other determiner forms (Restrepo and Gutierrez-Clellan, 2001). These data suggest that the production mechanism indeed utilizes statistical analyses of the input, extracting the most regular, predictable morphophonological patterns across the gender system of the language. When the mechanism is unable to take advantage of the full range of patterns it is exposed to or

when the system is in the developmental stages, the system's preference for the morphophonologically regular forms of the feminine gender system over the more variable forms of the masculine gender system can be clearly observed.

In addition to evidence that the child's production mechanism operates off of regularities and distributional patterns, there is also evidence that children develop abilities to retrieve the words they know. Dapretto and Bjork (2000) tested English-speaking children between 14-24 months in an object naming task as well as an object retrieval task and found that children in the vocabulary spurt group made reliably more naming errors than children in both the pre-vocabulary spurt and the post-vocabulary spurt group. They found that the size of the child's productive vocabularies was reliably correlated with their performance on the label retrieval task (object naming) but not on the object retrieval task. There is also evidence that when a child encounters a familiar word whose sequence has been well practiced, processing is more efficient and fewer article omissions are evidenced compared to unfamiliar words and non-words. In an elicited imitation task Boyle and Gerken (1997) found that 2-year old English-speaking children omitted fewer object articles with familiar versus unfamiliar words and non-words and that this lexical familiarity effect operated independently of effects of metrical complexity on children's patterns of article omissions. These data suggest that when a child knows a word, he/she attempts to access and retrieve an existing lexical entry and that the initial stage of learning to do so creates an increased demand on the system; however, when compared to unfamiliar sequences, production of familiar words evidences a clear advantage. Taken together the data support the notion that production

processes are lexically driven as proposed in the lemma-based account; however, it is possible that the regularity and predictability that clearly affect the workings of the developing production system also biases lexical familiarity effects to those words the child knows well that also demonstrate the most regular, predictable morphosyntactic patterns that are easiest to produce. The combination of effects of lexical status and morphosyntactic regularity would be more difficult to detect in languages like English, the language of the above-mentioned studies. The Spanish nominal gender system, however, shows a distinct asymmetry with respect to regularity and lexical familiarity in that the masculine system demonstrates variability with respect to predictability of patterns as well as consistency of form while the feminine system shows both regularity of patterns and consistency of form. This dissertation capitalizes on the characteristics of this system providing the opportunity to explore the contribution of lexical status and regularity on the development of the Spanish-speaking child's ability to produce noun phrases.

1.1.4   Summary of Chapter 1

In summary, research exploring the timing and organization of the adult production system suggest crosslinguistic differences with respect to the storage and retrieval of gender information in the production of noun phrases. Unlike languages such as Dutch and German, Spanish demonstrates no gender congruency effect in picture-word interference production tasks, suggesting the possibility that gender at the lemma level can be bypassed for the production of noun phrases in Spanish whereas in other languages this is not a viable option. The research on grammatical gender in child

acquisition; however, has focused on the child's use of gender for learning and formation of gender categories as well as the child's use of gender in perception and online comprehension. In this domain, it has been shown that children attend to morphosyntactic cues to learn gender independent of semantic information of the type stored with lemmas. In an eye-tracking procedure, monolingual Spanish children between 34 and 42 months were shown pairs of pictures depicting objects that were either congruent in gender (*la pelota*, "the ball"-masculine, *la galleta*, "the cookie"-feminine) or incongruent in gender (*la pelota*, *el zapato*, "the shoe"-masculine). Children heard sentence prompts to find one of the depicted objects. Children were quicker to orient to the prompted referent in the gender incongruous condition (Williams and Fernald, 2007). These data underscore the fact that children like adults are sensitive to gender marking and utilize such information when useful for establishing reference; however, they are not informative with respect to identifying the source of such facilitation as processing of gender could potentially be aided by the determiner alone, the noun alone or the combination of cues present in the syntactic frame as a whole.

What is known about children's use of gender for production comes primarily from acquisition studies examining the naturalistic speech of a small number of children. These data suggest that monolingual Spanish-speaking children progress through stages of development in the acquisition of the Determiner Phrase producing bare nouns initially, then nouns with filler determiner-like elements, followed by the production of full determiner/noun combinations (Hernández-Pina 1984; López-Ornat, 1997; Montrul, 2004). Both bilingual and monolingual children are also said to make errors in

overgeneralization of either masculine or feminine articles (Clark, 1985; Barreña, 1997; Restrepo, Gutiérrez-Clellen, 2001; Mariscal, 1996; Hernández-Pina, 1984). Computer simulation using associative networks suggest that the mechanism underlying the developmental patterns shown for children's production of noun phrases is driven by a statistical analysis of the input, extracting regularities in surface morphophonology as well as co-occurrence patterns of nouns with the determiners that precede them (Smith, Nix, Davey, López-Ornat and Messer, 2003). Within an experimental paradigm, children's ability to generalize based on cues to grammatical gender has been investigated via elicited production tasks. For example, Pérez-Pereira (1991) found that Spanish-speaking children presented with pictures of novel creatures accompanied by various cues to gender (semantic, syntactic, morphophonological) showed greater accuracy with syntactic and morphophonological cues over semantics with children at different stages showing a preference for either use of the stem morphology or use of the gender of the article. The results also showed that accuracy increased with an increased number of concordant cues (Pérez-Pereria, 1991). This pattern has also been shown for French-speaking children (Karmiloff-Smith, 1979). While production data of this sort are informative in many respects, they do not dissociate underlying knowledge about gender categories and closed-class elements from the organization and development of the processing mechanism responsible for the use of such information in online speech production. This dissertation takes a step in that direction.

The goal of this dissertation is to determine whether young bilingual children learning Spanish access grammatical gender for production with the lemma of a word,

utilize gender for production in a manner similar to that shown in acquisition of gender categories based on distributional information provided in surface morphophonological information stored with syntactic phrasal frames, or whether alternatively, children use grammatical gender in a manner that reflects the use of input statistics provided by the regularity of surface features as well as regularity and distributional features extracted from the lexical structure of the language to which the child is exposed.

1.2 Significance of this dissertation

The research described in this dissertation should inform various domains of scientific inquiry such as developmental production models, bilingualism, specific language impairment (SLI) and adult processing models within the context of gender processing. First, this dissertation will determine how young Spanish-speaking children retrieve lexico-syntactic information at the word level and subsequently coordinate this information with syntactic phrasal construction at the sentence level for the production of determiner phrases. Evidence in the adult processing domain suggests that gender is stored with individual words and accessed via lemma-level retrieval processes (Vigliocco et al, 1997; Badecker, Miozzo and Zanuttini, 1995). Determiners are said to also be indirectly retrieved as a result of this process as abstract features of syntactic planning frames (Garrett, 1982; 1984). Research in the child area, however, has provided evidence that children are able to use the morphosyntactic surface cues available in distributional co-occurrence patterns across the language to learn gender categories, distinguish between referents and produce determiner-noun sequences (Gerken, Wilson and Lewis, 2005; Williams and Fernald, 2007; Pérez-Pereira, 1991). This dissertation bridges the

gap between child and adult research in the areas of gender processing and determiner production and is unique in that it is designed to disentangle the effects of lexical status and morphophonological surface features in a simple elicited imitation paradigm by manipulating lexical status, congruity and gender. By testing both adults and children within the same methodological paradigm, developmental aspects of processing can be observed in differential patterns of results shown for both groups.

Second, this dissertation informs the study of bilingual production processing. There are many issues that must be considered in order to understand the nature of the relationship between the languages a person knows with respect to structure, organization and relative degree of overlap or autonomy. Age of acquisition (child versus adult), order of acquisition (simultaneous versus sequential) and language dominance (balanced versus unbalanced) are all posited to affect the organization of the bilingual's languages and, as a consequence, the bilingual's processing patterns. There is some evidence in the child literature that the languages of the developing bilingual influence one another (Kupisch, 2007); however, there is also evidence to suggest that bilinguals follow a developmental trajectory comparable to that of a monolingual child in each of the respective languages the child knows (Barreña, 1997). This dissertation contributes to what is known in this area, albeit indirectly, in that the testing procedures involved measurement of vocabulary size in both Spanish and English per parental report on a developmentally norm-referenced vocabulary checklist. This not only allowed for the observation of language dominance patterns, but also provided the opportunity for analysis of each child's respective Spanish lexicon in terms of the distribution of nouns across the Spanish gender

system. These data were then able to be compared to patterns shown for both child and

adult monolinguals in order to establish comparability of the observed patterns of

performance for the bilingual child participants with monolingual speakers, both adults

and children.

As an extension of the application of the research outlined in this dissertation to

the study of bilingualism, this dissertation also informs the study of language disorders,

specifically the study of specific language impairment in Spanish-speaking children. The

exact nature of the underlying mechanism involved in the disorder is unknown though the

most prevalent theory posits a general deficit in cognitive processing capacity. Limited

resources are said to make perception of grammatical morphemes such as determiners

and inflectional elements difficult for the child to perceive and subsequently map onto

functional representations (Leonard, 1989; 1998). Nevertheless, there is evidence that

children with SLI are, in fact, sensitive to these elements despite the fact that they fail to

produce them (McNamara, Carter, McIntosh and Gerken, 1998; Bortolini, Casselli and

Leonard, 1997). Conflicting patterns of results shown across studies have been attributed

to differences in language exposure patterns (Spanish monolingual versus Spanish-

English bilinguals) for the children tested. This dissertation attempts to establish a

developmental processing account of determiner production in a population of children

identified as normally developing with respect to language. Additionally, children

included in the study were exposed in varying degrees to both Spanish and English as

well as speak one or the other with greater frequency. This research thus takes an early

step towards understanding language impairment by providing insight into the workings

of the developing production system of a young group of typically-developing peers as compared to the processing patterns shown by adult Spanish-speakers.

Finally, this dissertation informs the domain of adult processing models as well as research in the area of gender processing. As mentioned previously, there is some evidence that gender is stored and accessed via lemma-retrieval processes in lexically-driven production planning processes (Schriefers, 1993; Schriefers and Teruel, 2000; Miozzo and Caramazza, 1999; Vigliocco, Antonini and Garrett, 1997; Badecker, Miozzo and Zanuttini, 1995). Conflicting results with respect to the gender congruency effect across languages suggest this might not be exclusively the case. Research within the picture-word interference paradigm posits language-specific processes based on the relative contribution of phonological and syntactic information in determiner form selection processes (Miozzo and Caramazza, 1999). The experiments described in this dissertation speak to these issues as they were designed specifically to disentangle effects attributed to lexical status from those that might be accounted for by morphophonological regularity of surface features across the gender system. Additionally, both adults and children were tested within the same paradigm providing not only for comparison between adult and child processing patterns but also for evaluation of processing patterns shown for adults in the experiment to findings in the area of adult gender processing research as a whole.

1.3 Road map of this dissertation

The three accounts put forward for how Spanish-speaking children produce grammatical gender within the determiner phrase are based on a wide range of evidence

from research with both adults and children. The two major delineating components that emerge from this research are (1) the relative contribution of lexically-specified grammatical gender and (2) the role of the regularity of morphophonological surface features and predictable distributional patterns across the gender system. There is an apparent rift between child and adult research. While research with Spanish-speaking children has focused on gauging morphosyntactic development as measured by article production and gender agreement within the noun phrase, research in the adult domain has focused on the time course of gender selection and determiner selection processing as well as distinguishing between differences in processing for closed-class and open-class vocabulary. In the domain of adult grammatical gender, crosslinguistic differences in gender processing are posited to account for discrepant findings with respect to the gender congruency effect.

Chapter 2 brings the wide assortment of findings from adult and child literature described above together within the context of the linguistic structure of the Spanish gender system. Section 2.1, therefore, begins with a descriptive analysis of the Spanish nominal gender system with a focus on the phonoprosodic characteristics of determiners across the system. Given that successful production of a noun phrase in Spanish depends on the selection of a gender appropriate determiner, this section also provides a basic description of language- specific details regarding gender agreement within the noun phrase. Section 2.2 then outlines the developmental trajectory of acquisition of gender agreement within the determiner phrase drawing on research from both typically-developing young Spanish-speaking children as well as findings from research with older

Spanish-speaking children with specific language impairment. Section 2.3 sets the stage

for situating child performance as described in the previous section within adult models

of production with a particular focus on determiner production, gender processing and

psycholinguistic models of gender agreement. In Section 2.4 the groundwork is laid out

for a developmental processing account of young Spanish-speaking children's production

of determiner phrases by providing specific evidence that children develop the ability to

access, retrieve and coordinate information in a way that allows them to express what

they know in increasingly complex ways as they approximate adult performance patterns.

Once this preliminary foundation has been established, Chapter 3 describes the

details directly relevant to the methodology and design of the experiments described in

this dissertation. In Section 3.4.6 the results of the experiment with adult Spanish-

speakers are presented. They are presented prior to the child data in order to provide a

clear picture of adult performance patterns relative to the three hypothesized accounts of

gender processing for the production of noun phrases within the context of adult

processing models. It is this analysis that provides the backdrop against which child

performance patterns as detailed in Chapter 4 can be evaluated with respect to patterns

shown for adult Spanish-speakers within the same paradigm, allowing for the observation

of developmental processing trends.

Finally, Chapter 5 brings both the child and adult data together in a comparative

analysis of performance patterns across populations. The findings for both groups are

then situated within the theoretical context of gender processing in adult production

models in Section 5.2. Section 5.3 explores the broader implications of these findings

with respect to developmental processing models, bilingualism, language impairment as

well as adult processing and production of grammatical gender.

CHAPTER 2   FUNDAMENTAL ISSUES OF THEORY AND DEVELOPMENT

Chapter 2 focuses on gender and gender agreement for the production of noun phrases. Section 2.1 begins with a description of the Spanish nominal gender system highlighting those aspects of the organization and structure that should prove informative to a child learning to speak Spanish. Next the general descriptive properties of agreement within the determiner phrase in Spanish are introduced. Within the scope of the determiner phrase the discussion is centered on the Spanish determiner system detailing specifics regarding regularity of form, stress patterns as well as frequency and consistency of syllabic structure. Section 2.2 then reviews the child literature relevant to the acquisition / production of gender agreement within the determiner phrase by young typically-developing Spanish-speaking children as well as older children diagnosed with speech impairment. This section provides converging evidence from both populations that young children's production of gender concordant article/noun sequences is affected by distributional patterns and morphophonological regularities of the language that provide maximal efficiency in access and retrieval processes as a function of consistency and regularity of form as well as frequency of syllable structure. In order to build a bridge between child and adult performance, Section 2.3 outlines the organization and structure of the adult production system with a focus on article production and gender agreement issues since the findings in this domain form the basis of comparison of the adult and child performance data. Finally, Section 2.4 details child production data that provide evidence for a developmental model of production since that is the focal point of the experimental design of this dissertation.

2.1 Characteristics of the system

2.1.1 The Spanish nominal gender system

As mentioned in Chapter 1, Spanish falls somewhere in between systems where semantics alone reliably predict gender and those demonstrating a correspondence between semantics, phonology and morphological case-marking for gender determination. There is a small set of Spanish nouns where biological gender offers a cue to grammatical gender status. The majority of inanimate nouns in Spanish demonstrate regularity with respect to the predictable pattern whereby the phonological cue of the stem, the vowel /a/ or /o/, corresponds predictably with feminine or masculine gender respectively. This group of nouns could prove particularly informative for the child learning Spanish given that those nouns ending in /o/ are generally preceded by the masculine definite article *el* and those nouns ending in /a/ are usually preceded by *la.* As mentioned in Chapter 1 and repeated here for the reader's convenience, there are exceptions, the most notable involving those feminine nouns beginning with a stressed /a/ such as *agua*. For these nouns, a phonological rule must be implemented when producing a singular definite noun phrase such that the feminine article *la* must be substituted for the masculine form *el*. Despite the substitution, the inherent specification of the noun's gender is invariant as can be seen below in examples (1a) and (1b).

(1)   a. el $_{masc,singl}$ agua $_{fem,sing}$ fría $_{fem,singl}$

The   water   cold

b. las$_{fem,pl}$ aguas$_{fem,pl}$ frías$_{fem,pl}$

The   waters   cold

In example (1a) above, the postnominal adjective "fría" demonstrates feminine gender inflection and corresponds to the feminine inherent gender specified on the noun, while the article does not in accordance with the above-mentioned phonological rule. Example (1b) further shows that this rule only applies to the singular form of the noun. When the plural form is used, the regular plural definite article *las* precedes the noun. The pattern described above leads to the observation that the masculine definite article *el* applies in all contexts whereas the feminine definite article does not. Based upon the structural analysis presented thus far together with corpus data analysis showing that there are slightly more masculine nouns than feminine nouns in the language, it appears logical to conclude that the masculine article is more reliable for a child in predicting the gender of the upcoming noun; however, a closer inspection of the breakdown of regular and irregular nouns within the masculine and feminine systems reveals a problematic issue with respect to regularity and reliability of cues. Table 2.1, based on the inverse dictionary analysis of Teschner and Russell (1984), illustrates the distribution of possible word-final phonemes for each gender in Spanish.

Table 2.1: Distribution of word-final phonemes adapted from Teschner & Russell (1984)

Word-final Phoneme	Masculine	Feminine	M-F Difference
/a/	591	15400	-14809
/d/	26	1042	-1016
/n/	2131	2273	-142
/z/	155	249	-94
/s/	649	483	166
/e/	2686	320	2366
/l/	1165	25	1140
/o/	12536	16	12520
/r/	1427	21	1406
/i/	309	23	286
/m/	30	0	30
/t/	39	3	36
/u/	97	5	92
/x/	30	3	27
/y/	89	6	83
/b/	12	0	12
/c/	23	1	22
/ch/	3	0	3
/f/	4	0	4
/g/	3	0	3
/j/	19	0	19
/k/	4	0	4
/ll/	4	0	4
/p/	5	0	5
Totals	**22037**	**19871**	**2166**

Table 2.1 reveals that while there are slightly more masculine nouns than feminine nouns

in general, there is much greater variability with respect to possible word-final phonemes

that are masculine than is seen for nouns that are feminine. We would expect the overall

structure of the nominal gender system shown for the adult corpus to be reflected in the

speech of young children if indeed they are able to track such statistical information. In

order to make this comparison, all of the nouns included on the MacArthur

Communicative Development vocabulary checklist developmentally norm-referenced for Spanish-speaking children between 16 and 30 months were extracted and categorized according to word-final phoneme and gender. The results are shown in Table 2.2 along with the adult corpus data for ease of comparison.

Table 2.2: Distribution of word-final phonemes in child and adult corpus data

Word-final Phoneme	Child			Adult		
	Masculine	Feminine	M-F Diff	Masculine	Feminine	M-F Diff
/a/	3	152	-149	591	15400	-14809
/d/	0	0	0	26	1042	-1016
/n/	19	1	18	2131	2273	-142
/z/	2	2	0	155	249	-94
/s/	1	0	1	649	483	166
/e/	31	8	23	2686	320	2366
/l/	10	1	9	1165	25	1140
/o/	101	4	97	12536	16	12520
/r/	9	1	8	1427	21	1406
/i/	4	0	4	309	23	286
/m/	0	0	0	30	0	30
/t/	1	0	1	39	3	36
/u/	1	0	1	97	5	92
/x/	0	0	0	30	3	27
/y/	1	0	1	89	6	83
/b/	0	0	0	12	0	12
/c/	0	0	0	23	1	22
/ch/	0	0	0	3	0	3
/f/	0	0	0	4	0	4
/g/	0	0	0	3	0	3
/j/	1	0	1	19	0	19
/k/	0	0	0	4	0	4
/ll/	0	0	0	4	0	4
/p/	0	0	0	5	0	5
Totals	184	169	15	22037	19871	2166

We can see from the data presented in Table 2.2 that the distribution of masculine versus feminine nouns in the child data is comparable to that of the adult corpus with slightly

more masculine nouns than feminine nouns present overall. The speech of young

Spanish-speaking children does not yet demonstrate the full range of word-final

phonemes as does the adult corpus; however, it is clear that children have noted the most

typical patterns present in the language with the distribution clustering around masculine

nouns ending in /o/ and feminine nouns ending in /a/. It is interesting to note that the

overall pattern and distribution of masculine versus feminine items shown in the adult

data for each word-final-phoneme category is largely preserved in the child data. For

example, the adult corpus shows that in Spanish the majority of nouns ending in /e/ are

masculine and the data show that this is true for children as well. This suggests that

children not only attend to the most obvious typical patterns of the system but that they

are also capable of detecting nuances of regularity present in data displaying atypical

patterns. Curiously, the adult pattern for word-final phoneme /n/ is reversed in the child

corpus such that children produce more masculine /n/-final words than feminine while

adults produce more /n/-final nouns that are feminine than masculine. The significance

of this observation in evaluating the speech of young Spanish-speaking children will

become clear in Section 2.2.1. In addition to discovering the structure and organization

of the nominal gender system in Spanish by utilizing the phonological regularities

available in word-final phonemes, children also must track the syntactic information

required for pairing gendered nouns with their appropriate gender-marked determiners.

The next section describes the characteristics of the Spanish agreement system with a

specific focus on agreement within the determiner phrase since this is directly related to

the questions addressed in this dissertation.

2.1.2 Gender agreement within the determiner phrase

Broadly speaking, agreement can be understood as the relationship established between particular elements that necessarily share features. The particular features involved in agreement vary as a function of language and include such possible elements as gender, number or person. It is generally understood that the agreement relationship established is driven by a "controller" that imposes its particular features in a matching process across the other elements involved (Nicol, Forster and Veres, 1997). There are numerous syntactic and semantic factors that enter into the agreement process as well as observable differences across languages accounted for by various proposed mechanisms. The discussion will return to these issues later in greater detail.

The noun is the agreement controller within the Spanish noun phrase. As mentioned earlier in this chapter, Spanish nouns are arbitrarily assigned to gender class, either masculine or feminine respectively. All agreement targets such as determiners and adjectives must agree with the gender of the head noun in the noun phrase. The one exception to this rule noted earlier is the case where a feminine noun with a stressed /a/ in onset position takes the form of the masculine determiner rather than the feminine determiner. Table 2.3 outlines the Spanish determiner system, excluding the neuter article *lo* that does not precede nouns:

Table 2.3: The Spanish determiner system

	Definite Determiners		Indefinite Determiners	
	Masculine	Feminine	Masculine	Feminine
Singular	el	la	un	una
Plural	los	las	una	unas

Both masculine and feminine definite articles pose a potential challenge to the

child learning to produce noun phrases in Spanish in that they are always weak,

unstressed elements that cannot stand alone; whereas indefinite articles, on the other

hand, appear in both stressed and unstressed forms. Metrically weak elements tend to be

omitted in the speech of young children and thus the definite determiners should prove

more susceptible to omission than the indefinite determiners (Gerken, 1991, 1992);

however, it is also important to note that Spanish is a syllable-timed language unlike

English which is said to be a stress-timed language (Bolinger, 1965; Pike, 1945; Pointon,

1980; Hualde, 2005). The terms syllable-timed and stress-timed refer to perceptual

differences between languages that can be understood in terms of rhythm where rhythm

is defined as the temporal duration of an interval in speech. In Stress-timed languages

like English, the duration between stressed syllables is perceived as relatively constant as

a result of reducing or expanding the duration of unstressed syllables. In this way

stressed syllables receive perceptual prominence. In syllable-timed languages, like

Spanish, however, both stressed and unstressed syllables are perceived as having the

same duration (Hualde, 2005). Stress, in Spanish, is understood in terms of changes in

intensity and pitch. There is little variation in duration of stressed and unstressed syllables

noted because of minimal variation in intensity between stressed and unstressed vowels (Hualde, 2005). Based on these characteristics, we would expect all forms of the determiner in Spanish to prove equally difficult.

While stress patterns may not be particularly informative in distinguishing characteristics across article forms, examination of syllable structure reveals distinct advantages and disadvantages across the system. There is evidence to support the notion that indeed, the syllable is the basic processing unit of the language. Syllable frequency effects in Spanish have been found in both lexical decision tasks as well as speeded naming tasks with adult monolingual speakers (Alvarez, Carreiras and Taft, 2001; Carreiras and Perea, 2004). In a speeded pseudoword naming task, Carreiras and Perea (2004) found a facilitative effect for high frequency syllables in onset position such that naming times were faster relative to low frequency syllables and high frequency syllables in other positions. The effect was shown to be independent of both stress placement, either first or second syllable, as well as the attested effect of lexical frequency. Analysis of syllable structure and frequency in a sample of written language of school-aged monolingual Spanish-speaking children revealed overall similar patterns in the composition of the syllabary for children as that demonstrated for adult Spanish speakers (Justicia, Santiago, Palma, Huertas, and Gutiérrez, 1996). Based on the similarity of structures and frequencies across child and adult syllabaries, it seems logical to extend the syllable frequency effect to child production as well. If this is the case, high frequency initial syllables should, by extension, be easier in terms of processing efficiency and thus be less susceptible to omission in the speech of young children

learning to speak Spanish. With respect to the determiner system, the definite articles are monosyllabic and three of the four indefinite articles are bisyllabic. In terms of syllable frequency, three of the four definite articles present with the two most frequent syllable structures in Spanish, consonant-vowel (CV) and consonant-vowel-consonant (CVC) while the fourth, the masculine definite singular article, is of the type vowel-consonant (VC), the fourth most frequent syllable structure identified in the corpus analysis mentioned above. The indefinite determiners all begin with vowel (V) or vowel-consonant (VC) patterns, the third and fourth most frequent syllable structures in Spanish (Justicia, Santiago, Palma, Huertas, and Gutiérrez, 1996). It seems clear that in terms of syllable type frequency of onset, the definite determiners should be overall easier to produce than the indefinite determiners. Within the definite determiner system, it is evident that the masculine singular definite determiner is at a distinct disadvantage and could prove potentially problematic with respect to accuracy and speed of production compared to the other forms and in particular compared to the feminine definite determiner *la*.

As mentioned earlier, determiners must agree in number and gender with the nouns they modify. In Spanish, adjectives must also agree in number and gender with the head noun. The majority of adjectives can carry either masculine or feminine gender specification as reflected in the stem morphology, /o/ for masculine and /a/ for feminine. Those adjectives not conforming to this pattern end in /e/ and are invariant with respect to gender specification. While adjective agreement does not directly bear upon the experiments in this dissertation, adjective gender inflection offers additional cues to the

regularity of patterns present within the determiner phrase and thus is germane to the discussion. Example 2 shows the typical agreement relationship between noun, definite article and adjective for both feminine and masculine forms.

(2)   a. el $_{masc,\ singl}$ perro $_{masc,\ singl}$ negro $_{masc,\ singl}$

        The   dog   black

    b. la $_{fem,\ singl}$ rosa $_{fem,\ singl}$ bonita $_{fem,\ singl}$

        The   rose   pretty

As can be observed in Example (2) as well as across the determiner system as a whole, the feminine article system demonstrates a greater regularity and consistency of form than does the masculine article system. The plural of both definite and indefinite feminine articles is formed by the simple addition of the plural /s/, whereas the plural of both definite and indefinite masculine articles necessitates a greater change in form from singular to plural. Additionally, the feminine article system provides a phonological cue in the repetition of the vowel /a/ across forms. In examination of Example (2), it becomes clear how this could prove potentially informative for a child tracking the regularity of the input and unraveling the gender system of the language given that the vowel /a/ present in all forms of the feminine article system is also the phonological stem marker most prevalent in the nominal gender system for feminine nouns and is additionally repeated in the morphology of the adjective stem.

In summary, analysis of the structural and distributional properties of the Spanish gender system reveals an asymmetrical relationship between regularity and type and token frequencies across the gender system. Overall, both children and adults produce

more masculine nouns than feminine nouns, evidence that masculine nouns outnumber

feminine nouns in the Spanish language. The majority of nouns ending in /o/ are

masculine and are preceded by the masculine singular definite article *el* while the

majority of nouns ending in /a/ are feminine and are preceded by the feminine singular

definite article *la;* however, the proportion of regular or typical nouns to atypical nouns is

distinct across genders with a greater difference between feminine regular versus

feminine irregular nouns than that found for masculine nouns. Masculine nouns not

conforming to the above-mentioned regularity outnumber feminine atypical nouns.

Feminine morphology demonstrates the most regular consistent form across determiners,

noun endings as well as adjective inflection, whereas masculine morphological patterns

are more variable in form, especially with respect to noun endings and determiners.

While the feminine determiners are all characterized by the vowel /a/ located most

frequently in word-final position (*la, una, esta*), the masculine articles are most typically

characterized by the vowel /e/ (*el, este*) whose position in the word is variable. In terms

of reliability of cues, *la* is highly predictive of the gender of the upcoming stem whereas

el is not. With respect to syllable structure and ease of production, recall that the more

frequent the syllable, the easier it is to produce and the more sonorant the vowel, the

more likely it is to form the nucleus of a syllable. The most frequent syllable structure in

Spanish is that of consonant vowel and the most sonorant of the Spanish vowels is /a/;

thus the feminine determiners, especially the feminine definite determiners, should prove

easier to produce than the masculine definite determiners. It seems fitting at this point in

time to turn to the speech of Spanish-speaking children and to evaluate the extent to

which their speech mirrors the linguistic systems governing gender agreement within the

determiner phrase.

2.2 Developmental course of article production and gender agreement

Section 2.2 presents data that support the idea that Spanish-speaking children do,

in fact, use a combination of characteristics from the input they receive to begin

producing gender concordant determiner / noun phrases. First, this section covers

available data from the spontaneous speech of very young typically-developing

monolingual children's production of real words as well as experimental evidence from

older children's production of pseudowords. Then, it details findings from research on

article production with children diagnosed with a developmental language disorder,

specific language impairment, which is posited to stem from an underlying deficit in

processing resources. In this discussion, overlapping error patterns are described that

lend support for a developmental processing account of noun phrase production within a

model that exploits statistical properties regarding the organization, distributional patterns

and regularity of the linguistic data available in the ambient language of exposure for

maximal efficiency and productivity.

2.2.1 Typically developing Spanish-speaking children

In a longitudinal analysis of data collected from María, a monolingual Spanish-

speaking child, López-Ornat (1997) explores the possibility that young children make use

of early phonoprosodic knowledge to bootstrap themselves into the morphological system

of the language as evidenced by early production of gender-marked noun phrases. In

order to test this hypothesis, all of Maria's "pregrammatical" NPs produced between 1;7

and 2;1were extracted from the database and analyzed. NPs were coded as either masculine or feminine and accuracy was evaluated with respect to determiner use in obligatory contexts and the data were divided into four age periods (1;7-1;8, 1;9-1;10, 1;11, 2;0 and 2;1). Each utterance was coded as either an article omission, a pre-fixed vocalic form (Vowel + Noun) or a full Determiner + Noun sequence. The data show that María's production of masculine nouns outnumbers her production of feminine nouns at all stages except period 1;11-2;0. María produces full unambiguous Det + N combinations as early as 1;7. María's utterances demonstrate greater accuracy and complexity earlier on with feminine morphology than do her utterances with masculine nouns. She produces slightly more nouns preceded by vocalic forms for feminine nouns than she does for masculine nouns for the first two age periods. Full Det + N sequences for feminine nouns outnumber production of Det + N combinations with masculine nouns at all stages except 1;9-1;10.

Analysis of the vocalic forms preceding nouns in María's speech revealed a preference for the vowel /a/ in pre-nominal position with feminine nouns. With masculine nouns there is greater variability of vowel forms with either /e/, /o/ or /u/ preceding the nouns she produces. María never uses the vowel /i/ which reflects the fact that /i/ does not appear in any form of determiner used in the Spanish language. According to Lopéz-Ornat (1997) the systematicity shown in María's pre-vocalic utterances and the high correspondence between forms present in her speech and those possible in the determiner system suggest that these pre-nominal vowels are in fact, phonemes of "morphological relevance" based on the fact that the child has extracted at

least some of the linguistic subregularities of the determiner system. This corroborates findings in an earlier study in which children between 1;6 and 2;2 were videotaped during guided play sessions (López-Ornat, 1996). Following the production of a noun, the researcher would ask for clarification, requiring the repetition of the noun or noun phrase the child had previously produced. Comparison of the first and second response showed that as early as 1;6 the child's utterances conform to the general pattern of the language. In general a gender-unambiguous vowel is optionally produced in the correct determiner position and precedes a minimum of one stressed syllable of the target noun. For example, one child's first attempt at the target "casa" resulted in the form "cá" while her second response for clarification was produced as "acá". She produces the obligatorily stressed penultimate syllable of the target form "casa" and in her second response adds the vocalic form /a/ corresponding to the correct gendered article and places it in the correct pre-nominal position.

These data are taken as evidence suggesting that morphological learning takes place as the child stores and codes the input for a phonoprosodic analysis that in turn results in the morphological representation of individual linguistic items (López-Ornat, 1997). López-Ornat (1997) points out that the greater transparency of form-function mapping shown for the feminine morphological system is responsible for facilitation in the above-mentioned analysis of linguistic input for grammatical learning. On this interpretation of the data, we might logically conclude that the asymmetry demonstrated between performance on masculine versus feminine nouns is the result of an underlying asymmetry in the perception of these forms. In other words, if the opaqueness of the

masculine morphological system makes learning the grammatical system more difficult than does feminine morphology, we would expect children´s comprehension of such forms to be equally affected showing similar patterns as those found in the production data. Available data suggest that this is not the case (Williams and Fernald, 2007). Young Spanish monolingual children between 34 and 42 months of age are quicker to orient to the referent when the two pictures presented are incongruent in gender versus when they are congruent, suggesting that children use the morphosyntactic cues available in the determiner phrase to differentiate between referents; however, this ability is not differentially affected by gender. That is to say that children perform equally as well on masculine versus feminine noun phrases. The data presented by López-Ornat (1997) do, however, support the notion that children perform statistical analyses of the input and that production processes are driven by morphophonological and distributional regularities across genders. In the early stages of development when the child system is not as robust as the adult system, the system's preference for the regular morphophonological forms of the feminine gender system over the more variable morphophonological forms of the masculine gender system can be more readily observed. This is evidenced by the fact that María consistently produces feminine morphological forms earlier and in more complex sequences than she does masculine forms.

The distinct preference for feminine morphology demonstrated in the speech of María is not always noted in the speech of young Spanish-speaking children. For example, in a longitudinal study of Rafael, Hernández-Pina (1984) noted that at age 1;11 nouns with gender-ambiguous endings are preceded by masculine gendered articles. For

example, Rafael uses the masculine indefinite article with the feminine irregular noun

producing the ungrammatical sequence "un llave" rather than the target "una llave".

Later, overgeneralization is recorded in substitution errors in the opposite direction such

that masculine articles are substituted with feminine articles preceding masculine nouns

yielding utterances such as "una camión" and "una pez". By age 2;7 Rafael's speech is

characterized by full agreement between nouns and articles, but not yet between nouns

and adjectives. He is reported to make errors of gender agreement between adjectives

and inanimate nouns until around age 2;8. The findings here suggest that there are

multiple factors that affect gender agreement patterns in children's speech. The patterns

shown in María´s speech above suggest that the production system is jumpstarted into the

production of gendered noun phrases by the feminine system's morphophonological

regularity and consistency of form. Rafael's speech, on the other hand, seems to reflect

the distribution of word-final phonemes in the nominal gender system. In each of the

examples cited above he produces the incorrect gendered article, but his choice of gender

is clearly not made at random as it demonstrates a systematic correspondence to the

gender attributed to the majority of nouns carrying that particular word-final phoneme.

Distributional patterns of this sort could prove to be a potentially informative source of

clarification for productivity of unfamiliar nouns whose gender might be underspecified

at the lexical level; however, a fine-grained statistical analysis of such patterns across the

nominal gender system could also prove to be an efficient processing strategy for access,

retrieval and production of even the most familiar lexical items already stored in the

child's lexicon.

Mariscal (2009) elicited noun phrases from four Spanish-speaking children via structured play sessions videotaped over a period of a month. The same set of toys was used each time to ensure multiple productions of the same noun whose variable structure could be observed over time. For those nouns produced five or more times by each child in each observational period a measure of variability was calculated representing the proportion of times the child produced a particular noun with an alternative form (vowel + N, Det + N or OtherDet + N) to the number of times the child produced the same noun without a determiner form. The results showed that in the initial stages some nouns are more likely to be produced with a determiner form than are others. For example, one child produced the feminine noun "bruja" (witch) 22 times in cycle one. Of those 22 repetitions, none of them included a form of the article. In the same cycle, the same child produced the masculine noun "león" (lion) 22 times with some sort of determiner form in pre-nominal position and 46 times as a bare noun. A similar pattern was found for nouns preceded by gender unambiguous vowel forms as well as for production of indefinite determiners whereby production of such forms appeared to be associated with specific items. The inter-type variability present in the data is interpreted as partial grammatical knowledge and the subsequent decrease of the variability over time as approximations of adult-like grammatical knowledge as well as evidence that articles are initially lexically specified. What appears to constitute specificity of articles attached to particular lexical items in fact provides striking evidence that the child has knowledge of the linguistic structures in question. Mariscal (2009) noted a very low error rate in article noun agreement suggesting that when the child produces a noun such

as "león" with a determiner, the form is the appropriate gender-congruous article in the majority of cases and its placement preserves correct word order. It could be the case that lexical specificity is in fact an effect of lexical familiarity associated with the development of lexical retrieval skills. This possibility will be explored in greater detail in Section 2.4.

The developmental data thus far suggest that Spanish-speaking children are sensitive to the frequency and regularity of features available in surface structures of the language and that they use such cues for producing gender agreement within the noun phrase. Additionally, findings suggest that producing articles with well-known, practiced lexical items is easier than producing articles with words that are either new to the child or unknown (Boyle and Gerken, 1997). What the child does when faced with a completely nonsensical noun that obeys the phonotactics of the language has also been a focus of experimental research with Spanish-speaking children. Pérez-Pereira (1991) tested the variable weight and reliability of cues to a noun's gender using an experimental picture naming task designed to elicit noun phrases from 160 monolingual Spanish-speaking children between ages 4 and 11. First children were shown a picture of an imaginary creature that was given a novel name. They were then prompted to name a subsequently presented creature of the same kind but of a different color. Morphophonological (stem ending /o/, /a/ or gender ambiguous), syntactic (determiner masculine, feminine or unmarked modifier) and semantic (picture with female or male characteristics versus gender ambiguous) cues to gender were varied across items in every possible combination. The child's choice of either a masculine or feminine

inflected adjective in naming the second differently colored picture was used to determine whether or not the child attributed masculine or feminine gender to the imaginary being, animal or thing previously presented. In attribution of gender, a slight difference was found between age groups such that the older children showed a preference for syntactic information present in the gendered article over morphophonological information marked on the stem when the cues were in conflict. Children were overall more accurate on items with morphophonological and morphosyntactic cues to gender than on items with semantic cues. Accuracy was found to increase with an increased number of concordant cues. He also found that when children were presented with a non-word carrying a gender-ambiguous ending, they tended to attribute masculine gender to the noun as evidenced by use of the masculine-inflected adjective in those cases. Overall, the data underscore the fact that children detect co-occurrence patterns of nouns and the elements with which they systematically occur such as determiners and gender-inflected adjectives as well as detect regularities of morphological patterns of the surface features of such syntactic frames. It is important to note, however, that some of the items included in the experiment were plural while the rest were singular. This mix of plurality marking presents a potential complication in interpreting the results given that there is evidence in the area of adult psycholinguistic research suggesting that number and gender agreement are separate processes in Spanish. There is additional evidence that within the gender agreement paradigm there are processing differences for determiner / noun agreement versus noun / adjective agreement. Production of an appropriate gender-inflected adjective, then, in this study

may not accurately assess the complexity of processes involved for gender agreement within the noun phrase. Additionally, the task involves computation of gender agreement for production with gender attribution evaluated on the basis of production data; therefore, what is taken as gender categorization may in fact reflect the production system's use of statistical properties of the input made visible by the lack of lexical familiarity. It is possible that in the absence of familiarity in the form of a stored lexical entry, the structure and organization of the system can be more clearly observed revealing a production mechanism that operates off of predictability of distributional patterns in the language as well as regularity and consistency of form. Inspection of the list of non-words included in the task in comparison to the distribution of word-final phonemes across genders in the nominal system reveals some interesting patterns with respect to possible response biases that support the above-mentioned production processing interpretation. Half of the items that carry gender ambiguous endings are marked by the word-final phonemes /r/ and /l/. Corpus analysis suggests that nouns ending in these phonemes are overwhelmingly designated as masculine. Of the remaining four nouns in the test items, three of them end in /n/ and one ends in /z/. There are a little over four thousand words in the Spanish language that end in /n/. Approximately half of them are feminine and half are masculine with slightly fewer masculine than feminine in the adult corpus. Recall from Section 2.1.1 that children, unlike adults, produce more masculine words with word-final phoneme /n/ than feminine words ending in /n/. Words that end in /z/ in Spanish are few in number and present in a similar manner as those ending in /n/ with slightly more feminine than masculine nouns respectively. It is thus unsurprising

that when performance on *un tanten* is compared with performance on *una pilin* a significant difference is found such that children more reliably produce a masculine adjective with *un tanten* than they produce a feminine adjective with *una pilin* when both items are presented without semantic cues to gender. Children were also found to more frequently produce a masculine adjective with *dos pilares* when presented with a masculine semantic cue than they produced a feminine adjective with *dos borales* when presented with a feminine semantic cue. Given that both pseudowords end in masculine-biased word-final phonemes, *dos pilares* actually can be considered as affording the child two concordant cues to masculine gender, that of the word-final phoneme as well as the semantic cue to masculine gender. Children's very low performance on *dos borales* is also logical given that only 25 nouns ending in /l/ in the corpus are specified for feminine gender. The overwhelming tendency for children to use masculine adjectives with *dos borales* in spite of its feminine semantic cue lends even stronger support for the superiority of linguistic cues over semantic cues. In fact, performance here suggests that the linguistic cues at the child's disposal are not merely those found in the surface morphosyntactic patterns of the noun phrase but also regularity found in even the most "non-typical" of distributional patterns found across genders in the nominal gender system of the language itself.

2.2.2 Spanish-speaking children with specific language impairment

Additional support for the notion that children use the predictable patterns of the language that demonstrate regularity and consistency of form comes from the study of article production in Spanish-speaking children with specific language impairment (SLI).

Children with SLI present with various deficits in speech production, demonstrating particular difficulty in the use of morphological elements such as verb tense and agreement as well as closed-class elements such as determiners. Children with SLI shown to omit articles or make gender substitution errors in speech, nonetheless demonstrate comprehension of these elements comparable to that of age-matched peers (Bortolini, Caselli and Leonard, 1997). For this reason, it is hypothesized that the deficits observed in the speech of children with SLI are due to a limitation in processing capacity that makes it difficult for children to fully exploit the cues present in surface features of the language, especially when the cues are weak, unstressed morphemes. Difficulty processing perceptual cues results in difficulty producing structures of the language requiring the use of such morphemes (Leonard, 1998).

The majority of the research in this area has focused on the use of verb morphology in English-speaking children, but has also been expanded to include other areas such as the production of agreement within the determiner phrase in languages that demonstrate a rich morphological system such as Spanish. Restrepo and Gutierrez-Clellan (2001) elicited language samples from 15 Spanish-speaking children with SLI and their age-matched peers via picture description, guided topic interview and story retelling. The children ranged in age from 5;1 to 7;1. They found that while children with SLI presented with more article omission errors and gender agreement errors than their typically-developing peers, errors in number agreement were not significantly different across both groups. With respect to article gender agreement errors on nouns showing atypical morphological patterns, children with SLI made the majority of errors

on "agua", a feminine noun that takes the masculine singular definite determiner because of the stressed /a/ in onset position. Overall, more errors were noted with definite articles than with indefinite articles. The most frequent pattern of article gender substitution error with definite articles was found to involve the substitution of *el* for *la* followed by substitution of *los* for *las*. The two less frequent error patterns involved masculine for feminine substitution such that *el* was used in place of *la* and *las* was used in place of *los*. Interestingly, the pattern of gender substitution errors observed showed preservation of number agreement. Restrepo and Gutierrez-Clellan (2001) also found that the majority of article omission errors occurred with *el* followed by *la* and then *los*. Article omissions were more frequent in prosodic contexts where the preceding syllable was weakly stressed. If we consider that *el* is harder to produce than *la* based on the fact that it participates in fewer regular patterns than the feminine determiner as well as the fact the typically-developing young Spanish-speaking children also demonstrate greater difficulty with masculine morphophonology than feminine morphophonology, these data suggest that children with SLI are also sensitive to morphophonological regularities across the language and, much like their younger peers, are unable to compensate for the variability of the masculine system in online production processing. The noun *agua* ends in the typical feminine vowel /a/ and indeed is specified for feminine gender. The most regular pattern in the feminine gender system leads to the conclusion that nouns ending in /a/ require the feminine determiner *la*. Children appear to have noted this pattern and apply it for maximum economy of productivity.

Anderson and Souto (2005) examined article production in a group of 22 monolingual Spanish-speaking children in Puerto Rico, half of whom had been diagnosed with SLI. The children ranged in age from 4;3 to 5;4. Three spontaneous speech samples were collected over several sessions, one via picture description, the second by picture book story telling and the third during structured play centered on a particular set of toys. In a subsequent session, noun phrases including both the determiner and gender-inflected adjective were elicited using a set of cards depicting 24 nouns that were counterbalanced for noun ending (typical, atypical), gender (masculine, feminine), semantic transparency (biological sex / transparent, inherent / non-transparent). The data were transcribed and coded for either correct or incorrect article usage in obligatory contexts. When the data for the SLI group were compared to that of the typical language learner (TLL) group in analysis of the spontaneous speech samples a significant difference was found between the two groups such that children with SLI made more errors than did the TLL group; however, the pattern of errors found for each group was similar. With respect to types of errors, children in both groups made significantly more article omissions than they did any other error type. Children in both groups made very few gender agreement errors and even fewer errors in number agreement on the determiner. Similar patterns of error were found across determiner groups for both definite and indefinite singular articles. This reflects the fact that in Spanish stress is not a significant influence as was noted earlier in the discussion. When prosodic context was considered and comparison of errors was made between contexts for both *el* and *la*, no significant difference was found. The results of the experimental task showed that for the TLL group, children's gender

errors outnumbered their article omission errors while the opposite pattern emerged for

the SLI group. An analysis of the characteristics of the nouns involved in gender

agreement errors for each group was then undertaken and an overlapping pattern was

found such that the same nouns produced with the incorrect article in the TLL group were

also shown to be susceptible to gender agreement error in the SLI group. All of the

nouns involved in article gender agreement errors for the TLL group were considered of

the "atypical" sort with respect to noun ending (*bebé*-baby, *piloto*-pilot, *torre*-tower,

policía-police officer). The first two nouns were paired with pictures demonstrating

female characteristics, the third (inanimate) noun was paired with a picture of a tower and

the fourth noun, animate, was paired with a picture depicting a male officer. Anderson

and Souto (2005) note that children in both groups tended to ascribe masculine gender to

unfamiliar nouns of this sort and cite this as evidence supporting the notion of a

masculine default. It is also possible, however, to interpret children´s performance with

these nouns in terms of statistical patterns of morphophonological regularity and

distributional patterns shown across the Spanish nominal gender system. Given that the

majority of nouns in Spanish that end in /e/ are masculine, 2,000 plus versus around 300,

it is not surprising that children opt for the more frequent pattern, producing *el* with *bebé*

and *torre* rather than the target feminine determiner. Performance here is even less

surprising when we consider the relative low lexical frequency of nouns like *torre*

(tower) compared to other target items such as *tenedor* (fork). The fact that both children

with SLI as well as TLL children produced both the masculine determiner as well as a

masculine gender-inflected adjective suggests that indeed *torre* was being treated as an

unfamiliar noun. In the absence of lexical familiarity, children used the most frequent

regular surface distributions corresponding to the morphophonology of the stem. The

fact that children produced the masculine determiner *el* with *piloto* rather than the target

la is also not unexpected given that the majority of nouns ending in /o/ are masculine.

Children's tendency to produce *la* with *policía* rather than the masculine determiner *el* in

accordance with the male features present in the picture is taken as a reflection of the

variable semantic specification of the noun. For example, when used to describe the

institution or collective group of policemen, the article is obligatorily feminine. When

used to refer to individual police officers the choice of article gender is dependent upon

the biological sex of the referent. While this may very well be the case, it is important to

note that children's article choice with this particular item, like the other nouns

mentioned above, reflects the most regular distributional morphophonological pattern of

the language. Children's pattern of gender agreement errors here not only corroborates

the preference shown for morphophonological and syntactic cues over semantic cues to

gender but also the demonstrated effect of lexical familiarity on children's production of

article/ noun sequences (Pérez-Pereira, 1991; Boyle and Gerken, 1997; Gerken, Wilson

and Lewis, 2005).

Errors in gender agreement in the production of noun phrases have traditionally

been treated as a deficiency in knowledge of the grammatical gender agreement system

as a whole in the typical monolingual child's developmental trajectory. Findings suggest

that children with SLI are deficient with respect to word learning skills (Alt, Plante and

Creusere, 2004; Kiernan and Gray, 1998). If, indeed, gender is exclusively stored and

accessed with individual lexical entries in the child's lexicon and if the Spanish-speaking

child with SLI in fact lacks knowledge of the gender agreement paradigm and has

incorrectly categorized a particular noun with respect to gender, we would expect

performance to reflect systematic errors in which the child consistently produces the

opposite gendered morphosyntax with a particular noun. When the data for each child

were considered separately, comparing performance on the experimental task with the

spontaneous speech samples, an interesting pattern emerged for children in the SLI group

who committed errors in article/ noun agreement. Anderson and Souto (2005) found that

children who produced the correct gendered article with a particular noun in the

spontaneous speech sample nonetheless produced the same noun in the subsequent

experimental task with the incorrect gendered article but with the correct gender-inflected

adjective. These data suggest that children with SLI are not deficient in linguistic

knowledge of the gender paradigm but rather have difficulty in consistently retrieving the

correct article form.

2.2.3 Summary of the evidence

Section 2.2 has focused on the data available for Spanish-speaking children's

production of gender agreement within the noun phrase both in typically developing

populations as well as in children diagnosed with language impairment. Variability with

respect to patterns of "over-regularization" was found in the speech of young children as

well as in the speech of children with SLI such that some masculine nouns are produced

with the erroneous feminine article while some feminine nouns are produced with the

incorrect masculine article. Article omissions were found to be most frequent in the

initial stages of noun phrase production for typically developing children and to persist in the speech of older children presenting with language impairment. The data are not without controversy, but by far children in both populations show greater frequency of article omission with masculine versus feminine forms. When errors in use of these forms is compared to comprehension of these structures in children with SLI it becomes clear that the locus of the deficit is in the processing of these forms for production with comprehension intact and comparable to age-matched peers. No such comparison was undertaken in the studies mentioned above describing the developmental trajectory for typically developing Spanish-speaking children, though there is evidence from experimental studies carried out in other languages suggesting that children are sensitive to complex morphosyntactic features of the language they are exposed to long before they are able to produce such forms (Gerken and McIntosh, 1993; Gerken, Wilson and Lewis, 2005). When the patterns shown in children's speech are compared to the morphological structure of the Spanish gender paradigm it is clear that overwhelmingly their error patterns reflect the use of morphosyntactic regularities found across the system as well as the consistency of easy-to-produce forms that prove most reliable predictors of noun gender. In the initial stages, children's use of determiners is shown to be linked with particular lexical items and accuracy on these forms is variable, evidence that lexical status also plays a role such that well-known, well-practiced sequences are consequently easier to produce with greater accuracy. When children produce less known or nonsensical items, they rely most heavily on intra-linguistic cues rather than semantic cues to gender taking advantage of the cues present in article gender as well as noun

endings (Pérez-Pereira, 1991). In addition, error patterns suggest that the child

production processing system capitalizes on the regularity of patterns found across the

gender system reflected in the distribution of word- final phonemes as well as the

probabilistic information available in article-noun co-occurrence patterns across the

language. This pattern also appears to be conditioned by use of the easiest to produce

regular forms in the system demonstrating high frequency syllable structure. This is very

clearly observed in the preference shown for feminine morphology in the speech of

typically-developing children such as María as well as that of children with language

impairment (López-Ornat, 1997; Restrepo and Gutierrez-Clellan, 2001). Processing

capacity limitation is cited as the driving force underlying the difficulties shown in the

speech of children with SLI while deficiency in grammatical knowledge is assumed to be

responsible for error patterns in typically developing Spanish-speaking children. Taken

together, however, these data suggest the possibility that young children learning to speak

Spanish develop the ability to coordinate retrieval of gendered nouns with the selection of

the appropriate form of the gendered article and that this process is driven by statistical

analyses of morphophonological regularities across the nominal gender system. It is

possible that because the child system is less robust than the adult system in this

developmental stage, the production system's use of such input statistics can be more

readily observed as evidenced by the fact that young children, in a manner similar to that

shown for their older peers with SLI, make use of easy to retrieve words that are well-

known and additionally demonstrate the most regular morphosyntactic patterns across the

system. The experiments outlined in this dissertation are designed to test this possibility

by combining real words with non-words while manipulating the processing load by presenting items preceded by either a gender-congruous or gender-incongruous article. The gender-incongruous conditions not only serve to place the processing system under increased pressure but also allow the unique opportunity to observe children's modification or spontaneous corrections in comparison to the target stimulus when the cues are in conflict versus when they are concordant. Additional evidence to support a developmental processing account of noun phrase production will be reviewed in Section 2.4. In order to provide a solid base of comparison between adult models of production and the developmental processing patterns evidenced in the speech of young children, the basic architecture of the adult production model will be reviewed first followed by a discussion of the production of gender agreement in Section 2.3. Section 2.4 then turns to the child production data.

2.3 Article production and gender agreement within adult models of production

As mentioned in Chapter 1, evidence from various types of research supports a lexically driven adult production model. Section 2.3.1 will outline the organization and structure of the adult production model as well as provide evidence supporting the order and timing of the multiple layers of processes. Section 2.3.2 will then present evidence that suggests possible alternatives to the organization and flow of activation in the above-outlined production model with respect to gender and gender agreement processes. Central to the discussion is the locus of the elusive gender-congruency effect and its role in gender selection versus determiner selection processes. Section 2.3.3 follows with a discussion on language specific processing and agreement mechanisms.

2.3.1 The basic architecture

Communicating a message in the form of a spoken utterance requires the selection

of appropriate lexical items that match intended meanings, the organization of these

elements according to permissible word order of the language and their subsequent

articulation in the proper linearized sequence. The process of recruiting the various

information types necessary for such an endeavor requires the timely coordination and

integration of processing components for lexical retrieval and sentence planning in a

manner that ensures the optimal modulation of planning rate and speaking rate for the

production of a fluent, grammatical utterance. Difficulty in processing at any level of

lexical retrieval and sentence planning results in breaks in fluency and in numerous types

of speech errors that offer insight into the workings of the multi-layered processes

involved in speaking. In fact, the type and distribution of naturally-occurring speech

errors motivates the distinction between syntactic multiphrasal planning (functional level

processes) and the generation of phonological phrases (positional level processes) as well

as the separation of lemma and lexeme at the word level for lexical retrieval processes.

Figure 2.1 outlines the structure of the processing model that will be used.
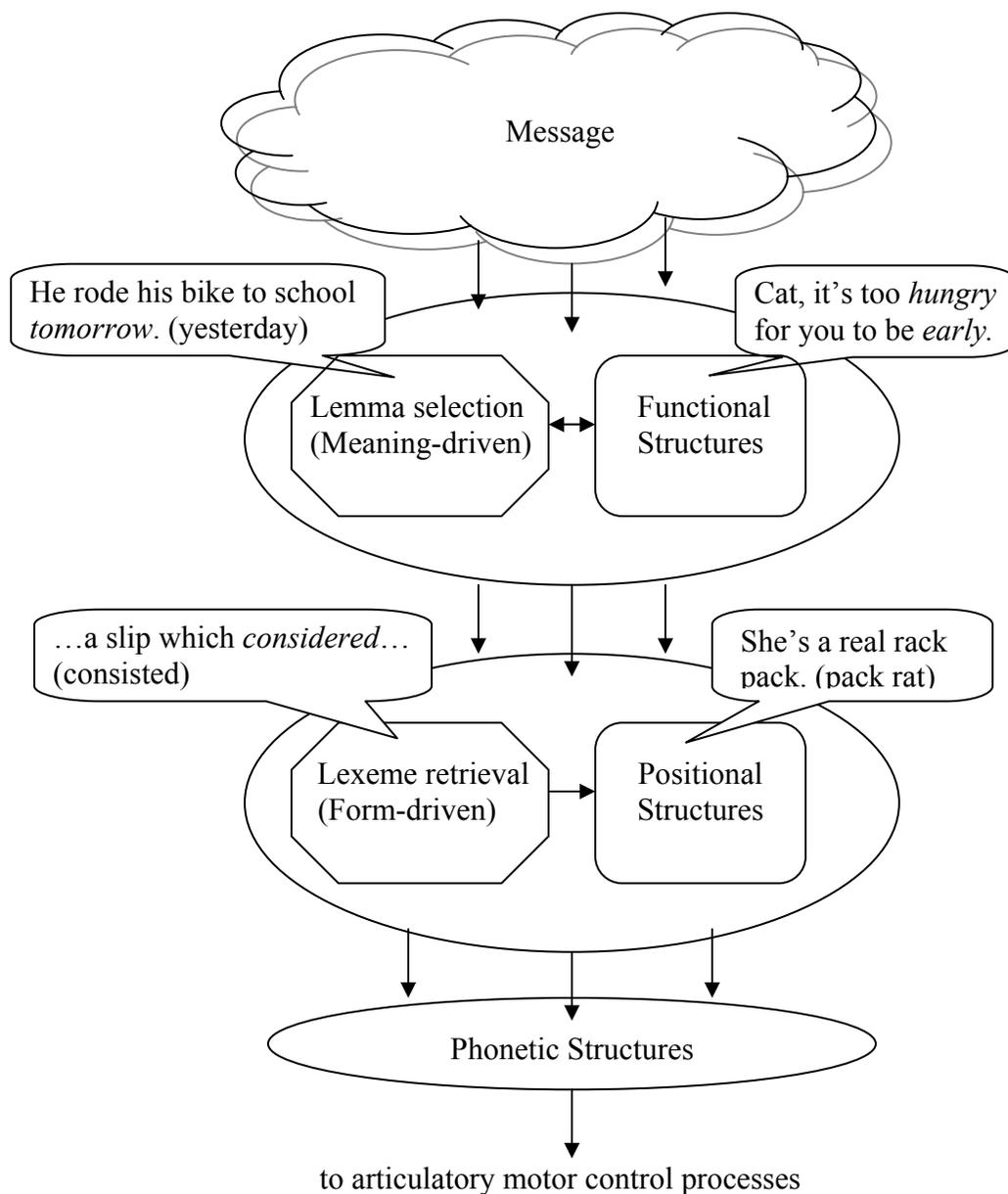
Figure 2.1: Model of adult production adapted from Bock and Levelt (1994), Garrett (1984) and Nicol and Greth (2003).

This distinction in levels of phrasal planning and retrieval processes is based on the dissociation between meaning and form (Garrett, 1982). The lemma is the abstract representation of a word that contains information regarding the word's syntactic features such as grammatical category, a word's grammatical function such as subject or object, a

word's subcategorization frames as well as language-specific information such as grammatical gender. In the speech error production model the lemma also contains a linking address that specifies partial information about the word's form such as first phoneme, number of syllables or stress (Vigliocco, Antonini,& Garrett, 1997). Sentence planning in the model is lexically driven, thus syntactic information made available through lexical retrieval processes at the lemma level determines structures at the functional level. Lemmas are assigned phrasal roles in the syntactic frame at this level and lexical retrieval processes are meaning driven. In the subsequent stage of planning, a word's segmental information must be retrieved and interpreted. Lexical forms are then assigned positions in the phrasal frame specified at the functional level and phrasal frames are then sited in terminal strings representing the linear order of utterance in a phonological representation (Garrett, 1982; Garrett, 1984).

Four types of speech errors involving either the substitution of elements or the exchange of elements support the distinction between functional and positional levels in sentence planning as well as the distinction between a word's lemma and lexeme in lexical retrieval. At the functional level meaning-based whole-word substitutions are characterized by similarity of meaning between the target and intrusion word and are constrained by grammatical category such that a noun is substituted for a noun and a verb for a verb etc. Neither target nor intruder demonstrates similarity of form in the majority of cases and thus these errors are said to arise as a result of lemma-level retrieval at the point where various potential candidates are considered on the basis of meaning as specified by message-level constraints. Form-based word substitutions, on the other

hand, arise as a result of retrieval of a word's form at the positional level and thus target and intruder demonstrate a correspondence of form, especially at word-initial segments. Both words are generally similar in placement of main stress as well as length. Importantly, there is no semantic similarity between target and intruder word, supporting the notion that at this level lexical form rather than meaning drive retrieval processes, meaning having been fixed at the functional level as lemmas are retrieved and assigned phrasal roles in the syntactic frame.

The meaning-form distinction is also reflected in processes of grammatical encoding within the model. At the point where content words are assigned phrasal roles and are inserted into the functional level phrasal configuration, whole-word exchanges occur. Like whole-word substitution errors, exchange errors are restricted to grammatical category and demonstrate no form similarity. At the subsequent level of sentence planning, exchange errors are similar to substitution errors in that they both involve similarity of sound segments rather than meaning. Sound exchanges usually involve exchange of word-initial segments that demonstrate similarity in form and thus are said to reflect processes involved in assigning segmental interpretation of open class lexical items to their respective slots in the positional level phrasal frame.

Within the model a distinction is made between retrieval of content words (open class vocabulary), and that of bound and free morphemes (closed class vocabulary). While open class vocabulary (nouns, verbs, adjectives) is directly retrieved under message-level control, closed class elements (determiners, pronouns, inflectional morphemes) are said to be "retrieved" indirectly as features of their respective phrasal

frames as a byproduct of the retrieval of a word's semantic and syntactic information specified at the lemma level. The identity of closed class items is thus said to be fixed upon selection of the appropriate phrasal frame at the functional level; however, their segmental structure is not fully elaborated until the phonological forms of content words have been inserted into the syntactic planning frame (Garrett, 1982). This category distinction is reflected by the differential pattern of speech errors shown for each class. For example, the exchange errors detailed above are primarily the result of movement of open class elements whereas shift errors involve movement of closed class elements. Closed class elements, as features of planning frames, are insulated from exchange processes, but not from movement as demonstrated by the fact that shift errors involve the movement of one particular element (free or bound morpheme) that is misplaced in the positional level process involving the placement of elements in the terminal string as illustrated in example (3) below (Garrett, 1984, pp.177-179).

    (3)   a. You have to *do* learn that. (you do have to learn)

             b. I'd forgot about*en* that. (forgotten about)

Additional evidence for differentiating closed class from open class retrieval is found in another type of speech error involving the exchange of elements that leave behind their respective inflectional morphemes. Example (4) shows one such case (Garrett, 1984, p177).

    (4)   It wait*s* to pay. (pays to wait)

In the stranding exchange error shown in example (4) the plural bound morpheme "s" has stayed with its assigned functional position or slot in the phrasal frame while the content/semantic part of the words has exchanged positions.

The dissociation between open and closed class vocabulary has particular consequences for young children learning to produce determiner phrases. Specifically, the model predicts that the young Spanish-speaking child must store gender with individual lexical entries, in particular with the lemma of a word. In order to produce a noun phrase the child must first locate and select the appropriate lemma corresponding to the child's intended meaning. Accessing the lemma of a word makes available categorial information, in this case, noun, that then calls the procedures responsible for processes of phrasal frame selection or construction. Grammatical gender information should also be available upon lemma access and the appropriate gender node should be both activated and selected given it is necessary for the grammatical encoding process. At this point, the abstract identity of the required determiner should be fixed as part of the phrasal frame under construction. At the positional level, the noun's segmental information should be retrieved and inserted into the appropriate slot of the positional level frame followed by the retrieval of the phonological form of the determiner. Phonetic details should subsequently be specified and regular language-specific phonological processes applied. This phonetic level representation then undergoes articulatory coding for output. This process may seem relatively straightforward and certainly simplistic in nature for an adult speaker of the language and yet rather precarious for the young child who must learn to recruit and coordinate the information he or she knows in a timely manner and

with a system lacking the robust quality of the adult system. The process is further

complicated for a child learning a language with grammatical gender as the research in

this area has yielded conflicting results across languages that make it somewhat

challenging to definitively situate grammatical gender within the model. The issue of

grammatical gender will now be addressed directly, reviewing available evidence as to its

location, storage, access and retrieval for production processes as the details bear upon

our interpretation of the nature of the Spanish-speaking child's utterance.

2.3.2 Where is gender?

The order, timing and availability of semantic, syntactic and phonological

information in lexical retrieval processes is controversial as is the location, storage,

access and retrieval of grammatical gender within the model. There is compelling

evidence that grammatical gender is stored and accessed via the lemma of individual

words. For example, tip-of-the-tongue states reflect successful retrieval of lexico-

syntactic and semantic information with failure to retrieve a word's form or lexeme. In a

TOT state a person is able to report detailed information regarding meaning and often

certain aspects of the word's form. In both Italian aphasic patients as well as normal

controls, subjects demonstrated the ability to report a word's meaning as well as syntactic

information regarding a word's grammatical gender even when they could not report any

information regarding a word's form (Vigliocco, Antonini & Garrett, 1997; Badecker et

al., 1995). An alternative explanation of TOT states has been put forward by Caramazza

and Miozzo (1997). Often subjects in a TOT state can report information regarding the

first few phonemes, first phoneme or number of syllables when they cannot produce the

entire form of a word. Based on this evidence, Caramazza and Miozzo (1997) proposed

the Independent Network Model. The IN model specifies that semantic-conceptual

representations directly activate word form and lexical-syntactic properties in parallel and

without mediation of a lemma node. A word's syntactic features such as gender can only

be selected upon selection of the word's lexeme node. Gender information thus becomes

available only via word form representations as the lexeme node is directly connected to

its syntactic and phonological content. Both Levelt, Roloefs and Meyer (1999) and

Caramazza and Miozzo (1997) propose that all nouns of the same gender are connected

to their corresponding gender node; however, Levelt et al (1999) necessitates access of

gender information via lemma level representations prior to access of a word's

phonological representation. The Levelt et al (1999) model of lexical retrieval specifies

that gender nodes, in turn, are connected to all agreement targets of the same gender such

as pronouns and determiners. Given that sentence production processes are lexically

driven within the model, construction of phrasal planning frames is initiated under

message level control via lexical retrieval processes, specifically the retrieval of a word's

lemma whose syntactic categorial information in turn calls syntactic phrase-building

procedures (NP, VP etc.). A noun's grammatical gender is crucial for agreement

processes over targets such as determiners and predicate adjectives in Romance

languages such as Spanish and French as well as languages like Dutch.

The phonological realization of gender, or word form class, for some groups of

words exhibits a systematic relationship with grammatical gender assignment leading to

controversy with respect to the directionality of links and activation flow between a

word's lemma and lexeme as well as the directionality of links at the lemma level between a word and its corresponding gender node. Dell's (1986) Interactive Activation Model allows for activation to cascade from the lemma level to the phonological form of a word prior to the selection of the target lemma. Activated candidates at the semantic level will spread activation to their corresponding phonological forms with feedback connections between the phonological level back to the lemma level. Within the serial, discrete model, the phonological form of the target is only activated once the lemma has been selected in a unidirectional feed-forward flow of activation (Levelt, 1999). Gender agreement should not be affected by phonological form since there should be no feedback from the lexeme of a word to the lemma and gender can in a sense be bypassed when not needed unless the syntactic environment of a given noun obligatorily triggers the selection of its corresponding gender node (Schriefers & Jescheniak, 1999; Roelofs, Meyer and Levelt, 1998). Gender is proposed to otherwise not be selected if it is not needed for computation of gender agreement on targets. On this model, a word's gender along with its other syntactic and semantic features is available prior to its phonological form. Support for the architecture of this model has been demonstrated via the traditional picture-word interference paradigm (Levelt, Roelofs & Meyer, 1999). Picture naming is accompanied by the presentation of an interfering distractor word that is customarily either related to the target word in form, in meaning, or is completely unrelated. The timing of presentation of the distractor is titrated with respect to picture presentation such that it appears prior to, during or after picture onset. At negative SOAs a semantically similar distractor demonstrates an inhibitory effect, slowing naming time while a

phonologically similar distractor has been shown to facilitate naming latencies at positive SOAs. These results are consistent with the discrete incremental model, corroborating a distinction between lemma activation and lexeme activation in the time-course of lexical retrieval.

When gender-relatedness is introduced into the paradigm, the results are not so easily interpreted. Schriefers (1993) used a modified version of the picture-word interference paradigm to investigate the processes involved in selection of a word's grammatical features by manipulating the gender congruency of the distractor word relative to the gender of the target word in the production of Dutch noun phrases. In a series of experiments participants named colored pictures with determiner-noun sequences and utterance onset times were recorded and compared across conditions (gender congruent distractor versus gender incongruent distractor). A significant difference was found between naming conditions such that subjects were significantly slower to name pictures accompanied by a distractor word of a different gender relative to naming times for pictures with gender congruous distractor words. These results suggest a competitive process in gender selection such that the gender of the distractor is activated and thus interferes with the lexical processing of the target noun at the level of gender node selection at the lemma level (Schriefers, 1993).

The well-known gender congruency effect observed for Dutch has also been demonstrated for other languages with grammatical gender such as German (Schriefers and Teruel, 2000); however, variability in the pattern of results found across languages suggests alternative interpretations with respect to the locus of the effect. For example,

Costa, Sebastián-Gallés and Caramazza (1999) tested Catalan and Spanish speakers within the same paradigm and found no significant difference between picture naming times with gender congruent versus gender incongruent distractors. To explore the possibility that stimulus onset asynchrony (SOA) contributes to the observed differences across languages, Miozzo, Costa and Caramazza (2002) manipulated the SOA such that pictures appeared simultaneously with the distractor (0) or appeared either 100 or 200 milliseconds prior to the appearance of the distractor word. In the first experiment Italian speakers named pictures with printed distractor words at the above-mentioned SOAs. Distractors were either gender congruent or gender incongruent with the picture name or were semantically related or unrelated. While the reliable inhibitory effect of semantically-related distractors was found, no significant gender congruency effect was shown at any of the tested SOAs. In the second experiment with Spanish speakers, the same SOAs were used as in the first experiment with gender-congruent and gender-incongruent distractor words; however, the semantic-relatedness condition used in experiment 1 was replaced by the X condition in which pictures were superimposed with a series of Xs rather than a word. This latter condition was included to determine the extent to which distractor words in fact exert an affect on lexical processing involved in the naming task for languages not demonstrating a gender congruency effect. The results showed a significant difference for naming times with X distractors versus word distractors at 0 as well as at +200ms SOA but no significant effect for gender-relatedness of distractor words. Miozzo and Caramazza (1999) interpret the discrepant results found between German and Dutch versus Spanish, Italian and Catalan in terms of differential

involvement of grammatical and phonological information in determiner selection

processes across languages. In Dutch as well as in German, the form of the article is

unaffected by the phonological form of the word it precedes; however, for Romance

languages such as Spanish, Italian and Catalan, the phonological shape of the noun's

onset sometimes determines the form of the determiner required. In Dutch access of

grammatical gender information at the lemma level is posited to be sufficient for

initiation of determiner selection procedures whereas for Romance languages, gender

selection procedures at the lemma level are said to be dissociable from determiner form

selection and retrieval processes. For the latter set of languages, determiner form

retrieval necessarily follows retrieval and interpretation of a content word's segmental

information in the time course of production processing. The late selection hypothesis is

consistent with the notion that closed class elements are associated with their respective

syntactic planning frames with retrieval of their phonological forms following the

retrieval of form for content words; however, the model does not account for differential

effects based on crosslinguistic differences (Garrett, 1982, 1984). It could be the case,

then, that the observed gender congruency effect for Dutch is a reflection of competition

in gender selection processes while the lack thereof described for other languages is a

result of a delay in determiner selection procedures that renders the gender congruency

effect invisible (Costa, Sebastián-Gallés and Caramazza, 1999). Subsequent research in

Dutch and German has explored these alternative accounts by capitalizing on the fact that

in Dutch and German, singular determiners are gender-marked while plural determiners

are not. Schiller and Caramazza (1999) found a gender congruency effect for production

of singular gender-marked NPs that disappeared during the production of plural NPs

suggesting that in fact, observed interference reflects competition in determiner selection

rather than gender selection at the lemma level.

The early versus late selection distinction can also be understood in terms of the

relationship between syntactic and phonological processing. The results for languages

like Dutch and German can be interpreted as a reflection of a clearly-defined separation

in syntactic versus phonological processes. The findings for Romance languages, on the

other hand, reflect the interaction between lexically-specified grammatical gender of the

head noun and the phonological context within the NP. For these languages, a close link

is posited between phonological and syntactic information during the process of lexical

access (Caramazza, 1997; Caramazza, Miozzo, Costa, Schiller and Alario, 2001).

Conflicting local phonological information within the NP then would be expected to exert

interference in the determiner selection process in such languages. Miozzo and

Caramazza (1999) tested this hypothesis by manipulating the consistency of phonological

information in Italian noun phrases. Both adjective and noun onsets dictate the

phonological form of the determiner. In cases where the adjective precedes the noun, it is

possible that the determiner consistent with the adjective's onset differs from the form of

the determiner required by the adjective's onset. The results showed that subjects were

slower to produce NPs containing inconsistent phonological information than they were

when both the adjective and noun provided consistent phonological information

regarding the form of the determiner substantiating the claim that determiner selection

processes are sensitive to phonological contexts within the noun phrase.

Interestingly, recent research within the picture-word interference paradigm with determiner distractor relatedness varied with respect to the gender of the target noun's determiner has challenged previous results with noun distractors. Alario, Ayora, Costa and Melinger (2008) explored the roles of number, definiteness and gender in determiner selection by varying the value of these features on determiner distractors that, unlike noun distractors, are posited to more directly tap determiner selection processes. In a set of 5 experiments in French, Spanish and German a similar pattern of results was obtained. Across all experiments a main effect of gender was found such that subjects were significantly faster to name pictures when the distractor determiner was gender congruent versus when it was gender incongruent. In the French experiments, a significant effect of determiner type (definite, indefinite) was also shown with faster naming latencies with congruent versus incongruent determiner types. They also found a significant effect of the interaction of the two factors. When subjects were instructed to name pictures with bare nouns rather than determiner phrases in the follow-up French experiment, the gender facilitation effect was still reliable mirroring the results of the first experiment. When the distractor determiners were constrained to the definite articles in the Spanish experiment with number (congruent, incongruent) and gender (congruent, incongruent) manipulated a similar pattern of results was found. Subjects were fastest when all of the features of the distractor determiner converged on the same features required for the production of the picture name and its gender congruent determiner. When the gender of the distractor determiner was congruent, a significant effect of number could be seen with slower naming times for number incongruent versus number

congruent trials; however, when the gender of the distractor determiner was incongruent, there was no significant effect of number evidenced. The results of all 5 experiments suggest that determiner selection is not a competitive process given that similarity between distractor and target resulted in facilitation and not inhibition. The fact that a facilitatory effect of gender congruency was found for both naming with determiner-noun sequences as well as naming with bare nouns suggests that the locus of the effect is retrieval of the target noun and its associated gender node and not the selection of the determiner as was suggested by prior studies. The effect is said to be modulated by the distractor determiner's features and the variable degree to which they activate representations in the production lexicon (Alario, Ayora, Costa, and Melinger, 2008). In this way, a gender congruent determiner activates its corresponding gender node which in turn is linked to all of the other elements sharing the same gender. The retrieval of the target noun is facilitated when it is of the same gender as the distractor as a result of the boost in activation of gender-similar candidates provided by the gender of the distractor determiner. In this way the results are consistent with the speech error model's distinction between processing and retrieval of closed class and open class elements. The process of determiner selection can be understood as an automatic reflex of retrieval of the lemma of a noun and the selection of its associated gender node which in turn initiates the selection of the appropriate syntactic frame and its related closed class elements as abstract features of such frame.

The locus of the gender congruency effect; however, is still somewhat unclear. When determiners are used as distractor words, a facilitatory effect for gender and

number congruent distractors on naming latencies is found for both Romance and Germanic languages. The effects of the distractor determiner are reliable at 0 and 150ms and begin to diminish at 300ms. Phonological-relatedness of the distractor determiner does not exert either an inhibitory or facilitatory effect on naming times nor does response set membership. Strikingly, the effect is not diminished by naming with bare nouns relative to naming with determiner phrases. This corroborates findings in previous studies showing that naming pictures with bare nouns is influenced by the presentation of a gender-marked determiner shown just prior to the picture to be named. In these studies either a facilitatory effect of gender-congruent determiners was observed speeding response times or an inhibitory effect of gender-incongruent determiners was shown slowing naming times or a combination of the two. These results are interpreted as evidence for activation of the prime determiner's gender feature which in turn either facilitates the noun's retrieval by means of overlapping activated gender representations or causes a slowdown in the activation of the target noun's gender feature as is the case in the gender-incongruent condition (Bentrovato, Devescovi, D'Amico and Bates, 1999; Jescheniak, 1999).

These results contrast sharply with those found for noun distractors within the picture-word interference paradigm previously discussed. It could be the case that additional factors are in play that cannot be observed in online adult processing such as the predictability of distributional patterns and the regularity of the morphological system itself. Investigating the production of gender-marked determiner noun sequences with children whose less robust systems operate at a slower processing speed provides the

opportunity to detect effects that cannot otherwise be seen in speeded adult processing.

Another possible contributing factor that has not been considered is the potential overlap

between comprehension and production processing systems, particularly in those cases

where determiners are superimposed on the pictures to be named or are presented prior to

the target pictures. It could be the case that the prime or distractor determiner is

considered together with the target noun and that at some point processes of monitoring

and detection of agreement violations are also initiated. For example, within a sentence

context, when a Spanish speaker reads a gender-marked determiner that is incongruent

with the gender of the noun pictured, an event-related potential develops to the

incongruous article demonstrating a greater negativity between 300-500ms than articles

that match the gender of the upcoming noun depicted (Wicha, Bates, Moreno and Kutas,

2003). These results suggest the possibility of an alternative route to grammatical gender

based on the distributional characteristics of the Spanish gender system that allows

Spanish speakers to generate an expectation for the gender of the upcoming noun on the

basis of the gender information carried by the determiner and that they are able to do so

even when the upcoming noun's morphophonological information is not overtly

available. This dissertation is designed to explore the potential contribution of

distributional morphological regularities in lexical processing by capitalizing on slower

child processing speed and providing opportunities to directly observe patterns of

spontaneous correction of agreement violations between determiners and both words and

non-words. In the next section the literature relevant to agreement processing in Spanish

will be reviewed.

2.3.3 Agreement processes in Spanish

Production data in the form of elicited errors have revealed crosslinguistic differences regarding the workings of the agreement mechanism for speech (Bock and Miller, 1991; Vigliocco, Butterworth, & Garrett, 1996; Vigliocco, Hartsuiker, Jarema & Kolk, 1996). In English, agreement is said to be driven by syntactic processes while in Italian, Spanish, French and Dutch the presence of a distributivity effect suggests that subject-verb agreement is semantically computed via a process of feature unification (Viggliocco, Butterworth and Garrett,1996; Vigliocco, Butterworth and Semenza, 1995; Vigliocco, Hartsuiker, Jarema & Kolk, 1996). In both Spanish and English fewer errors of gender are noted in comparison to number errors (Nicol and O'Donnell, 1999; Antón-Méndez 1996; 1999). In Spanish the production of number agreement has been shown to involve separate processes and operate independent of gender agreement for native speakers (Antón-Méndez, Nicol and Garrett, 2002). In a sentence completion task, Antón-Méndez, Nicol and Garrett (2002) found that errors in subject-verb number agreement patterned with errors in subject-predicative adjective agreement and that the distribution of number agreement errors differed significantly from errors in subject-predicate adjective agreement. Igoa, García-Albea and Sánchez-Casas (1999) proposed the Dissociation Hypothesis to account for differential error types and rates for number versus gender agreement processes. In examination of speech error data, they found that in word exchanges gender was displaced along with the stem of the noun involved while number, however, was more highly associated with stranding, holding its syntactic "slot" in the frame. The following example from Del Viso, Igoa and García-Albea (1987)

demonstrates how gender does, indeed, appear to "follow" the stem in word exchanges and thus suggest that gender is lexically specified whereas number is computed externally in association with syntactic phrasal frame construction.

(5) Estos son los coche<u>s</u> de la llave.

Intended: Estas son las llave<u>s</u> del coche.

Patterns of event-related potentials (ERPs) corroborate this notion. Using the ERP technique Barber and Carreiras (2005) manipulated gender and number congruity in word pairs or sentences read by native Spanish speakers. Word pairs either contained a noun and a gender-inflected adjective or a noun and a gendered article. An N400 effect located in central-posterior regions was found for disagreement conditions for both word-pair types relative to the agreement condition for both number and gender; however, article-noun pairs produced an additional left anterior negativity between 300 and 450ms. While the N400 effect is said to reflect difficulties in the integration of different types of features, in this case, morphological features of the word pairs presented, the late anterior negativity (LAN) effect suggests the integration of syntactic phrase-building information. This difference in ERP patterns disappeared when both adjective-noun sequences and article-noun violations were embedded in a sentence context across various positions. While no significant differences were noted between number and gender agreement violations at early stages with both violations eliciting a LAN and P600 effect, differences did emerge at the late stage after 700ms with a larger effect size for gender than for number disagreement. While the early P600 effect detected could be said to reflect sentence-level syntactic analysis, the late phase in which a distinction is made

between number and gender processing is interpreted as a reflection of processes involving reanalysis of the violation. No effect of word-pair type (adjective-noun versus noun-article) was found. The difference between number and gender ERP patterns at the late stages suggests that the detection of a gender agreement violation and its subsequent reanalysis is more costly than is the reanalysis process for number agreement violations. Gender agreement violations are proposed to provoke a backtracking procedure that necessitates return to lexical recognition and access for verification of gender features at the lemma level.

As discussed in the previous section, there is also evidence to suggest that within the scope of gender agreement, processing of article agreement is separate from that of adjective agreement. Centeno and Obler (1994) tested the degree of impairment for number versus gender of an agrammatic Spanish-speaking subject using a picture description task. The results showed no significant difference in number agreement patterns across nouns, adjectives and articles; however, interestingly, adjective agreement preservation surpassed that of article gender agreement. This suggests that not only are there distinct processes for number versus gender agreement, but also for gender agreement targets.

These results support the notion that gender is stored and accessed via the lemma level representation of individual words and that selection of a gender congruent article, like other closed-class elements, is an associated feature of syntactic planning frames that are made available via lexical access; however, the cumulative results of the adult data reviewed above are not without controversy and do not exclude the possibility of

alternative routes to grammatical gender in noun phrase production. The current study

addresses these issues in presenting children and adults with gender congruous and

gender incongruous determiner/noun pairs. While work in the above-mentioned area has

focused exclusively on processing of lexical items with a focus on the workings of the

production mechanism, the research in the domain of noun phrase production with

children has focused on grammatical competence in the areas of the functional category

determiner as well as the gender agreement paradigm. This dissertation bridges the gap

between adult processing models and child developmental research in evaluating

children's online processing of both words and non-words in the production of

determiner-noun sequences providing a means by which effects of grammatical gender at

the word level can be disentangled from any potential effects of grammatical gender

found in the regularity of surface morphophonological patterns. The next section outlines

research corroborating a developmental processing account of noun phrase production.

2.4 Evidence for a developmental model of production

Recall from the previous section that models of adult production detail the

architecture and timing of message generation, selection of lexical items, retrieval of

lexico-syntactic information for construction of syntactic phrasal planning frames that are

phonologically encoded with respect to segmental and suprasegmental information for

articulation (Garrett, 1984; Dell, 1986; Fromkin, 1971; Levelt, 1989). Lexical retrieval

proceeds under message level control and syntactic information is made available via

access to individual lexical items that in turn drive the construction of syntactic frames.

Adult speech errors are taken as evidence of the organization and timing of processes,

whereas children's errors such as omission of obligatory elements and overgeneralization or misuse of elements have been generally taken as a direct reflection of deficient developing underlying knowledge systems. It is also possible, however, to interpret such utterances in the context of a developing processing system. In fact, the study of the developing language system depends upon dissociation of what the child knows from what the child says in approximations of the adult-like utterance.

As discussed in Section 2.3, the preparation and construction of an utterance involves multiple levels of processing and is dependent upon timely retrieval and coordination of information at each layer. As seen in the adult data, problems at any stage in planning can result in breaks in fluency and or any number of speech errors even for the linguistically mature production system. It is thus unsurprising that the young child's less robust system reflects the development of procedures for coordinating elements at the various layers of production planning and execution resulting in missing or misused elements. Findings from various types of research will now be presented that suggest this is indeed the case.

Clearly children perceive and comprehend a great deal more than they are able to express in the initial stages of development. By 14-months, infants demonstrate sensitivity to the sentential constituent structure of the language they are exposed to (Hirsh-Pasek and Golinkoff ,1996). Additionally, by 17-months, infants demonstrate comprehension of word order (Hirsh-Pasek and Golinkoff, 1996). Williams and Fernald (2007) showed that like monolingual adults, young monolingual Spanish-speaking children are not only sensitive to a word's gender marking but also use such syntactic

cues when they are informative for interpreting noun phrases with respect to referent. Disentangling linguistic knowledge from productive processing skill necessitates a re-evaluation of the nature of the child's utterances both with respect to the adult target form as well as the present state of the child's underlying knowledge system. The research in this area (analysis of child errors/slips of the tongue) focuses on making a distinction between systematic versus non-systematic errors. Systematic errors are seen as reflections of the current state of underlying knowledge—the error is in this way "faithful" to the internal structure of the system; whereas non-systematic errors then can be seen as "slips" that violate the current underlying grammar, thus reflecting the development of procedural knowledge or processing systems (Jaeger, 1992; Stemberger, 1989; Gerken, 1992). Child slips of the tongue have been reported to appear as early as age 1;4 and comparison to adult speech errors reveals that children, like adults, make more phonologically-based errors than they do word-based or phrase-based errors (Jaeger, 1992). The data show that the distribution of speech error types in the child data progressively approximate that of the adult system over time suggesting that the child operates with an adult-like system from the very beginning (Jaeger, 1992; Stemberger, 1989).

2.4.1 Misused and missing elements

Where child production data differ from adult production data with respect to slips of the tongue or hesitation and disfluency patterns, insight can be gained with respect to how the information types and processes of the production system are "built up" over time. There is compelling evidence that performance is significantly affected by

the less robust nature of the child system with respect to the access and coordination of

information for online processing in the initial stages of development. It is in this stage

of development that the influence of input statistics on the underlying workings of the

system can be readily observed. McKee and Iwasaki's (2001) analysis of Japanese child

speech underscore the fact that each child error potentially reflects breakdown at any

number of stages in the multi-layered process of producing an utterance. For example, a

Japanese child who uses the genitive marker "no" with an adjectival noun instead of the

particle "na" could be considered to lack general grammatical knowledge regarding

adjectival nouns. However, if the child is shown to use other adjective nouns correctly,

the locus of the problem could be lexical in nature. Another possibility, given the child

sometimes does and sometimes does not produce the correct utterance, could be failure to

access a particular part of the lemma's information or implement a particular functional

procedure. Failure to retrieve procedural information can also result in misused elements,

specifically overuse of a particular closed-class element. In Japanese the child's use of

the particle "no" rather than "na" could be interpreted as the application of a default

developed by the system based on distributional information of the language to avoid a

crash when timing and retrieval processes break down. In fact, the particle "no" is

reported to be overused by both L1 child and L2 adult learners of Japanese (McKee and

Iwasaki, 2001; Murasugi, 1991; Sekiguchi, 1995).

Within the production system, failures of retrieval at various points in the layered

process can result in missing elements. Italian children often omit the preverbal

pronominal clitic in obligatory contexts producing "mangiati" [eaten-masculine/Pl]

instead of "li ha mangiati" [them-Masc/Pl has eaten-Masc/Pl]. The first utterance shows verb-object agreement, evidence that a functional procedure for frame building has been called up and only partially applied, lacking the phonological realization of the preverbal unstressed elements. The processing analysis proposed here is consistent with the Metrical Hypothesis proposed to account for English children's omissions of sentence-initial elements (Gerken, 1991). In an elicited imitation task, English-speaking children between 23 and 30 months were shown to omit subjects less frequently when the object was a pronoun (a weak syllable metrically dependent upon the verb) than when it was either a proper or common NP (more metrically complex elements) (Gerken, 1991). These results rule out a strictly pragmatic mechanism for omission based on evidence that children's omissions can systematically be accounted for within the context of metrical complexity, not solely upon discourse referent. The Metrical Hypothesis is based on the premise that unstressed syllables from iambic feet are more difficult and thus require the implementation of templates to reduce the complexity. The fact that children were also found to omit lexical NPs, even though they did so less frequently than they omitted pronouns or articles, can also be understood as the processing mechanism's reduction of complexity. When the metrical complexity of a given sentence cannot be appropriately handled by the system in a timely fashion, the mechanism converts lexical NPs into pronouns, weakly-stressed elements, and then subsequently omits them (Gerken, 1991). These findings provide evidence that procedures for the coordination of information in online processing are still under development and that the system accommodates the increased level of difficulty by reducing complexity. Sometimes this reduction reflects

an inability to handle the difficulty of metrically complex utterances or a failure to

retrieve forms or procedures resulting in the omission of obligatory elements. Other times

processing reflects the implementation of strategies or defaults based on the distributional

regularities of the language. In a lexically-driven production model, access and retrieval

of syntactic information of the type shown to be stored with individual words is

especially critical for initiation of procedures essential for grammatical encoding. For

example, there is evidence that practice producing forms the child knows well facilitates

efficient retrieval of those items and the closed-class elements that accompany them in

the syntactic frame. As familiarity decreases, omission of obligatory elements such as

articles increases (Boyle and Gerken, 1997). The next section will present further

evidence that children develop the skill required for successful retrieval and production of

lexical items the child knows.

2.4.2 The development of lexical retrieval skills

The well-attested "word spurt" involving rapid growth of a child's productive

vocabulary around the end of the second year has been attributed to various factors

including the use of linguistic constraints, the development of representational skills, the

discovery that words refer to things as well as an increased implementation of fast

mapping of object labels or a rise in categorization (Markman and Markman, 1991;

Mervis & Bertrand, 1994; Gopnik & Meltzoff, 1987). An increased rate of naming errors

has been reported to accompany this phase of development. Instances where a child

produces an erroneous object label have been interpreted as errors of miscategorization;

however, there is evidence that the causal mechanism underlying the sudden growth in

the child's vocabulary size and subsequent increase in naming errors is in fact due to the

development of lexical retrieval processes that allow the child to talk about things outside

his immediate environment without the prompting of perceptual cues and to do so with a

greater rate of speed. In a longitudinal study of children between 14.4 and 15.9 months,

Gershkoff-Stowe and Smith (1997) elicited object names in a picture book story retelling

task. Unambiguous naming attempts where the child clearly pointed to a particular object

and produced an object label were analyzed and those cases where the child pointed to an

identifiable referent and produced the incorrect label were coded as errors. Children's

vocabulary growth throughout the 8 sessions was also measured via parental report, both

with the diary method as well as with a vocabulary checklist. The results showed a

significant increase in the mean frequency of naming attempts between session 1 and

session 3 after which naming attempts leveled off. For each child an identifiable peak in

naming errors was shown spanning 1 or 2 sessions. When rate of vocabulary growth was

aligned with this naming error peak, a significant difference was found between this

session of maximal error and the one preceding it with no other significant contrasts

between sessions shown. These results suggest that there is a temporal overlap between a

steep rise in the number of words a child is producing and the brief period in which

naming errors also reach maximal levels. They also analyzed the number of words

produced per minute per session for each child and comparison between sessions

mirrored the previous results with the only significant contrast between the session of

maximal error and the prior session. At the moment in time when the quantity of words

produced increases, the density of words produced in close temporal succession also

increases placing an increased demand on retrieval of object labels resulting in an increase in the number of naming errors. Analysis of the types of naming errors identified for each child with consideration of the number of times the child had previously successfully labeled a particular object prior to the observed naming error they found that for 76% of the total errors produced for the session in which the most errors were recorded the child had previously produced the correct label for the same object at least once prior to the error. Repetition effects were also found such that 61% of the total number of errors reported for the period of maximal error could be attributed to repetition of one of the three preceding words produced by the child. The fact that only 31% of these errors involved the word immediately preceding it suggests a slow decay rate for activation levels in the lexicon during lexical retrieval processes.

Dapretto & Bjork (2000) triangulate production data with comprehension data, showing that for children between 14 and 24 months, naming errors increase as the productive vocabulary expands. Children in this "spurt" who could previously name an object and previously locate it, experienced difficulty spontaneously producing it in the naming experiment. Children in the vocabulary spurt group made reliably more naming errors than children in both the pre-vocabulary and post- vocabulary spurt groups. The majority of the naming errors (72%) involved a label that had been previously used by the child. Most of the naming errors, 75%, consisted of categorical errors involving meaning-based word substitutions indicative of lexical selection processes while 34% were based on perceptual features such as color or shape similarity and 9% involved phonetic similarity in form-based word substitutions. The size of the child's productive

vocabularies was reliably correlated with their performance on the label-retrieval task but not with their performance on the object-retrieval task.

These findings suggest that the initial stages of learning to retrieve lexical items the child knows places increased pressure on the system resulting in naming errors. In a lexically-driven production model the demand for resources early in the planning process during lexical retrieval can result in fewer available resources for processing at later stages. Boyle and Gerken (1997) showed that lexical familiarity exerted an effect independent of effects of metrical complexity in children's pattern of object article omissions. Thus, it could be the case that the development of lexical retrieval skills interacts with coordination of elements at later stages such as utterance control timing with respect to modulation of duration between strong and weak syllables (Boyle and Gerken, 1997). Difficulties in timing and availability of information in the coordination of lexical retrieval and grammatical encoding processes have been shown to result in a variety of dysfluencies. The next section will detail analyses of child speech dysfluencies that provide evidence for the development of the ability to coordinate information at various levels of sentence planning and production.

2.4.3 Coordination of information

Dysfluencies arise as a result of problems in the coordination of functional and positional level processes at clause-initial, phrase-initial closed-class words, thus children who don't have this architecture in place should present a different pattern and distribution of dysfluencies that over time approximates the adult model. Wijnen (1990) proposes the "Development of the Formulator" hypothesis to account for the shift from

telegraphic speech to larger, more complex utterances based on types and distribution of dysfluencies (repetitions, self-corrections, incomplete sentences etc.) of two 2-year-old Dutch boys. Repetitions, revisions and incomplete sentences are shown to increase between period one and three and decrease from period three to four with a peak established at period three. In the initial stages of study, the distribution of location of dysfluencies in sentences is random followed by a period where dysfluencies begin to cluster with function words and sentence-initial words, approximating adult patterns of dysfluency. The Growth and frequency of use of closed class elements, according to Wijnen (1990), reflects simultaneity of emerging developmental processes such that the development of positional level structures accompanies grammatical development. This conclusion would suggest that children who do not correctly produce closed class elements such as determiners show an underlying deficit in comprehension of such elements; however, there is evidence to suggest that this is not the case. In a picture selection task, normally-developing 2-year olds as well as 3 to 5-year olds with SLI were asked to select the appropriate target picture among semantically-related and unrelated distractors. The target object was imbedded in sentences with correct grammatical morphemes ("Find the bird for me"), incorrect grammatical morphemes ("Find was bird for me"), a nonsense syllable ("Find gub bird for me") or no grammatical morpheme ("Find ___ bird for me"). Both groups of children identified the correct object more frequently when the target was embedded in a sentence with correct grammatical morphemes or nonsense syllables (McNamara, Carter, McIntosh & Gerken, 1998; Gerken and McIntosh, 1993). Thus, it is clear that a failure to produce functional

elements cannot be due to a deficit in the underlying system. This distinction between comprehension and production corroborates Wijnen's proposal that positional planning processes are in fact, developing at this stage.

Children not only make slips of the tongue in a manner comparable to that of adult speakers but they also demonstrate development of the ability to monitor their own utterances and to make subsequent repairs as was shown in the data above (Wijnen, 1990). In a longitudinal analysis of children's speech errors, Jaeger (1992) found that between ages 2 and 3 word-based speech errors were corrected with the greatest frequency and that across the board at all ages included in the study (1;0 to 5;0) phonological speech errors are the least likely to be corrected. Between ages 2 and 4 word-based self corrections outnumbered phrase-based corrections and began to equalize at age 4. By age 5 the pattern reverses with phrase-based self-corrections outnumbering word-based corrections. Between ages 2 and 4 children's rate of self corrections progressively increases for all three categories of errors.

Rispoli (2003) studied the stall rate and revision rate of children between the ages of 1;10-4;0. Stalls included filled pauses (um or uh), unfilled pauses, and repetitions of phones, syllables, whole words, and phrases while revisions were considered disruptions resulting in the alteration of lexical, morphological, syntactic, semantic, or phonological material of an already produced utterance. Rispoli (2003) found that revisions were significantly correlated with mean length of utterance (MLU) while stall rate was not. In a similar study, Rispoli and Hadley (2001) found that initially there was no difference in the length and complexity of disrupted versus fluent sentences and that this difference

subsequently increased as grammar developed as measured by MLU and the Index of

Productive Syntax (IPN). By 4;0 disrupted sentences were on average discernibly longer

and more complex than fluent sentences (Rispoli and Hadley, 2001). Thus, it could very

well be the case that the process of packaging grammatical knowledge in such a way as to

allow for morphosyntactic procedures to be readily integrated into online sentence

planning for production initially is a difficult precarious task resulting in an increased

stall rate. The process of proceduralization as outlined by Rispoli and Hadley (2001)

depends on practice; thus, unfamiliar, unpracticed morphosyntactic formulas are one

source of processing difficulty for the production mechanism. As the processing system

becomes more efficient in coordinating information at the various levels of sentence

planning, additional resources become available allowing monitoring via the perceptual

system as evidenced by a steady increase in self corrections noted in the data above

(Jaeger, 1992; Wijnen, 1990; Rispoli, 2003).

  In summary, the available data regarding child production provides evidence for a

developmental model of production. Children must develop the retrieval processes

necessary to access the forms of words they know. In the initial stages, a sharp increase

in naming errors arises as a result of an increase in the total number of words the child

attempts to produce and an increase in the rate with which the child produces such words.

Error patterns suggest that lingering activation within the lexicon resulting from

previously retrieved words is a contributing factor. If producing a grammatically well-

formed syntactic frame is dependent upon retrieval of information stored with individual

words and retrieving individual words is initially difficult, it is logical to expect that early

child utterances lack evidence of the complex syntax we know they are capable of understanding. As lexical retrieval becomes more automatized, processing resources are freed up for later stages of sentence planning involving the proceduralization and implementation of complex syntactic structures. Remarkably, from the earliest stages children not only demonstrate the capability to detect their own errors and make subsequent repairs but their ability to do so increases progressively over time. There is also evidence that when a glitch in timing of retrieval or coordination of processes arises, the system is able to compensate using various strategies that allow the child to keep speaking. Sometimes the system reduces complexity in such a way that an omission of an obligatory element results and other times the system uses the most regular patterns of the language as a sort of default morphosyntactic procedure that sometimes results in the apparent misuse of an element.

The above-mentioned studies supporting a processing model are primarily with children whose first language is either English or Dutch while the available data for Spanish children has focused on demonstrating evidence of underlying morphosyntactic competence in noun phrase production and gender agreement. The adult data reviewed in previous sections suggest that production processes are lexically driven, though there is controversy with respect to the possible overlap of syntactic and phonological processes and the directionality of activation flow within the system. With respect to the use of grammatical gender for speakers of languages with such a feature, there is conflicting evidence. While there is evidence to support the notion that determiner selection is distinct from gender selection processes involved in noun retrieval, there is evidence that

determiner selection necessarily involves selection of the noun's corresponding gender

node. Across languages, there are data to suggest the variable interaction of phonological

context with syntactic information. For example, in Spanish, feminine words with a

stressed /a/ in onset position require the masculine determiner form in the singular.

Additionally, the high correspondence between morphophonological surface patterns of

stems with gender category (/a/= feminine; /o/= masculine) demonstrated for Spanish

increases the likelihood that these features play a role in processing. While feminine

nouns display very little variability with respect to word-final phoneme, masculine nouns

demonstrate a great deal of variability. In terms of co-occurrence patterns between nouns

and their corresponding gender-marked determiners, feminine morphosyntactic patterns

demonstrate greater regularity in form than do masculine patterns. The feminine

determiners not only provide an advantage with respect to the phonetic quality of the

vowel /a/ present across determiners, stems and adjectives, they also demonstrate the

most frequent syllable structure in the language. The dichotomy evidenced between

masculine and feminine gender systems in Spanish makes it particularly well-suited to

evaluate the possibility that morphophonological regularity contributes to processing

patterns shown in noun phrase production for languages with grammatical gender. The

variable nature of the gender congruency effect across the adult findings could potentially

be accounted for within a model that can accommodates the influence of input statistics

such as morphosyntactic surface regularity on the organization, access and retrieval of

gendered nouns and determiners for production. It could be that the contribution of

regularity shown across morphophonological features of the gender system is constrained

to a developmental model or that any artifact of such an influence is obscured by the efficiency and speed of adult online processing. On this latter notion, the adult system placed under sufficient processing pressure should demonstrate an influence of language-specific input statistics such as morphophonological regularities across the gender system. In order to evaluate the possible contribution of both lexical status and morphophonological regularity in young Spanish-speaking children's use of grammatical gender in the production of noun phrases within a developmental processing account, the performance of adult Spanish speakers must also be considered. The experiment outlined in Chapter 4 is designed to address these questions extending the small but growing body of evidence for a child developmental processing model to a language for which there is scarce research in this domain. The design of the experiment is based on a well-tested method for studying child language production that is not typically used with adult speakers and in particular within the research on grammatical gender processing. Adults are generally tested within the picture-word interference paradigm in which pictures are presented with either an auditory or visual distractor that is either a noun or a determiner, a task that would prove particularly complex for a young child. Given the importance of evaluating the child's utterance with respect to patterns of adult speech in the most comparable way possible, both child and adult Spanish speakers were tested using the method most suited to explore child online processing as well as the investigation of the questions at hand. The next chapter will discuss in more detail the general design of the elicited imitation task employed in this experiment as well as the predictions specific to expected patterns of adult response. Chapter 4 will then lay out the predictions specific

to child response patterns as well as cover in greater detail the child-specific

methodology and procedures implemented in this study to explore the three major

possibilities that emerge from both the child and adult literature for how children store,

access and retrieve gender for noun phrase production: (1) children must access and

retrieve gender stored with individual words stored in the lexicon, (2) children bypass

information stored with individual words in favor of using morphophonological surface

features and distributional patterns or (3) children use an input-based mechanism

reflecting the influence of morphophonological regularity on retrieval of familiar lexical

items as well as the coordination of these gendered nouns with their corresponding

gender congruent definite articles. The results of the adult experiment will be presented

first in Chapter 3 in order to facilitate evaluation of the child data that will then be

covered in Chapter 4.

CHAPTER 3   EXPERIMENT 1: SPANISH-SPEAKING ADULTS

This chapter begins with a brief description of the experimental task and is followed by an explanation of how the experiment is designed in general. It then offers a brief review of the relevant adult literature regarding gender processing prior to covering the predictions for the adult experiment for all three possible accounts discussed in Chapter 1. The data for the Spanish-speaking adults are then presented in order to provide a basis of comparison for the results of the child experiment that will be discussed in Chapter 4. The next section provides a sketch of exactly how target utterances were manipulated within the elicited imitation paradigm to ascertain the contribution of lexical status, gender and congruity in noun phrase production.

3.1 General description of the experiment

Elicited imitation procedures have traditionally involved object or action naming within the context of a picture book or phrasal target elicitation with props such as puppets that enact various scenes (Gerken, 2000). The design of the elicited imitation task implemented in this dissertation involves slight modifications of the above-mentioned typical procedures which are briefly outlined in this section. Details regarding the child-specific methodology will be further discussed in Chapter 4. Table 3.1 summarizes the eight experimental conditions of the three-factor within-subjects design with Lexical Status (word, non-word), Stem (masculine, feminine) and Article (masculine, feminine) as the three factors.

Table 3.1: Design of the elicited imitation task

el word_o	*la* word_o	*el* word_a	*la* word_a
el non-word_o	*la* non-word_o	*el* non-word_a	*la* non-word_a

As mentioned in the previous section, the goal of the experimental design sketched in Table 3.1 is to tap online processing involved in the production of gendered noun phrases. A fundamental distinction between the hypothesized accounts for how Spanish-speakers coordinate gendered nouns and determiners involves differentiating between strategies requiring the retrieval of lexically-specified grammatical gender representations versus those that exploit the correspondence between morphophonology and noun gender specification allowing for the use of generalizations extracted from surface morphophonological features and distributional patterns. In order to evaluate these possibilities, lexical status was manipulated such that adults were presented with auditory stimuli that consisted of both real Spanish words and phonologically-legal Spanish non-words whose presentation was synchronized with the computerized presentation of the same cartoon creature throughout. Importantly, no visual cues to the meaning of the stimuli were provided in the form of pictures or enactment. There is well-attested evidence that producing a word, and in particular a high frequency word, that corresponds to an actual lexical entry in the adult's mental lexicon produces a facilitatory effect in naming onset latencies relative to lower frequency words and pseudowords (Carreiras and Perea, 2004). Additionally, children have been shown to more accurately produce a familiar word than an unfamiliar word or a nonsensical word (Gerken and

Boyle, 1997). Based on this evidence, faster utterance onset latencies were expected overall with words than with non-words. This should be the case regardless of whether gender is lexically specified or made available via morphophonologically regular distributional patterns across the nominal gender system.

Clearly the lexical status manipulation alone is insufficient to delineate between the two above-mentioned routes to grammatical gender; therefore, in addition to lexical status, a gender congruency component was also included in the design based on effects found for adult Spanish speakers in gender priming studies. For example, when adult Spanish-speakers are shown a determiner prime congruent in number and gender with the determiner of the target noun, naming latencies are faster than when they are shown a gender-incongruous prime determiner (Alario, Ayora, Costa and Melinger, 2008; Bentrovato, Devescovi, D'Amico and Bates, 1999; Jescheniak, 1999). Equally, children have been shown to perform better on gender categorization / assignment tasks when all of the available cues converge on the same gender versus when they provide conflicting cues to gender (Gerken, Wilson and Lewis, 2005; Pérez-Pereira, 1991; Karmiloff-Smith, 1979). Based on these data, gender congruency in the current experiment was manipulated such that words and non-words appeared in both gender congruous (article and stem gender match) and gender incongruous (article and stem gender mismatch) conditions. This manipulation not only allowed for the observation of congruency effects as evidenced by a slowdown in naming latencies relative to congruent conditions, but it also provided the opportunity to elucidate the relative strength and contribution of various cues to gender for noun phrase production such as (a) lexical status (b) article gender (c)

stem morphophonology and (d) regularity of distributional co-occurrence patterns across the language.

The inclusion of the gender incongruous conditions also allowed for the evaluation of response times with respect to frequency of distributional patterns across the Spanish gender system. Recall from Chapters 1 and 2 that the majority of masculine nouns end in /o/ and are preceded by the masculine determiner *el* and that likewise, the majority of feminine nouns end in /a/ and are preceded by the feminine determiner *la*. However, there is a small group of masculine nouns that end in /a/ and thus take the masculine determiner *el* and an even smaller group of feminine nouns that end in /o/ and take the feminine determiner *la*. There is also a small group of feminine nouns whose stressed /a/ in onset position necessitates the use of the masculine determiner form *el* thereby creating a conflict between determiner and noun gender. As can be observed, feminine nouns are more frequently preceded by the masculine determiner than are masculine nouns preceded by the feminine determiner. Based on this pattern, Spanish-speakers might very well find the sequence *el_a* more acceptable and thus demonstrate faster utterance onset latencies in these conditions than in incongruent sequences beginning with the feminine determiner *la_o*. Note that incongruent sequences for words result in a definitive gender agreement violation whereas incongruent sequences for non-words reflect sequences that are more or less frequent but nonetheless potentially plausible. Only the most regular morphophonological stem patterns were used for both words and non-words (/o/ = masculine; /a/ = feminine) in this experiment.

The congruency manipulation together with that of lexical status and the use of regular, frequently-occurring morphophonological patterns in the experimental design allowed for observation of two potentially-viable routes to production of gender agreement within the noun phrase, either access to grammatical gender stored with individual lexical items or the use of generalizations based on the predictability of distributional patterns and the regularity of surface features. Each of the three hypothesized accounts for how grammatical gender is involved in noun phrase production that emerge from this basic dichotomy makes different predictions with respect to expected response patterns in the eight conditions outlined in Table 6; however, before discussing these specific predictions, the next section will provide a brief review of relevant findings in the domain of adult gender processing for the production of noun phrases. These findings are then situated within the most prevalent model for adult production with particular focus on the proposed distinction between processing of closed-class versus open-class vocabulary.

3.2 Review of findings for gender processing

Recall from Chapter 2 that the data are somewhat unclear with respect to the nature of the gender congruency effect. When pictures are named with noun distractors that are either congruent or incongruent in gender with the pictured noun, adult Dutch and German speakers are faster to name pictures with gender congruent distractor nouns relative to naming with gender incongruent distractors (Schriefers, 1993) Schriefers and Teruel, 2000). When speakers of Romance languages such as Spanish, Italian, Catalan and French are tested within the same design, no effect of gender congruency is observed

(Costa, Sebastián-Gallés and Caramazza, 1999; Miozzo, Costa and Caramazza, 2002).

One possible explanation of the discrepant results found across languages proposes that

determiner selection is dissociable from gender selection processes for Romance

languages. Determiner selection on this account is posited to occur later in sentence

planning procedures for languages in which the form of the determiner depends on the

phonological instantiation of the upcoming word's onset than for languages like Dutch

and German in which the form of the determiner could potentially be fully specified upon

access to lexically-specified gender features stored with individual words. Indeed,

findings in Italian provide evidence to corroborate the notion that phonological context

within the noun phrase bears on the process of determiner selection (Miozzo and

Caramazza, 1999).

When noun distractors are substituted with determiner distractors within the

picture-word interference paradigm the gender congruency effect re-surfaces and is

shown not only for speakers of Spanish and French but for German speakers as well

(Alario, Ayora, Costa and Melinger, 2008). Interestingly, the effect is also observable

when nouns are produced without a determiner. These findings have led to the proposal

that determiner distractors of the same gender as the target determiner exert a facilitatory

affect on processing the pictured noun by means of activating representations in the

production lexicon. On this proposal, picture naming speed increases as a function of an

increasing number of features (number or gender) shared between the distractor and the

correct form of the target determiner.

Within the adult language production model a distinction is made between retrieval of open-class and closed-class words. The retrieval of open-class elements drives phrasal planning while closed-class elements are said to be associated with syntactic planning frames that are selected as a consequence of open-class retrieval, specifically, lemma-level processing at the functional level (Garrett, 1982, 1984). Likewise, phonological encoding processes for morphemes and inflectional elements follow the encoding of open-class words in the time course of production planning. Some of the above-mentioned findings can be easily accounted for within this architecture; however, the crosslinguistic discrepant results for the gender congruency effect with noun distractors is not predicted by this processing model. In fact, if both determiner and noun distractor gender congruency facilitates lexical retrieval processes of the target noun by means of activation of shared gender features in the production lexicon which consequently facilitates gender selection processes of the target noun, it is unclear why similar effects are not found across experiments. Despite the fact that Alario, Ayora, Costa and Melinger (2008) observed a congruency effect for both Romance and Germanic languages, subtle differences were noted between the German results and the results for Spanish and French. While it could be the case that the processing of gender conforms in a broad sense with the overall structure and organization of the production processing model described in Chapter 2, it is also possible that language-specific differences in the morphophonological regularity of gender patterns and the frequency of distributional patterns across genders is also a factor involved in noun phrase production. There is some evidence that adults are sensitive to the frequency with which a particular

noun co-occurs with certain morphological features such as singular, plural, diminutive or base-form (Spalek and Schriefers, 2005). There is also evidence that adults, like children, are able to extract surface morphophonological cues to gender for a language they do not know (Richardson, Harris, Plante and Gerken, 2006). It is possible that adult Spanish-speakers demonstrate evidence for an input-based production mechanism that exploits statistical patterns such as morphophonological regularities across the Spanish gender system that subsequently affect processing strategies for noun phrase production. It could be the case that the influence of input statistics is only observable when the system is placed under enough pressure; however, it could be that the phenomenon is constrained to a developmental model and that adult Spanish-speakers, like speakers of other gendered languages must access and retrieve gender stored with individual lexical items.

The experiment with Spanish-speaking adults addressed this issue by testing adult Spanish-speakers using a speeded response version of the elicited imitation paradigm. The results of the adult experiment evaluate the influence of lexical status, congruity and gender on the production of noun phrases as well as provide a basis of comparison for the patterns of performance found in the child experiment that will be discussed in Chapter 4. In this way the results with Spanish-speaking children can be situated within models of adult production, and the cumulative data for both children and adults can be evaluated with respect to previous findings in the domain of grammatical gender processing. The next section details the predicted patterns of performance expected based on the above-mentioned findings in production processing and grammatical gender.

3.3 Predictions

The predictions outlined in this section for the adult experiment are based on the

expectation that adults would neither omit obligatory elements nor modify the stimulus in

any way. Utterance onset latencies were therefore used as an indicator of relative ease or

difficulty of processing rather than accuracy of stimulus repetition. Table 3.2

summarizes the experimental predictions expected to be observed for each hypothesized

account for how Spanish-speakers use grammatical gender for the production of noun

phrases. Note that a facilitatory effect on naming times is predicted across the board for

words relative to naming times for non-words and thus it is whether or not lexical status

interacts with the other factors as well as the manner in which it does so that will

differentiate between the three accounts shown in Table 3.2 as will be explained in detail

in the discussion of each account that follows.

Table 3.2: Predicted pattern of results for each experimental manipulation according to
each account.

	Lexical Status	Congruity	Gender
Lemma-based	Main effect	Stem x Article x Lexical Status	No effect
Frame-based	Main effect	Stem x Article	No effect
Input-based	Main effect	Stem x Article	Main effect Stem Feminine match better than masculine match

3.3.1 The lemma-based account

Based on evidence that grammatical gender is lexically-specified and that the

phrasal frame must be accessed via lemma retrieval processes, the observation of a main

effect of lexical status would be expected such that overall words are produced more quickly than non-words. There is evidence that determiner distractor features such as number and gender affect processing of the upcoming noun in such a way that naming is speeded when distractor features are congruent versus incongruent with the to-be-named noun's determiner. Lack of competition in processing is inferred from facilitatory effects found in congruent conditions. This is expected to be the case if determiner selection is lexically dependent (Alario, Ayora, Costa, Melinger, 2008). Based on these findings, a gender congruency effect is expected such that incongruent sequences take longer to produce than congruent sequences. Crucially, this difference should be larger for words than for non-words. Given that gender within this model is represented with lexical items, both masculine and feminine genders should be equally as available upon access to the word's lemma; thus, no difference in naming times should be observed between production of masculine versus feminine morphosyntax for either stems or articles.

3.3.2 The frame-based account

Like the lemma-based account, the frame-based account also predicts an interaction between stem and article gender such that naming times are faster in congruent versus incongruent conditions. As with the lemma-based account, a main effect of lexical status is expected based on evidence that retrieval of a well-known word is more efficient than retrieval of an unknown word. The frame-based account, however, is based on evidence that both adults and children are capable of extracting morphophonological cues to gender, especially when the cues available are concordant and numerous. The possibility that Spanish speaker's production of noun phrases is

based on extraction of patterns in the form of gendered frames is bolstered by the high correspondence between noun gender and stem morphophonology shown in Spanish in addition to the predictable correspondence of determiner gender with stem morphology shown to be the case across the Spanish nominal gender system. If the adult processor indeed exploits the predictability of determiner gender and is sensitive to morphophonological cues available in the co-ocurrence patterns of determiners and stems as discussed in Chapter 2, the pattern of the congruency effect predicted in the interaction of stem and article should be similar for both words and non-words. Importantly, the pattern of results should not be conditioned by gender such that adults are equally as fast to name masculine congruent sequences as they are to name feminine congruent sequences. Additional evidence that Spanish speakers are making use of input statistics should be evident in utterance onset latencies for incongruent sequences for both words and non-words such that the more frequently occurring *el_a* sequences are produced faster than the less frequent *la_o* sequences.

3.3.3 The input-based account

As with the other accounts, the input-based account predicts a main effect of lexical status based on evidence that lexical familiarity is a processing advantage given that production of the noun phrase involves retrieving known representations stored in memory. Thus, adults should be faster to name real words than they are to name non-words. As with the previous accounts, the input-based account predicts an interaction of stem and article gender producing a congruency effect evidenced by faster naming of sequences where the article and stem match in gender versus sequences where they do

not. If the crosslinguistic differences observed for the gender congruency effect are in part due to the morphophonological regularity and predictability of gender patterns within a particular language, it can be predicted based on the regularity and consistency of form demonstrated for the feminine gender system relative to the variability of masculine morphology that processing feminine morphology is more efficient than processing masculine morphology as evidenced by faster utterance onset times for sequences containing feminine versus masculine morphology. If this is the case, and if lexical familiarity is conditioned by morphophonological regularity, the gender congruency effect evidenced by the interaction of stem and article gender should be further defined by this regularity such that adults are faster to produce noun phrases in feminine congruent sequences than in masculine congruent sequences. This pattern should be observed for both words and non-words. If, additionally, the predictability and frequency of distributional patterns exerts an influence on noun phrase production, incongruent sequences for feminine stems (el_a) are expected to be produced more quickly than masculine incongruent sequences (la_o). If this effect is partially due to the predictability of the determiner as well as the variability in regularity demonstrated by stem morphophonology across genders, a main effect of stem is expected such that sequences containing a masculine determiner are overall named slower than feminine stems.

3.4 Method

3.4.1 Participants

A total of 21 adult Spanish-speakers participated in the study. It is difficult to find completely monolingual Spanish speakers in southern Arizona; therefore, the inclusion of a participant's data was dependent upon language exposure as measured by a language background survey. The data of 6 participants were excluded from the analysis based on early or simultaneous exposure to a language other than Spanish. The data for the remaining 15 participants were included in the analysis. The group consisted of 6 females and 9 males who were either enrolled in graduate programs at the University of Arizona or were members of the community. All 15 adults whose data were included in the analysis learned Spanish as their first language and did not learn to speak English or any subsequent languages prior to age 10. On average, participants learned to speak a language other than Spanish at age 15.

3.4.2 Materials

Language exposure and experience were assessed via self report on a language background survey. In order to elicit noun phrases, Spanish-speakers listened to and repeated a total of 32 items presented in two counterbalanced lists. Each list consisted of 16 words and 16 non-words presented in either a gender congruous or gender incongruous condition such that on half of the items the stem of the word or non-word was presented in a matching syntactic frame preceded by the gender-congruous article (el perro/ el tupo) and on half of the items the stem of the word or non-word was presented in an incongruent syntactic frame preceded by the gender-incongruous article (la perro/ la

tupo). The lists were counterbalanced for gender such that an equal number of feminine

and masculine stems (words and non-words) appeared in each list. The stems (words and

non-words) were also balanced with respect to marking: All of the stems exhibited

regular systematic gender morphophonology such that the word-final phoneme /o/

corresponded with masculine gender or the word-final phoneme /a/ corresponded with

feminine gender. The test words were non-human nouns drawn from the Spanish version

of the MacArthur CDI developmentally-normed vocabulary checklist, and no words with

English cognates were included. Non-words were created based on nouns from the

MacArthur CDI Spanish version and were formed by changing the onset plus one other

phoneme of the existing two-syllable Spanish word. All words and non-words were two-

syllables in length with stress falling on the penultimate syllable, the most common stress

pattern in Spanish. Prosodically, each Det + Noun/Non-word combination exhibited the

pattern *weak-strong-weak*, the stress pattern said to facilitate article production for young

Spanish-speaking children (Restrepo and Gutierrez-Clellan, 2001). The complete list of

words and non-words is shown in Table 3.3.

Table 3.3: Experimental items: Words and non-words

Words		Non-words	
Masculine	Feminine	Masculine	Feminine
libro	casa	tupo	bapa
viento	rana	crepo	fupa
oso	vaca	pacho	rulla
horno	cama	flebo	lipa
globo	chancla	buepo	chorga
pato	torta	cherpo	palta
queso	bolsa	disto	tolpa
techo	gorra	resplo	nupa

The lists were counterbalanced such that if a word or non-word appeared in the article / stem congruous condition in List A, it appeared in the incongruous syntactic frame in List B. To control for possible ordering effects, presentation order was also balanced by reversing the presentation order of items for both List A and List B, thereby creating List A1, List A2, List B1, and List B2. Items in each list were semi-randomized such that no more than two items from a condition appeared consecutively. Table 3.4 shows a sample list of items in order of presentation for list A1 and list B1. The complete list of items can be found in the Appendix.

Table 3.4: Sample counterbalanced item lists coded for condition-Word, Stem Masculine, Article Masculine (WSMAM), Word, Stem Masculine, Article Feminine (WSMAF), Word, Stem Feminine, Article Masculine (WSFAM), Word, Stem Feminine, Article Feminine (WSFAF), Non-word, Stem Masculine, Article Masculine (NWSMAM), Non-word, Stem Masculine, Article Feminine (NWSMAF), Non-word, Stem Feminine, Article Masculine (NWSFAM), and Non-word, Stem Feminine, Article Feminine (NWSFAF).

List A1	Condition	List B1	Condition
el libro	WSMAM	el viento	WSMAM
la crepo	NWSMAF	la pacho	NWSMAF
la vaca	WSFAF	la bolsa	WSFAF
la lipa	NWSFAF	la fupa	NWSFAF
el fupa	NWSFAM	el bapa	NWSFAM
la queso	WSMAF	la libro	WSMAF
la torta	WSFAF	la gorra	WSFAF
el cherpo	NWSMAM	el crepo	NWSMAM
la bapa	NWSFAF	la tolpa	NWSFAF
el gorra	WSFAM	el casa	WSFAM

The stimuli were recorded by a native speaker of Spanish who speaks a dialect of Spanish typical of this area. All recordings were made in a sound-proof room using a headset USB microphone and Sound Studio, an acoustic recording and analysis software. The digitized stimuli were normalized for amplitude using the same software. In order to eliminate the possibility that ungrammatical phrases would have different acoustic properties than grammatical phrases and that child or adult responses might be influenced by these subtle acoustic differences, all phrases were created by splicing a masculine or feminine determiner onto the same set of nouns. The determiners spliced onto the test words were taken from grammatical noun phrases matching the test phrases for number of syllables, stress placement as well as first two phonemes. Two practice items were

also included in this set and consisted of real words with ambiguous gender marking, each preceded by a gender ambiguous modifier.

3.4.3 Procedure

Each experimental session was preceded by a brief instructional session. The researcher used a puppet to introduce Spanish-speakers to the experimental cartoon creature, Pombo, and to subsequently familiarize adults with the elicited imitation task. Adults were explicitly told that they would hear simple Spanish noun phrases containing either real Spanish words or non-words and that these items would be preceded by either a gender matching or a gender mismatching article. They were instructed to repeat what Pombo says as quickly as possible. The speeded response format was included to minimize conscious processing of stimuli that could potentially lead to reanalysis and modification of the target, especially in the incongruent conditions. Following the instructional phase, adults were taken to the toddler testing room. The stimuli were then presented to adults in an elicited imitation task while seated at a toddler-sized table in front of an LCD flat screen using DMDX software for stimulus presentation developed by Kenneth Forster and Jonathon Forster at the University of Arizona (Forster and Forster, 2003). A size-appropriate chair was provided to the adults. Each auditory stimulus was synchronized with the appearance of Pombo on the screen. A practice session preceded the test item presentation to orient the adult to the computerized task. Adults were reminded to say what Pombo says as quickly as possible. All instructions were given in Spanish. Following each repetition of the target, a reward screen appeared

consisting of a smiling made-up cartoon creature synchronized with applause. Each item was presented only once for the adults.

3.4.4 Data analysis

Experimental sessions were recorded and the data transcribed for quantitative analysis. Each transcription was checked by a native speaker of Spanish for accuracy and 100% agreement was shown between coders. Each adult's response was analyzed with respect to accuracy relative to the target stimulus; however, unlike the analysis of the child data, items where the adult modified the utterance either by correcting the gender of the article or by producing the incorrect stem were excluded from the analysis. The only dependent measure in the adult study was response time. Naming latencies were measured from the end of the target word to the onset of the adult's utterance and all measurements were independently analyzed by a separate data coder. A high rate of agreement was shown with an average difference between coders of 58.13ms. The digital sound files were amplified and normalized using sound editing software and measurements were made using visible formant activity.

3.4.5 Results

For the analysis of the adult data, mean naming latencies for each condition for each participant were calculated and the data were analyzed using a three-factor within-subjects ANOVA with Lexical Status (Word, Non-word), Stem (Masculine, Feminine) and Article (Masculine, Feminine) as the three factors. The resulting mean response times can be seen in Figure 3.1.
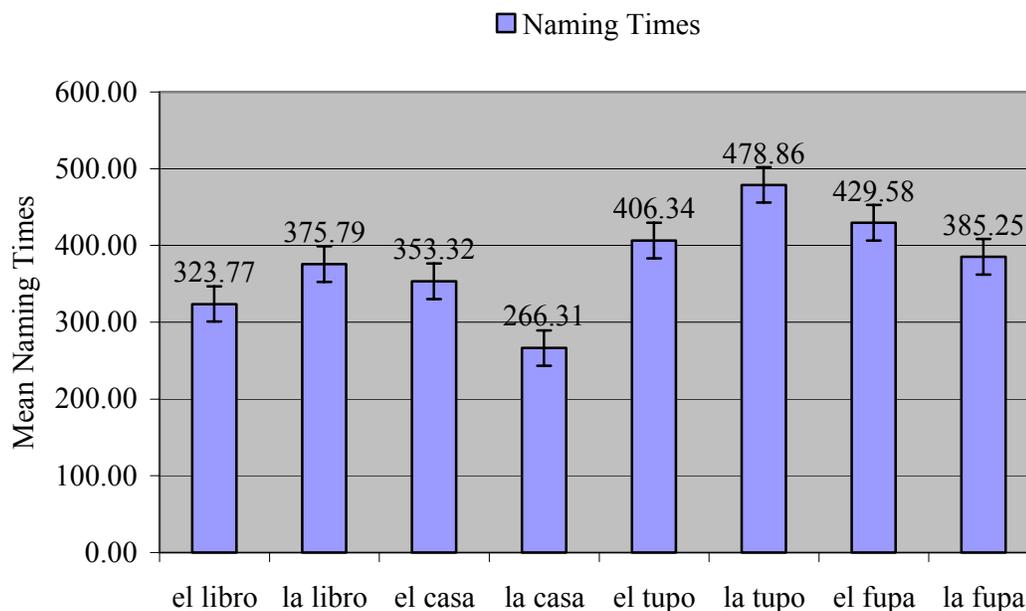
Figure 3.1: Mean naming latencies (in ms) for all eight conditions

The ANOVA showed a main effect of Lexical Status (F (1, 14) =9 .75, p < 0.01) such

that phrases containing real words were produced faster than those containing non-words.

There was also a main effect of Stem (F (1, 14) = 17.35, p < 0.002) showing that

participants produced phrases in which nouns had feminine stems faster than those with

nouns with masculine stems. Additionally, there was a significant two-way interaction

between stem and article (F (1, 14) = 13.32, p < .0.004). Participants were faster to

initiate repetition of the stimulus in conditions where the article and stem were gender

congruent than they were in conditions where the article and stem were gender

incongruent. Figure 3.2 shows the mean naming times for the two-way interaction

between stem and article.
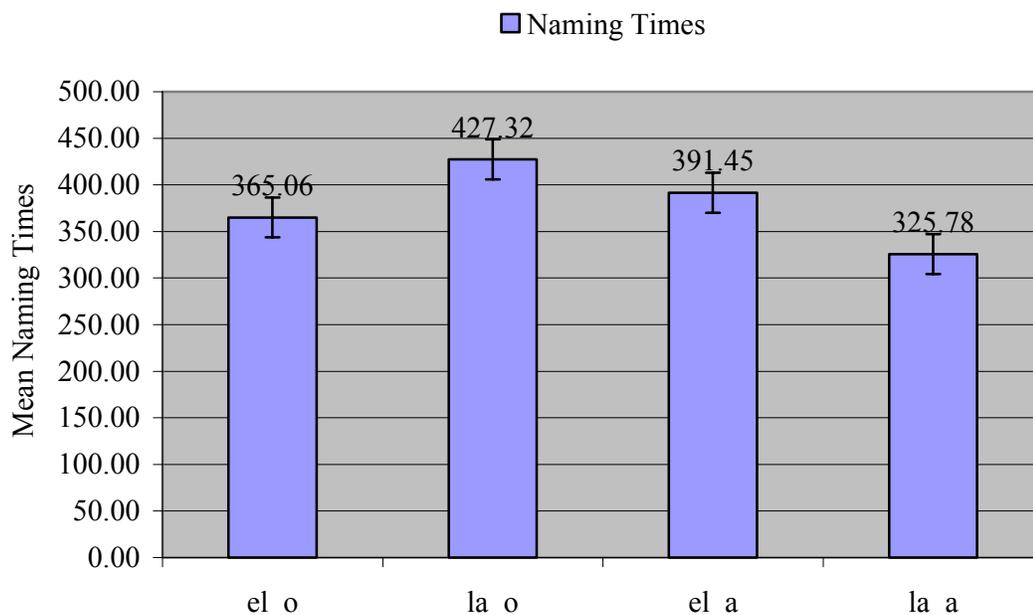
Naming Times

Figure 3.2: Mean naming times (in ms) for the two-way interaction of stem and article

The nature of the significant two-way interaction of Stem x Article was further investigated by splitting across Article and testing the simple effects of Stem at each level of Article with one-factor within-subjects ANOVAs with Stem (Masculine, Feminine) as the factor testing masculine and feminine articles separately. The results of the analysis for masculine articles showed no significant effect of Stem ($F (1, 14) F > 1$). Participants were not significantly slowed by the mismatch of a feminine stem preceded by a masculine article (el_a) relative to the masculine congruent condition (el_o). The results for feminine articles showed a significant effect of Stem ($F (1, 14) = 27.88$, $p < 0.001$) such that subjects were significantly slower to produce masculine stems preceded by feminine articles (la_o) than they were to produce feminine stems preceded by feminine articles (la_a).

3.4.6 Discussion

The pattern of results predicted to be observed for each account is summarized in

Table 3.5. A check mark is used to indicate where the results of the adult experiment

correspond to a predicted pattern for a particular hypothesis.

Table 3.5: Pattern of results for each experimental manipulation according to each account.

	Lexical Status	Congruity	Gender
Lemma-based	✔Main effect	Stem x Article x Lexical Status	No effect
Frame-based	✔Main effect	✔Stem x Article	No effect
Input-based	✔Main effect	✔Stem x Article	✔Main effect Stem ✔Feminine match better than masculine match

As predicted by all three accounts, a congruency effect was observed as

evidenced by the two-way interaction of stem and article gender. When the features of

the determiner match the features of the determiner that would be expected to accompany

the stem morphology, Spanish-speaking adults are faster to produce the sequence than

when these features are incongruent. The nature of this interaction, however, is

conditioned by the regularity of morphophonological patterns. As expected on the input-

based account, an advantage for the regularity of feminine morphophonological patterns

was observed such that adults were faster to produce feminine congruent noun phrases

than they were to produce masculine congruent noun phrases. Interestingly, this

difference, though not as large, was also shown for non-words. This finding suggests that

adults are sensitive to the asymmetrical patterns of regularity found across the Spanish

nominal gender system and that the relative variability or regularity of morphophonological patterns affects the speed of processing in the planning and production of determiner phrases.

As predicted by all three accounts, a main effect of lexical status was found, with words overall produced faster than non-words; however, contrary to both the lemma-based account and the frame-based account, the overall pattern of results is the same for both words and non-words. Not only do adults name feminine congruent sequences faster than they do masculine congruent sequences, they also name sequences containing a feminine stem faster than they do those consisting of a masculine stem. The fact that this effect, much like the gender congruency effect noted above, is not conditioned by lexical status is consistent with an input-based model of production that utilizes a fine-grained analysis of the input, operating off of morphophonological regularities and distributional patterns across the nominal gender system. When a Spanish-speaker must produce a determiner phrase, an overall advantage is observed for items corresponding to a known entry in the speaker's lexicon; however, retrieving masculine words that demonstrate variability in morphophonological patterns is somehow less efficient than retrieving feminine words that demonstrate morphophonological regularity. This effect cannot be due to any potential differential effects of onset syllable frequency between masculine versus feminine stems in the item set as will be demonstrated in the syllable frequency analysis reported in Chapter 4. In fact, as noted in the results of the analysis, masculine non-words were inadvertently biased with respect to the syllable frequency of the onset compared to feminine non-words. According to research in this area with adult

Spanish-speakers, a syllable frequency effect should be found for the production of words containing a high frequency syllable in onset position facilitating faster naming times for high versus low frequency onset syllables (Alvarez, Carreiras and Taft, 2001; Carreiras and Perea, 2004). Based on this premise, adults in the experiment should be faster to produce masculine non-words than feminine non-words; nevertheless, the opposite pattern is shown.

The results also provide some evidence that morphophonological regularity across the gender system interacts with the frequency and regularity of distributional patterns. Spanish-speaking adults were slower to produce the less frequently-occurring pattern of exceptional agreement (la_o) than they were to produce the opposite and more frequent pattern (el_a). Adults were not significantly slower when the masculine article mismatched the stem (el_a) than when the article matched the gender of the stem (el_o). With the feminine article, however, adults were significantly slower when the feminine article mismatched the gender of the stem (la_o) than when the feminine article matched the stem (la_a). It could thus be the case that the slowdown in producing *la_o* sequences is a result of the fact that there are few nouns in Spanish ending in /o/ that are feminine. This in turn could potentially lower the acceptability of the sequence, producing a significant slowdown in processing as evidenced by the increased naming times. Conversely, the faster naming times shown for *el_a* sequences could be accounted for in terms of higher frequency of occurrence in the language and thus the sequence could be perceived as more acceptable relative to *la_a* sequences. It is also possible that performance in these conditions is a combined effect of predictability of determiners

across genders, frequency of co-occurrence patterns as well as the regularity of morphophonological patterns across the nominal gender system. The fact that masculine stems overall create a significant slowdown in producing the stimulus suggests that this could be the case. There is evidence that Spanish-speakers generate expectancy for the gender of the upcoming noun based on the gender of the determiner. It could also be possible that this effect is greater for feminine morphology than for masculine morphology; thus, *la* creates a stronger expectancy for a feminine stem than does *el*. If we consider this together with the fact that masculine stems are slower than feminine stems, the significant slowdown in *la_o* sequences could be understood as the combined effect of masculine morphophonology on the stem as well as the strong expectation created by the feminine determiner. Likewise, the faster naming times shown for *el_a* sequences could be considered the combined effect of facilitation via the feminine morphophonology of the stem together with the low predictive value of the determiner. This combination alone could sufficiently characterize performance differences across these conditions although frequency of distribution of the patterns could also be a contributing factor.

The overall pattern of results shown in the adult data reflects the combined influence of lexical status and morphophonological regularity, suggesting that Spanish-speakers implement an input-based production processing mechanism for the production of gendered noun phrases. Lexical familiarity effects are shown in the data with an advantage for words over non-words broadly speaking; however, the effects are conditioned by morphophonological regularity across the Spanish gender system.

Importantly, a similar pattern of results emerges for both words and non-words. Masculine morphology is overall less efficiently produced than is feminine morphology. Crucially, these effects cannot be attributed to characteristics of the stimuli. These findings seem to rule out a strictly lemma-based account for access and production of gender as well as a strictly frame-based account; however, before discussing the results of these experiments with respect to previous empirical findings, the results of the child experiment will be presented in Chapter 4.

CHAPTER 4   EXPERIMENT 2: STUDY OF SPANISH-SPEAKING CHILDREN

This chapter begins with a description of the elicited imitation paradigm. In this chapter the results of the experiment carried out with Spanish-speaking children are presented for both child productions as well as child naming latencies. Children's speed and accuracy in production are evaluated with respect to the manipulation of lexical status, congruity and gender in order to assess the relative contribution of morphophonological regularity of surface features and predictability of distributional patterns as well as lexical status on the production of gender in the noun phrase. Additionally, the results of a distributional analysis of the nouns produced by the children in the experiment are reported followed by a general discussion of the results across dependent measures.

4.1 The elicited imitation paradigm

The elicited imitation production paradigm is well suited to explore the question of how children use grammatical gender for production of noun phrases. While naturalistic data involving spontaneous child utterances provide insight of a descriptive nature, they fall short in capturing the well know asymmetrical relationship between the state of the child's linguistic representations for perception and comprehension and the lag noted in the development of the child's ability to verbally express such knowledge. Very young Spanish-speaking children are sensitive to gender marking present in determiner-noun sequences and have been shown to use these cues in differentiating between referents as evidenced by head turn in a preferential looking paradigm; however, what appears to reflect sensitivity to morpho-syntactic cues to grammatical gender

features of the auditory stimulus could also reflect the use of extralinguistic cues available in the visual presentation of the objects themselves (Williams and Fernald, 2007; Gerken, 1987) Young Spanish-speaking children's use of grammatical gender in spontaneous speech is nevertheless characterized by the omission of obligatory determiners, the use of variable vocalic forms as well as the misuse or overgeneralization of a particular determiner form (Lopéz-Ornat, 1997; Mariscal, 2009). A close link has been established between the patterns shown in young children's spontaneous speech and the patterns of modification resulting from young children's imitations (Brown, 1973). Additionally, research has shown that a child's actual utterance may not accurately reflect the intended form of the utterance, leaving multiple possible interpretations and an inaccurate assessment of the child's linguistic development (McKee and Iwasaki, 2001; Gerken, 2000; Gershkoff-Stowe and Smith, 1997). Presenting a child with a specific target utterance allows for examination of how, when and if the child modifies the particular utterance. The primary goal of the research presented in this dissertation was to examine more carefully procedures of automatic processing in the production of gendered noun phrases, differentiating between lexical effects and effects of morphological and distributional regularity. It was therefore crucial to use a task that would effectively tap production processes in a manner most faithful to a child's actual spontaneous speech.

In order to achieve the above-mentioned goals, the elicited imitation task implemented in this dissertation manipulated lexical status, congruity and gender of the stimulus presented requiring children to repeat simple words and non-words preceded by

either gender congruous or gender incongruous articles. Table 3.1 from Chapter 3 summarizing the 8 resulting conditions of the general experimental design is reproduced here as Table 4.1 for the reader's convenience.

Table 4.1: Design of the Elicited Imitation Task

el word_o	*la* word_o	*el* word_a	*la* word_a
el non-word_o	*la* non-word_o	*el* non-word_a	*la* non-word_a

The next section covers the expected patterns of child response for the conditions shown in Table 4.1 according to each hypothesized account for how children use grammatical gender for the production of simple noun phrases.

4.2 Predictions

In this section the basic theoretical underpinnings of each hypothesis for how Spanish-speaking children use grammatical gender for the production of noun phrases are briefly reviewed. The specific patterns of response that are expected to be observed on each account within the experimental design described in the previous section are then laid out.

Each hypothesis for how Spanish-speaking children produce gendered noun phrases makes specific predictions with respect to the probability that the majority of child responses in a particular condition will conform to one of the most prevalent response types (exact repetition, article omission or article gender switch) which will be further discussed in Section 4.3.4. A summary of the statistical pattern of results

predicted to be observed on each account is shown in Table 4.2 followed by a discussion

of the details of the specific response patterns expected on each hypothesis.

Table 4.2: Predicted pattern of child responses for each experimental manipulation
according to each account.

	Lexical Status	Congruity	Gender
Lemma-based	Main effect	Stem x Article x Lexical Status	No effect
Frame-based	Main effect	Stem x Article	No effect
Input-based	Main effect	Stem x Article	Main effect of Article Feminine match better than masculine match

4.2.1 The lemma-based account

The production model outlined in Chapter 2 specifies that sentence planning is

guided by lexical retrieval processes, specifically, retrieval of syntactic categorial

information stored with the lemma of a word. This lexico-syntactic information in turn

facilitates the selection and retrieval of an appropriate syntactic structure. Functional

elements such as inflectional morphemes or determiners are posited to be indirectly

retrieved at this level as abstract features of the syntactic frame selected. The serial

discrete model makes specific predictions with respect to the Spanish-speaking child's

ability to produce noun phrases. On this account as with the other accounts,

asymmetrical performance on words versus non-words is expected such that a facilitatory

effect for article production with real words should be evidenced in comparison to

performance with non-words. In other words, a main effect of lexical status should be

observed such that children produce more determiners when the stem is a word than

when the stem is a non-word and likewise omit fewer articles with words than non-words. If selection of an appropriate syntactic frame and its associated determiner is dependent upon accessing information stored with lexical items a child knows and if additionally grammatical gender is lexically-specified and must be accessed and retrieved via retrieval of individual words, no difference should be evidenced between performance on feminine morphology relative to masculine morphology. Crucially, an interaction between stem gender, article gender and lexical status should be observed such that children produce more articles in conditions where all of the cues are concordant (article gender matches the noun's gender) compared to those conditions where they are not (article gender does not match the noun's gender). This difference should be greater for words than for non-words.

Young children have been shown to make spontaneous corrections of their own speech (Jaeger, 1992; Wijen, 1990: Rispoli, 2003). The adult data with Spanish speakers suggests that reanalysis of a gender agreement violation is more costly than reanalysis of a number agreement error given a gender violation requires backtracking to the lemma of the particular noun and access of its gender feature (Barber and Carreiras, 2005). If access to the lemma is necessary for gender repair, children should repair the gender of the article more frequently in incongruous versus congruous conditions for words but not for non-words given they have no lexical entry with which to verify the item's gender.

4.2.2 The frame-based account

The frame-based account is based on evidence that children are sensitive to morphosyntactic distributional patterns of the input they receive and that they are able to

extract regularities for generalization based on surface features alone. For example, computer simulation using an associative network results in a pattern of determiner-noun gender assignment that is similar to patterns found in Spanish-speaking children's production of noun phrases (Smith, Nix, Davey, López-Ornat and Messer, 2003). There is evidence that both children and adults are capable of learning gender categories of a language they have not previously been exposed to based solely upon analysis of surface cues (Gerken, Wilson and Lewis, 2005; Richardson, Harris, Plante and Gerken, 2006). Additionally, when presented with phonologically legal Spanish non-words, children show a preference for use of syntactic information available on the determiner in combination with morphophonological information carried by the stem of the novel word over semantic cues to gender (Pérez-Pereira, 1991). There is also evidence to suggest that in the initial stages of producing more words and more complex structures children encounter difficulties in accessing, retrieving and coordinating information for production in a timely fashion. When faced with failures of retrieval, either lexical or procedural, children have been shown to make use of defaults based on the most frequent regular distributional patterns of the language (McKee and Iwasaki, 2001; Murasugi, 1991; Sekiguchi, 1995). The frame-based account posits that morphophonologically regular gender is predictable from surface forms. On this account the child's speech should reflect the predictable correspondence between stem morphophonology and noun gender as well as the reliable co-occurrence patterns shown for determiner gender and noun gender across the Spanish nominal gender system. As with all three accounts, children should produce more articles with familiar lexical items than with non-words for which

the child has no supporting stored lexical entry. Overall, children should produce more well-formed articles/fillers in the gender congruous (article and stem match in gender) versus the gender incongruous conditions (article and stem mismatched in gender). Spanish-speaking adults demonstrate sensitivity to gender agreement violations between the article and an upcoming noun with the effect localized at the determiner. This suggests that hearing *el* or *la* creates expectancy for the upcoming noun's gender, either masculine or feminine respectively (Wicha, Bates, Moreno and Kutas, 2003). Based on the frequency of distributional patterns of the Spanish nominal gender system, *la* less frequently co-occurs with the word-final phoneme /o/ than *el* co-occurs with the word-final phoneme /a/, thus children should repeat *el*_a sequences more often than they do *la*_o sequences if they are sensitive to distributional frequency. When *el* precedes a feminine word or non-word, children would be expected to switch the gender of the article to match the morphology of the feminine stem equally as often as they switch *la* to *el* when the feminine determiner is preceded by a masculine stem. Crucially, on the frame-based account, the pattern of results should not be significantly different for masculine versus feminine morphology given that what is activated is an abstract gendered frame based on extraction of generalizations based on morphosyntactic surface features found in the language across genders.

4.2.3 The input-based account

    In addition to the evidence showing children's sensitivity to surface morphophonological features and distributional patterns, there is also evidence that children perform a more fine-grained analysis of the input they receive and are not only

sensitive to surface features but exploit morphophonological regularities and their relative distribution across the nominal gender system for organization, access and retrieval of familiar words as well as the production of unfamiliar words. If this is the case, the morphophonological regularity of the feminine gender system should prove easier to process than the variable morphophonology of the masculine gender system and, indeed, there is evidence that this is indeed the case. For example, young typically-developing Spanish-speaking children as well as older children with SLI demonstrate overall greater accuracy in production of feminine morphology versus masculine morphology (López-Ornat, 1997; Restrepo and Gutierrez-Clellan, 2001). Comparison of distributional patterns of nominal gender in child speech to that of adult corpus data results in a similar distribution of noun types across genders that in turn reflects the structure of the Spanish nominal system. Both adults and children produce slightly more masculine versus feminine nouns overall; however, feminine regular nouns outnumber masculine regular nouns and there are far fewer feminine irregular nouns than masculine irregular nouns present overall.

Based on this evidence, the input-based account posits that the child's speech should reflect the predictability and regularity of morphophonological forms across the Spanish nominal gender system as well as the predictability of distributional patterns; thus, the input-based account predicts differential performance for masculine versus feminine morphology as well as a gender congruency effect evidenced by the presence of a two-way interaction between Stem (Masculine, Feminine) and Article (Masculine, Feminine). Unlike on the other accounts, however, on the input-based account children

should be more accurate with feminine congruent sequences than with masculine congruent sequences.

In addition to the ability to extract regularity of surface features and distributional patterns, there is also evidence that children are sensitive to lexical familiarity. Children are less likely to omit obligatory elements such as determiners when producing lexical items that are well known relative to unfamiliar or unknown items (Boyle and Gerken, 1997). As with the other accounts, the input-based account predicts an overall advantage of words over non-words such that children produce more articles with words than they do with non-words. A key difference between the input-based account and both the lemma-based and frame-based accounts is that the child's system is not only able to track distributional information regarding the words that co-occur with nouns and that mark gender such as determiners and gender-inflected adjectives as well as extract morphophonological regularities that link such elements, but is shaped by these detailed patterns of morphophonological regularities, using them to organize, access and retrieve the words they know as well as produce words they do not know. Gender is neither constrained to the data available in the extraction of abstract distributional patterns found in surface features as predicted by the frame-based account nor is it stored exclusively with individual lexical entries as posited by the lemma-based account. On the input-based account, then, the system should show sensitivity to the familiarity and regularity of lexical data to which it is exposed, evidenced by the presence of a main effect of lexical status that is conditioned by morphophonological regularity. For both words and non-words, a facilitatory effect of feminine morphology compared to masculine

morphology is predicted as previously noted. The advantage of the regularity of distributional patterns of the feminine gender system should be further enhanced by the morphophonological regularity of the pattern, specifically the repetition of the vowel /a/ across forms (la, las, una, unas) as well as the high frequency consonant-vowel syllable structure of the feminine definite determiners. Feminine morphology should thus prove to be easier to retrieve and produce than the more complex patterns of the masculine morphological gender system. Based on the feminine / masculine asymmetry, a main effect of article gender is expected such that overall children produce *la* with greater frequency and ease than they do the masculine determiner *el* and likewise make fewer omissions of *la* than *el*.

With respect to article gender switches, the pattern should reflect the priority of the stem given that the noun is the agreement controller in Spanish; thus, even for non-words the input-based account predicts that children will switch the gender of the article to match the morphology of the stem rather than switching the morphology of the stem to match that of the article. Within the incongruent conditions, if the system is using the distributional probabilities across the gender system, we might expect that the sequence *el_a* will be considered as more acceptable and thus easier than *la_o* based on the sheer quantity of nouns conforming to the former versus the latter exceptional pattern of agreement and thus resulting in fewer switches in the feminine mismatch *el_a* relative to the masculine mismatch *la_o*. If, however, the production system weights morphophonological regularity higher than frequency of distributional patterns of the

language, we would expect children to switch *el* to *la* more frequently than they switch *la* to *el*. This overall pattern should be shown for both words and non-words.

In summary, the three hypotheses put forward as possible accounts for how children produce gender in the noun phrase predict a gender congruency effect evidenced by a significant interaction between stem and article gender. Children should be overall more accurate in gender congruous sequences versus gender incongruous sequences and likewise produce more gender repairs in incongruous versus congruous sequences. However, on the lemma-based account the congruency effect should be further conditioned by lexical status such that the congruent / incongruent difference should be larger for words than for non-words. On both the lemma-based account and the frame-based account, children should be equally as accurate on both masculine and feminine morphology; however, the input-based account predicts better performance in congruent feminine conditions compared to congruent masculine conditions. All three accounts predict a main effect of lexical status with overall performance better on words versus non-words; however, this performance should be differentially affected by gender on the input-based account but not on the lemma-based or frame-based accounts.

4.3 Method

4.3.1 Participants

The participants for this study were Spanish-English bilingual children. Given that bilingual children represent differing patterns of exposure and experience with the language, they provide a developmental continuum, allowing us to look at a population of children who are mature enough to complete the experimental task but who are also at

various stages of Spanish production ability with respect to article production and gender

agreement. There is some evidence that patterns of article production for bilingual

children exposed to more than one language are influenced by the languages to which the

child is exposed. For example, Italian-German bilingual children compared to

monolingual children of both languages, are somewhat slower to begin producing articles

in Italian relative to monolingual Italian children, but surpass age-matched monolingual

German children with respect to age of onset of article production as well as rates of

article omission (Kupisch, 2007). However, there is also evidence that the bilingual child

follows a developmental trajectory that mirrors that of the monolingual child even when

the structure of the two languages diverges. For example, in Basque the determiner

follows the noun whereas in Spanish the determiner is pre-nominal. Spanish has gender

and number agreement between nouns and adjectives, but Basque does not. In a

longitudinal study, Barreña (1997) recorded and analyzed the pattern of noun phrase

production for a Spanish-Basque bilingual child in both of his respective language

between the ages of 1;6 and 3;6. When compared to monolingual children for each

language, the bilingual child's speech mirrored the patterns shown for monolingual

Basque and Spanish children at each stage of development. Looking at Spanish-English

bilinguals provides the opportunity to evidence the differential effects of exposure to two

languages on the development of the production system if, in fact, differences in

processing patterns do emerge.

A total of 30 Spanish-English bilingual children ranging in age from 2;0 to 4;0

were recruited for the study. The data for 12 children were not included in the analyses.

Some of these children either did not complete the task (n = 11) or no data were available

regarding language background or vocabulary size for either Spanish or English (n = 1).

The remaining 18 children included in the analyses were between 24 and 48 months with

a mean age of 35.88 months. The group consisted of 6 girls and 12 boys. Parental report

indicated that all of the children were exposed regularly to both Spanish and English to a

sufficient degree as to be able to complete the experimental task of repetition of simple

Spanish noun phrases. Vocabulary scores as measured by the MacArthur-Bates

Communicative Development Inventory: Words and Sentences ranged between 6 and

680 words for English with a mean score of 326.4 and between 72 and 675 words for

Spanish with a mean score of 343.8.

4.3.2 Materials

Vocabulary size in both English and Spanish was assessed for all children based

on the MacArthur-Bates Communicative Development Inventory: Words and Sentences.

The CDI is a developmentally-normed test of productive vocabulary and sentence

complexity that has been standardized for both English and Spanish (Fenson, Dale,

Reznick, Thal, Bates, Hartung, Pethick, & Reilly, 1993; Jackson-Maldonado, Thal,

Marchman, Bates, & Gutierrez-Clellen, 1993). Additionally, language background for

each child was measured based on parental report on a language background survey

designed to assess the child's exposure to both Spanish and English on a daily basis.

The design of the experiment was the same for both the child and adult

experiment. As detailed in Section 3.2.1, children listened to and repeated a total of 32

items consisting of either a masculine or feminine stem that was preceded by either a

gender congruous or a gender incongruous determiner. Half of the items were words and half of the items were non-words. For the reader's convenience, Table 3.3 from Chapter 3 showing the complete list of words and non-words included in the experiment is reproduced here as Table 4.3.

Table 4.3: Experimental Items: Words and Non-words

Words		Non-words	
Masculine	Feminine	Masculine	Feminine
libro	casa	tupo	bapa
viento	rana	crepo	fupa
oso	vaca	pacho	rulla
horno	cama	flebo	lipa
globo	chancla	buepo	chorga
pato	torta	cherpo	palta
queso	bolsa	disto	tolpa
techo	gorra	resplo	nupa

4.3.3 Procedure

Each experimental session was preceded by a brief play session. Once the child was comfortable, the researcher used a puppet to introduce the child to the experimental cartoon creature, Pombo, and to subsequently familiarize the child with the elicited imitation task. Following familiarization and play, the child, accompanied by the parent, was encouraged to find Pombo's identical twin hiding in the toddler testing room. The stimuli were then presented to the child in an elicited imitation task while seated at a toddler-sized table in front of an LCD flat screen using DMDX software for stimulus

presentation developed by Kenneth Forster and Johnathon Forster at the University of

Arizona (Forster and Forster, 2003). Each auditory stimulus was synchronized with the

appearance of Pombo on the screen. A practice session preceded the test item

presentation to orient the child to the computerized task. Children were instructed as

follows: "Say exactly what Pombo says, even if it sounds funny". Instructions and

prompting were given in varying degrees of both Spanish and English, depending on the

child's proficiency in Spanish. Following each repetition of the target, a reward screen

appeared. When the child was distracted or fussy, the presentation of the item was

repeated. Each child was given a non-functional computer mouse to encourage active

participation in the task.

4.3.4 Data Analysis

Experimental sessions were recorded and the data transcribed for quantitative

analysis. Each child's response was analyzed with respect to accuracy in article

production relative to the target stimulus and, where appropriate, naming latencies were

measured as will be detailed below. Each transcription was checked by a native speaker

of Spanish for accuracy and the reliability check yielded a high rate of agreement, 93%,

between the coders. Where there was disagreement, those items were independently

transcribed by a third person and a consensus was reached. Individual responses were

coded with the following categories for well-formedness with respect to repetition of the

target stimulus, specifically the determiner: Exact Repetition (both fillers and full

determiners), Ambiguous Article (fillers and full determiners not clearly marked for

gender), Switch (article gender switched to something other than the stimulus presented),

Omission (only the stem produced), Miscellaneous (cases where the child changed a non-word to a real word or the child repeated the incorrect stimulus because a sibling repeated it for the child, all other partial, unintelligible responses), and Refusals (no response given). A filler syllable is here defined as one or more phonemes produced in article position, preceding the noun. A filler syllable containing a vowel indicative of gender marking such as the vowel /a/ in lieu of the feminine determiner *la* or the vowel /e/ in lieu of the masculine determiner *el* was considered a scoreable gender-marked response. Responses coded as Ambiguous were therefore stems preceded by one or more phonemes not containing the appropriate gender-marked vowels /a/ or /e/. Table 4.4 shows example child utterances coded for each of the above-mentioned categories.

Table 4.4: Sample of scoring categories

Category	Target	Sample Child Utterance
Exact Repetition	el libro	el libro / e libro
Miscellaneous	la casa	Queca queca
Omission	el bolsa	bolsa
Switch	el vaca	ga vaca
Ambiguous	la lipa	li yiyipa

Systematic variations from the target utterance such as the replacement of the onset /l/ in "la casa" with the onset /y/ produced as "ya casa" were scored as correct full determiners.

Naming latencies were measured from the end of the target word to the onset of the child's utterance. Successful elicitation of the target utterance usually requires that

the target utterance be presented twice; thus, the stimulus was often repeated for the child along with prompting by the researcher or the parent (Gerken, 2000). In order to ensure that naming latencies accurately reflected online processing, an utterance was measured for the production latency analysis if only one prompt intervened between the first presentation of the stimulus and the child's response. A child's set of data was included in the overall analysis if at least half of the utterances were measurable. The digital sound files were amplified and normalized using sound editing software and measurements were made using visible formant activity. In an effort to differentiate and characterize processes involved in article omissions, article productions, and article gender repairs, measurements corresponding to each of these dependent variables were separated for the analysis. Separation of the data in this manner resulted in missing cells for one or more conditions in some cases. Where data were missing for only one condition, the missing score was estimated using the row and column sums and the data for that child were included in the overall analysis. The data for article gender switches were too few to include in the production latency analysis. As with the accuracy analysis, the measurements were independently analyzed by a separate data coder. The mean difference between the two sets of coder measurements was 45.39ms.

Data from the MacArthur-Bates Communicative Development Inventory (Words and Sentences) for both Spanish and English were collected via parental report and compiled using the CDI scoring program version 4.1 for Mac OS 10. Children between 24-30 months were compared separately to the norm-referenced developmental range for native Spanish and English speaking children of the same age. Children outside this age

range were compared with the developmental norm for a 30-month-old child in English as well as Spanish. The number of words produced in English and Spanish out of a possible 680 on each survey was calculated and used to measure vocabulary size for each child in each language.

Data from the Spanish MacArthur CDI were also analyzed with respect to the distribution of nouns across genders shown in the production lexicon of the bilingual children who participated in the experiment. The children in the experiment spoke varying degrees of both Spanish and English and the data are controversial with respect to the variable influence of the development of one language on the other. The purpose of the distributional analysis was therefore to ascertain the extent to which the Spanish-English child's repertoire of nouns demonstrated a distribution of gender similar to that of Spanish-speaking child and adult monolinguals. The total number of nouns produced by the entire group per parental report on the developmentally norm-referenced Spanish version of the MacArthur CDI vocabulary checklist was categorized and analyzed with respect to the distribution of nouns across genders for both regular and irregular nouns. One child's Spanish vocabulary checklist was not returned and thus a total of 17 children were included in this analysis.

4.3.5 Results

A limited set of response patterns were possible. When presented with the stimulus, the child could repeat the stimulus exactly as presented with a gender unambiguous article, switch the gender of the article relative to the stimulus, omit the article producing only the bare noun, produce a gender ambiguous article or unintelligible

response or simply refuse to respond. The majority of the child responses fell into one of

three categories: Exact repetitions, article gender switches and article omissions;

therefore, the statistical analyses presented of the child data presented in this section were

performed with these three response types as the dependent variables.

The results section is divided into three major subsections: (1) Section 4.3.5.1

covers the results of the accuracy analysis on the child production data, (2) Section

4.3.5.2 presents the results of the analysis of naming latencies, and (3) Section 4.3.5.3

provides the results of the distributional analysis of nouns produced by the children in the

experiment.

4.3.5.1 Productions

The overall distribution of response types shown in the analysis of child

productions is shown in Figure 4.1. Because there were few responses coded as

miscellaneous, ambiguous or refusals, these individual categories were collapsed to form
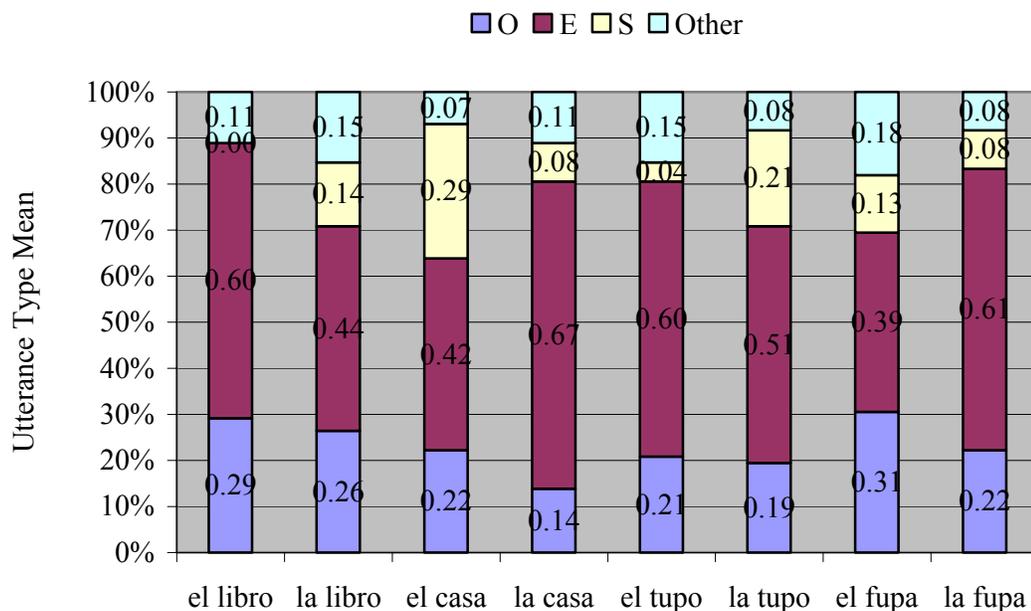
one category.

Figure 4.1: Overall distribution of response types for all 18 children included in the study. O = omission, E = exact repetition, S = article gender switch and Other = the combined responses of the miscellaneous, ambiguous and refusal categories. The mean English CDI vocabulary score for the group was 326.4 and the mean Spanish CDI vocabulary score was 343.8. The mean age was 35.89 months.

The child production data were analyzed using a three-factor, within-subjects ANOVA with Lexical Status (Word, Non-word), Stem (Masculine, Feminine) and Article (Masculine, Feminine) as the three factors. To determine whether children use gender for production based on a lemma-driven system, a morphosyntactic frame strategy or an input-based strategy based on lexical familiarity and input regularity, ANOVAs were performed on the production accuracy data for the following dependent measures: Exact repetitions, article gender switches, and omissions. Given the small number of responses for the miscellaneous, refusal and ambiguous categories, these were not

separately analyzed. The results for each dependent variable will be presented and briefly discussed separately in the above-mentioned order.

4.3.5.1.1   Production of exact repetitions

The total number of responses where the child produced an article or a filler in each condition for each subject was used to form a ratio of exact repetitions of the target (both full and filler determiners) to the total number of articles produced by the child in each condition. All 18 children produced at least two exact repetitions and thus were included in the following analysis with a total of 12 boys and 6 girls. The children ranged in age from 24 to 48 months with a mean age of 35.88 months. The resulting means for each of the eight conditions averaged across subjects are shown in Figure 4.2.
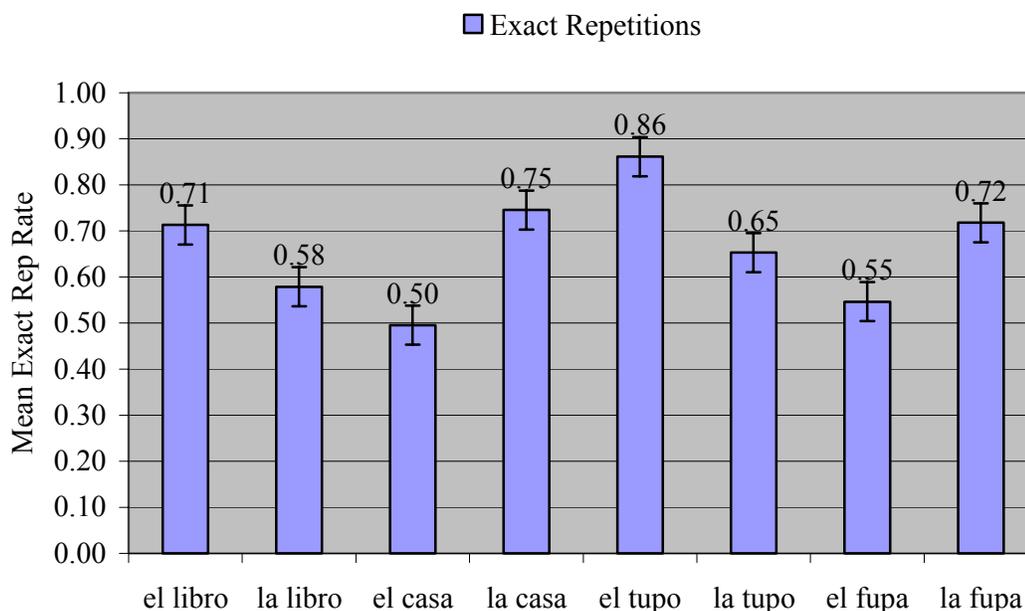

Figure 4.2: Mean exact repetitions out of all articles produced for all eight conditions for all 18 children. The mean English CDI vocabulary score for the group was 326.4 and the mean Spanish CDI vocabulary score was 343.8. The mean age for the children included in this analysis was 35.89 months.

The results of the three-factor within-subjects Anova with Lexical Status (Word, Non-word), Stem (Masculine, Feminine) and Article (Masculine, Feminine) as the factors showed a significant interaction between stem and article ($F(1, 17) = 12.80$, $p < 0.01$). Children produced more exact repetitions of the stimulus when the gender of the article and the gender of the stem were congruent (el_o, la_a) versus when they were incongruent (la_o, el_a). This difference was slightly greater for feminine stems than for masculine stems.

The significant two-way interaction of Stem x Article was then analyzed with two separate one-factor ANOVAs, splitting across Article and testing the simple effects of stem at the levels of Article with Stem (Masculine, Feminine) as the factor for both masculine and feminine articles. The resulting means for the four remaining conditions are shown in Figure 4.3.
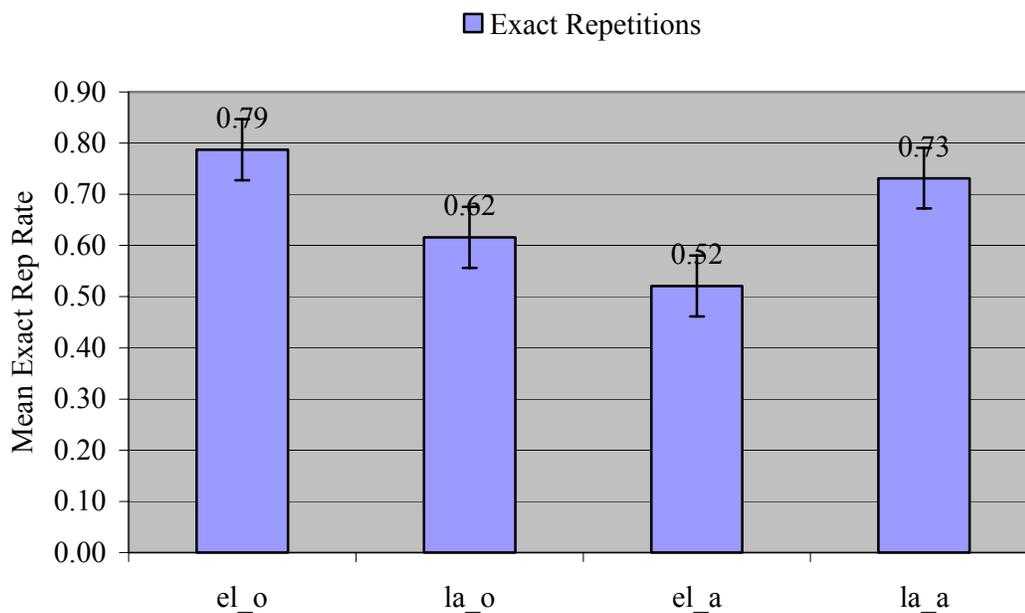
□ Exact Repetitions

Figure 4.3: Mean exact repetitions collapsed across Lexical Status showing the significant interaction between stem and article.

The results of the one-factor within-subjects ANOVA with Stem (Masculine, Feminine) as the factor for masculine articles showed a significant effect of Stem ($F (1, 17) = 13.09$, $p < 0.01$) such that when masculine articles preceded masculine stems (el_o) children produced more exact repetitions of the target stimulus than when they preceded feminine stems (el_a). With feminine articles, however, there was no significant effect of Stem ($F(1, 17), F > 1$) such that children did not make significantly more exact repetitions of the stimulus when a feminine article was followed by it's gender-congruent stem (la_a) than when the feminine article was followed by the gender-incongruous stem (la_o).

4.3.5.1.1.1 Discussion

Table 4.5 provides a summary of the expected patterns of results predicted for each hypothesis. Those effects demonstrated in the analysis of exact repetitions are checked.

Table 4.5: The results of the analysis of exact repetitions in the context of the predicted patterns of response for each experimental manipulation according to each account.

	Lexical Status	Congruity	Gender
Lemma-based	Main effect	Stem x Article x Lexical Status	No effect
Frame-based	Main effect	✔ Stem x Article	No effect
Input-based	Main effect	✔ Stem x Article	Main effect of Article Feminine match better than masculine match

With respect to the accuracy data, children produced more articles coded as exact repetitions of the stimulus when the article and stem were congruent in gender marking compared to when they were gender incongruous as predicted by all three accounts. This effect, however, was not conditioned by whether or not the stem was a word as was expected on the lemma-based account neither was the expected advantage of the feminine match condition over the masculine match condition predicted by the input-based account evidenced. The presence of a congruency effect for children's exact repetitions of the stimulus, coupled with the fact that lexical status does not significantly affect the pattern of article production, suggests that children have, in fact, noted the dependency between article gender and stem gender. Given that lexical status did not exert a significant affect on the processing of the stimuli nor did it interact with the congruency effect as expected

on the lemma-based account, it appears that not only have children noted the dependency between article and stem, but that this relationship is defined by the statistical co-occurrence patterns present in the surface morphophonological structure of the determiner/stem combination. When given matching cues to the gender of the target item, children were able to use these cues to produce the appropriate determiner/ noun combination with an accuracy rate of 71% or higher and this ability does not appear to be lexically dependent.

The input-based account predicts an advantage for the regularity of the feminine gender system. Interestingly, this advantage was not noted in the congruent sequences where what appears to be most imperative is the convergence of cues. Nonetheless, an effect of feminine morphology was shown in the data as evidenced by the magnitude of the difference between congruent and incongruent conditions for feminine versus masculine stems. When feminine stems were preceded by the incongruent masculine article (el_a), children were much less likely to repeat the utterance as presented relative to the gender congruous condition (la_a). This difference was greater than when a masculine stem was preceded by a feminine article (la_o) relative to the gender congruous condition (el_o).

When the match is considered from the article, the role of regularity of the feminine gender system becomes more evident. In the follow-up analysis, a significant effect of stem was found with masculine articles (el_o versus el_a), but not for feminine articles (la_a versus la_o). This difference can be understood in terms of predictability and regularity. Given the greater variability present in the masculine gender system, the

masculine determiner *el* is not a reliable predictor of the upcoming stem's gender, thus it appears that the child must employ a "wait and see" procedure to verify the gender of the noun phrase with the morphology of the stem. When the determiner / noun sequence begins with the feminine determiner *la* however, the effect of stem disappears. This is contrary to what would be expected if children were strictly operating off of predictability of features as constrained by the frequency of distributional patterns of the Spanish language. There are over five hundred words in the language that are inherently masculine that end in /a/ and in addition, a small group of feminine nouns beginning with a stressed /a/ that take the masculine article. When this distribution is compared to the handful of Spanish words ending in /o/ designated as feminine, a potentially informative generalization emerges: the masculine article applies in all contexts whereas the feminine article does not. Upon this premise, one might expect the mismatch of a feminine stem with a masculine article (el_a) to have a smaller impact on children's processing and production of the combination than when a masculine stem is preceded by a feminine article (la_o) based on the frequency of these exceptional agreement patterns. As shown by the data, however, this does not appear to be the case, suggesting that indeed, the observed effects reflect the development of production system processes. In this developmental stage, the regularity and consistency of patterns trumps the frequency of patterns.

4.3.5.1.2 Production of article gender switches

The total number of responses where the child produced an article in each condition for each subject was used to form a ratio of articles switched in gender (full and

filler determiners) produced to the total number of articles produced by the child in each condition. Those children who produced at least one article gender switch were included in the analysis. Only one child made no article gender switches at all and was thus excluded from the analysis. The resulting means for article gender switches for all eight conditions are shown in Figure 4.4.
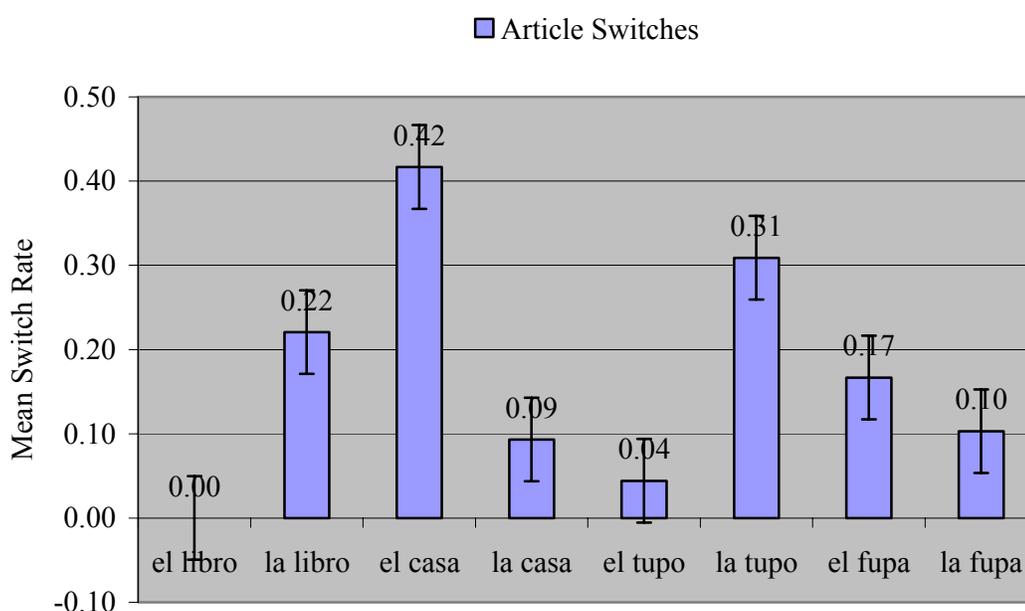
Figure 4.4: Mean article gender switches for all eight conditions for 17 children. The mean English CDI vocabulary score for the group was 337.8 and the mean Spanish CDI vocabulary score was 358.7. The mean age for the children included in this analysis was 36.53 months.

The results showed a significant two-way interaction between stem and article (F (1, 16) = 16.31, p < 0.01). When children were given gender congruous cues, they made fewer article gender switches than when they were given conflicting cues. The two-way interaction between lexical status and stem approached significance (F (1, 16) = 4.49, p < 0.06) such that children switched the gender of the article more often with feminine

stems for words, whereas with non-words children made more article gender switches with masculine stems. It is important to note that an article gender switch in a congruous condition constitutes an agreement error whereas an article gender switch in the incongruous conditions reflects an article agreement repair. In fact, the data show that children made very few errors in gender agreement overall relative to their article gender repairs in the incongruous conditions. Only 6 of the 17 children included in the above analysis made errors in article/stem gender agreement. Table 4.6 shows the data for those 6 children who made agreement errors.

Table 4.6: Error rate for each of the 6 children who made article gender switches in congruous conditions for both words and non-words as well as age and vocabulary size as measured by the MacArthur CDI for English (CDI_E) and Spanish (CDI_S). Five of the 6 children who committed agreement errors were English dominant as reflected by higher vocabulary scores for English than for Spanish. Only one of the 6 children was Spanish dominant and this child was also the youngest of the group.

	Words		Non-words				
	Masculine	Feminine	Masculine	Feminine	CDI_E	CDI_S	Age
	el libro	la casa	el tupo	la fupa			
S2	0	0.50	0.25	0.25	668	371	43
S6	0	0.33	0.25	0	606	72	43
S12	0	0.50	0	0.66	34	559	28
S15	0	0.25	0	0.50	570	514	48
S16	0	0	0.25	0	679	86	48
S19	0	0	0	0.33	567	150	32
Means		0.26	0.12	0.29	520	292	40

Given the very low error rate in article/stem agreement and the interest in understanding the mechanism underlying the child's ability to coordinate stem gender with article gender when given conflicting cues, the data for article gender repairs were

separated from the data for agreement errors for analysis using a two-factor within-

subjects ANOVA with Lexical Status (Word, Non-word) and Stem (Masculine,

Feminine). Only the data for those children who produced at least one article gender

switch were included in the analysis for a total of 15 children consisting of 10 boys and 5

girls. The children in this group ranged in age from 24 months to 48 months with a mean

age of 35.33 months. The average CDI Spanish vocabulary score was 372.7 and the

average CDI English score for the group was 293. The resulting means for article gender

switch rate for the four incongruent conditions are shown in Figure 4.5.

☐ Article Repairs

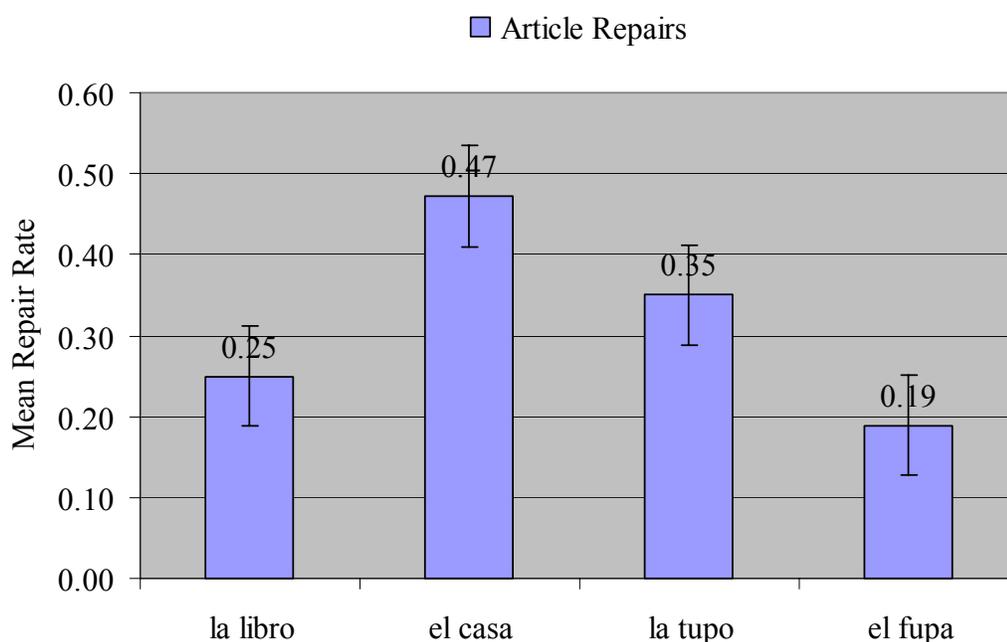Figure 4.5: Mean article gender switches (repairs) for incongruent conditions for both
words and non-words for the 15 children who produced at least one repair.

The ANOVA showed an interaction approaching significance between lexical

status and stem (F (1, 14) = 4.10, p < 0.07) such that children made more article gender

repairs for words with feminine stems than for words with masculine stems. This pattern

reversed for the non-words such that children made more corrections of article gender with masculine stems than with feminine stems.

The two-way interaction was then analyzed by testing the simple effects of Lexical Status at each level of Stem using separate one-factor within-subjects ANOVAs. For feminine stems there was a significant effect of Lexical Status ($F (1, 14) = 7.54$, $p < 0.02$). Children made more corrections of article gender with feminine stems that are words than they did for feminine stems that are non-words. The results for masculine stems, however, showed no significant effect of Lexical Status ($F (1, 14) < 1$) such that the status of a masculine stem as a word did not provide a significant advantage in increasing children's rate of article gender repairs relative to masculine stems that are non-words.

4.3.5.1.2.1 Discussion

The results of the analysis of article gender switches are indicated with a check mark in Table 4.7 summarizing the predicted patterns of results for each hypothesis. Effects that were shown in the analysis but were not predicted are indicated with a star.

Table 4.7: The results of the analysis of article gender switches within the context of the predicted response patterns for each account.

	Lexical Status	Congruity	Gender
Lemma-based	Main effect	Stem x Article x Lexical Status	No effect
Frame-based	Main effect	✔ Stem x Article	No effect
Input-based	Main effect	✔ Stem x Article	Main effect of Article Feminine match better than masculine match ★ Lexical Status x Stem

Consistent with the predictions for all three accounts, a significant interaction between stem and article was observed. The interaction can be understood as the difference between children's error rate (article gender switches in the congruous conditions) and children's agreement repair rate (article gender switches in the incongruous conditions). The data show that when children are given gender congruous cues, they make significantly fewer switches in article gender than when the cues are conflicting. In other words, when given the correct information, children are very accurate in gender agreement making very few errors overall. When given conflicting cues to gender agreement, children make significantly more corrections to the article gender compared to errors in article gender.

When the corrections were considered separately from the errors, the data showed that children made more gender repairs for words with feminine stems than masculine stems; whereas, they made more repairs for non-words with masculine stems than feminine stems. The differential effects shown for words versus non-words, however,

were only statistically significant for feminine stems. Note that masculine stems are preceded by the feminine article while feminine stems are preceded by the masculine article. Children did not make significantly more repairs with words than with non-words overall; nonetheless, the effect of lexical status that was visible in the patterns of article gender repairs appears to be modulated by the morphological regularity of the feminine versus masculine gender systems. The fact that there was no significant difference between repair rate for words compared to non-words rules out a strictly lemma-based account and the interaction of lexical status with gender likewise rules out a strictly morphophonological surface feature approach.

The patterns observed in the data corroborate the notion that children use morphophonological regularities across the gender system for the production of both words and non-words as predicted by the input-based account. Lexical familiarity, however, is only an advantage when coupled with morphophonological regularity. When the sequence contains a word that is additionally marked by regular feminine morphology, retrieval processes are very efficient and resources are available to counteract the low predictability and phonetic difficulty of the masculine article that precedes it resulting in a very high rate of article gender repair for feminine words compared to feminine non-words. In the absence of lexical familiarity, the variability and low predictability of the masculine article results in fewer article gender switches for the feminine non-words. Children repaired the gender of the article almost twice as often with feminine words as they did for masculine words. Additionally, they repaired the gender of the article slightly more often for masculine non-words than for masculine

words. These findings suggest that morphophonological regularities permeate the organization and processing of the entire system in such a way that access and retrieval of familiar words and the production of non-words is facilitated by morphopohonologically regular feminine gender patterns and likewise adversely affected by morphophonologically variable masculine gender patterns. When presented with a masculine word, children attempt to access the representation stored in memory; however, the variability of the morphology appears to result in lexical retrieval difficulties, especially when the masculine noun is preceded by a feminine determiner and thus fewer article gender repairs are evidenced. Masculine non-words, on the other hand, lack lexical familiarity as well as morphophonological regularity. On the input-based account fewer article gender switches should have been observed for masculine non-words than for masculine words; however, this difference was not found to be significant. The pattern of results seems to suggest that the locus of the inhibitory effect for masculine -words is difficulty in lexical retrieval processes. Given that feminine words are both familiar and regular in morphology, the overall pattern of results seems to suggest that morphophonological regularity is not only easier to produce, but also affects the overall organization of the system making it somehow easier to retrieve from the lexicon.

4.3.5.1.3 Analysis of article omissions

The total number of coded responses for each item in each condition was used to form a ratio of the total number of responses lacking a determiner to the total number of utterances the child produced. Article production is known to increase as a function of

age, thus, a ceiling effect was observed for article production with some of the older

children. Therefore, only the data for those children with at least one omission were

included in the analysis of this dependent measure resulting in a total of 15 children, 9

boys and 6 girls ranging in age from 24 to 48 months with a mean age of 34.13 months.

Spanish vocabulary size as measured by the CDI checklist ranged from 72 to 675 with a

mean score of 331.2 and English vocabulary size ranged from 8 to 679 with a mean score

of 263.8. The resulting means for article omissions can be seen in Figure 4.6.

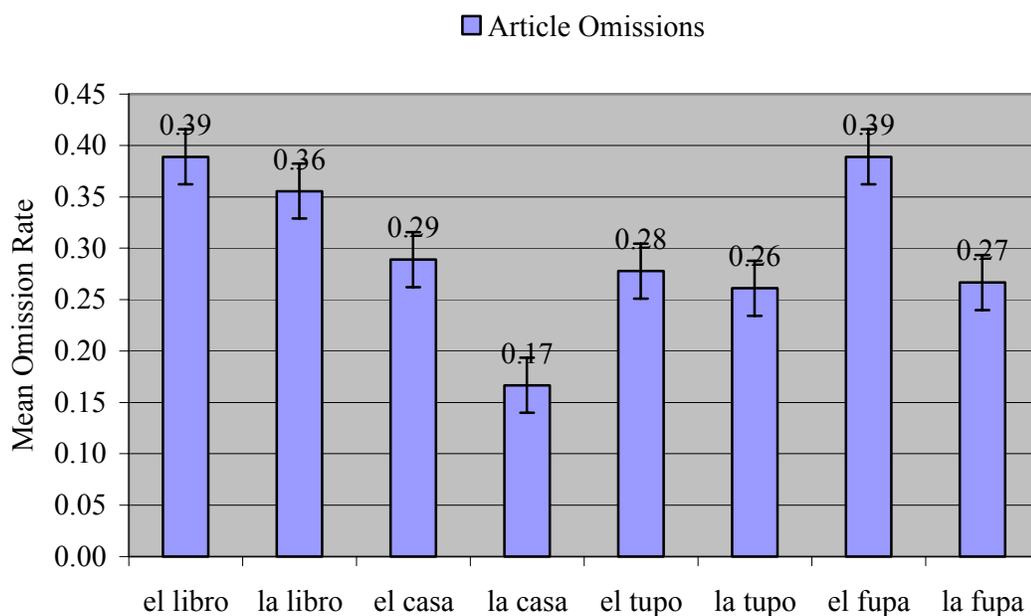Figure 4.6: Mean article omission rate for all eight conditions for a total of 15 children.

The results of the three-factor within-subjects ANOVA with the factors Lexical

Status (Word, NonWord), Stem (Masculine, Feminine) and Article (Masculine,

Feminine) showed a main effect of Article approaching significance ($F_{(1, 14)} = 3.90$,

$p < 0.07$) such that children omitted more masculine articles than feminine articles.

There was also a significant interaction between Lexical Status and Stem (F (1, 14) =

4.82, p < 0.05). For words, children omitted articles more frequently with masculine

stems than with feminine stems, whereas for non-words children omitted articles more

frequently with feminine stems than with masculine stems. The two-way interaction

between Stem and Article approached significance (F (1, 14) = 3.84, p< 0.08). Children

made fewer article omissions when the gender of the article was congruent with the

gender of the stem than when these cues were conflicting.

The significant two-way interaction of Lexical Status x Stem was then analyzed

by splitting across Stem and testing the simple effects of Lexical Status at each level of

Stem (Masculine, Feminine) with separate one-factor within-subjects ANOVAs with

Lexical Status (Word, Non-word) as the factor. The resulting means are displayed in

Figure 4.7.
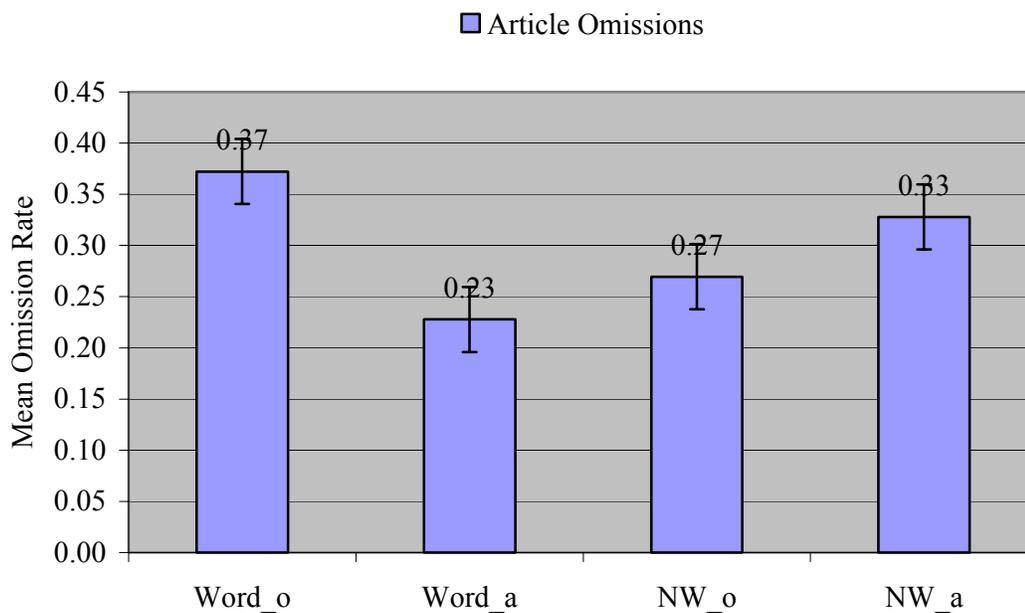
Figure 4.7: Mean article omission rate for masculine versus feminine stems for both words and non-words.

The ANOVA for masculine stems showed a significant effect of Lexical Status $(F (1, 14) = 6.46, p < 0.03)$ such that children omitted more articles with masculine stems for words than with masculine stems for non-words. The ANOVA for feminine stems, however, was not significant $(F (1, 14) = 2.63, p < 0.2)$. Children's rate of article omission was not shown to be significantly affected by whether the feminine stem was a real word or a non-word.

The two-way interaction between article and stem was also analyzed by splitting across stem and testing the simple effects of article at each level of Stem with Article (Masculine, Feminine) as the factor testing masculine and feminine stems separately. The resulting means collapsed across lexical status are shown in Figure 4.8.
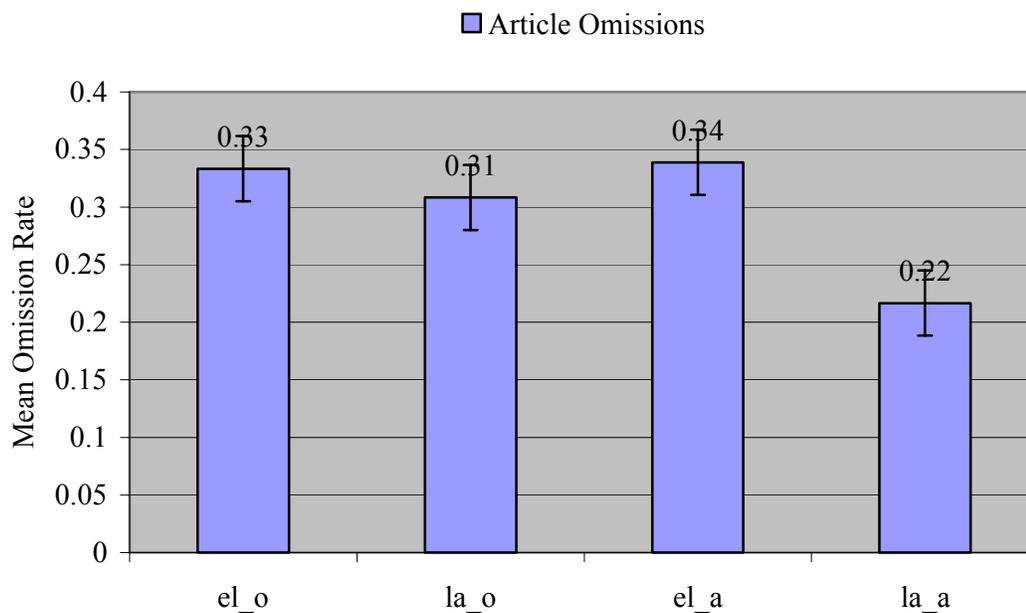
□ Article Omissions

Figure 4.8: Mean article omission rate for masculine and feminine articles, *el* and *la* respectively with either gender congruent (*el_o*, *la_a*) stems or gender incongruent stems (*el_a*, *la_o*).

4.3.5.1.3.1 Discussion

Table 4.8 shows the predictions for the three accounts of how children produce gender within the noun phrase. The findings from the analysis of article omissions that correspond to the predicted pattern of results are indicated with a check mark. Those findings that do not correspond to a specific prediction are starred.

Table 4.8: Pattern of results found for article omissions in relation to the predicted results for each hypothesis.

	Lexical Status	Congruity	Gender
Lemma-based	Main effect	Stem x Article x Lexical Status	No effect
Frame-based	Main effec	✔Stem x Article	No effect
Input-based	Main effect	✔Stem x Article	✔Main effect of Article ✔Feminine match better than masculine match ★Lexical Status x Stem

As with the data for article gender switches, the results of the article omission analysis suggest that morphophonologically regular input plays a role in the production of noun phrases. This is reflected in the fact that overall, children produce the most regular, phonetically-consistent determiner form displaying the most frequent syllable structure, *la ,*more often than they produce the more variable masculine determiner form, *el.* Additionally, children did not produce significantly fewer articles with non-words than with words, but rather the effect of lexical status was conditioned by the gender of the stem, specifically masculine stems. In fact, upon careful inspection of the pattern of results it becomes clear that it is children's asymmetrical performance on masculine versus feminine words that seems to drive the effect. This observation is verified by the fact that the only significant contrast shown between words and non-words was that of masculine stems. This suggests that retrieving a familiar lexical entry is only a significant advantage when it is accompanied by regularity; thus, despite the fact that masculine words are familiar items and thus should prove easier for children to produce

with the corresponding article relative to masculine non-words, the variability of the masculine morphological system produces an inhibitory effect relative to both unknown words carrying masculine morphophonology as well as feminine stems characterized by regularity and consistency.

The influence of morphophonological regularity on the organization and processing of both familiar lexical items and unfamiliar non-words is further observed in the follow-up analysis of the stem by article interaction. In this analysis, no gender congruency effect for masculine stems was found such that children's article omission rate was not overall significantly affected by the mismatch in gender between the article and stem (*la*_o) relative to the match condition (*el*_o). In fact, children's article omission rate was slightly higher when the masculine article was congruent with the gender of the stem (*el*_o) than when it was incongruent (*la*_o). This is true for both words and non-words. This result is contrary to what one would expect since the congruent conditions provide converging cues and thus should be easier to process and result in fewer article omissions than the incongruent conditions overall. However, these results can be accommodated within a processing model that exploits statistical properties of the input it receives in such a way that morphosyntactic regularities affect the organization of familiar lexical items and the processing and retrieval of such forms for production. Within such a model, masculine morphology is more difficult both to retrieve from the lexicon and to produce than is feminine morphology and lexical familiarity exerts differential effects accordingly-- inhibitory for masculine morphology but facilitatory for feminine morphology. This combination makes the congruent masculine conditions

overall more difficult than the masculine incongruent conditions where the presence of

the feminine article provides a processing advantage in regularity resulting in fewer

omissions relative to the masculine congruent conditions.

4.3.5.2 Analysis of production latencies

In this section the results of the analysis of production latencies will be presented.

As outlined in Section 4.3.4, naming latencies were measured from the end of the

stimulus to the onset of the child's utterance. In the interest of tapping online processing,

only those utterances where the stimulus was presented once followed by no more than

one intervening prompt by the researcher or the child's parent were measured and

included in the analysis. Successful elicitation of an utterance within the context of an

elicited imitation task usually necessitates presenting the stimulus at least twice (Gerken,

2000). This, in fact, was often the case in the child experiment as was re-focusing the

child's attention to the task. In order to include a child's data in the production latency

analysis, he/she first had to have produced a scoreable response in each condition for the

particular dependent variable in question (exact repetition, omission, switch). In

addition, at least one of the scoreable responses in each condition for a particular

dependent variable had to meet the above-mentioned criteria for number of stimulus

presentations and intervening prompts. It was therefore stipulated that at least half of a

child's responses meet these criteria for consideration of his/her data set in the analysis.

If a score was missing for more than one condition, the child's data were excluded from

the analysis. For children who were missing one score, row and column sums were used

to impute the value of the missing score. As a result of these constraints, the sample was

significantly reduced in size and data were available for two of the three dependent variables, exact repetitions and article omissions. The remaining data for each dependent variable were analyzed with a within-subjects, three-factor within-subjects Anova with Lexical Status (Word, Non-word), Stem (Masculine, Feminine) and Article (Masculine, Feminine) as the factors. The results for the analysis of exact repetitions and article omissions are presented in Section 4.3.5.2.1 and Section 4.3.5.2.2 respectively.

4.3.5.2.1 Exact repetitions

The total number of measurable responses coded as exact repetitions in each condition for each subject was used to calculate average production latencies for each child in each condition. As mentioned above, the data for a child were included in the analysis if a score was missing for no more than one condition. Seven children, 6 boys and 1 girl, were included in the analysis ranging in age from 28 to 48 months with an average age of 43 month. The means for all eight conditions are shown below in Figure 4.9. Spanish vocabulary scores for this group ranged from 72 to 675 words with an average score of 399 words. English vocabulary scores for this group ranged from 34 to 668 with an average of 452 words.

☐ Naming Times Exact Reps
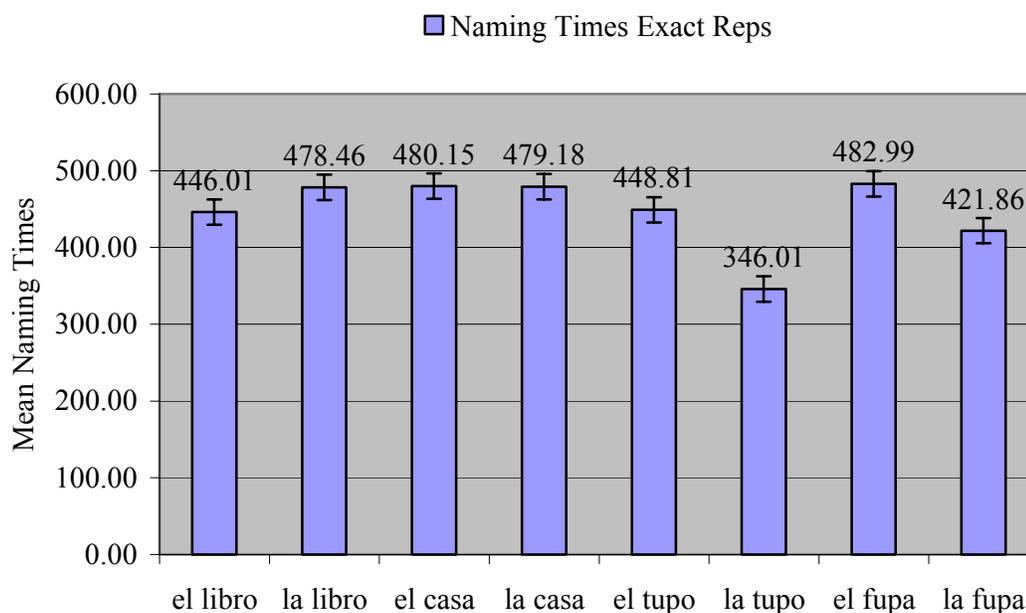
Figure 4.9: Mean naming times (in ms)for exact repetitions.

The ANOVA showed no significant results (F (1, 6), all p < 1.0). The main effect of

Lexical Status and Stem showed a trend towards a significant effect with Lexical Status

(F (1, 6) = 2.45, p < 0.17) and Stem (F (1, 6) = 2.27, p < 0.19). Children were overall

slower to produce articles with words than they were to produce articles with non-words.

With respect to stem gender, children were slightly slower to produce feminine stems

than they were to produce masculine stems.

4.3.5.2.2 Article omissions

The total number of measurable responses coded as an omission in each condition

for each subject was used to calculate average production latencies for each child in each

condition. As mentioned above, the data for a child was included in the analysis if the

child was missing a score for no more than one condition. Data for 3 children met this

criterion. There were 2 boys and 1 girl in this group ranging in age from 24 to 33 months

with a mean age of 27 months. Spanish vocabulary scores for this group ranged from 112

to 352 with an average score of 254. English vocabulary scores ranged from 180 to 426

with an average of 331 words. The resulting means for all eight conditions are shown

below in Figure 4.10.
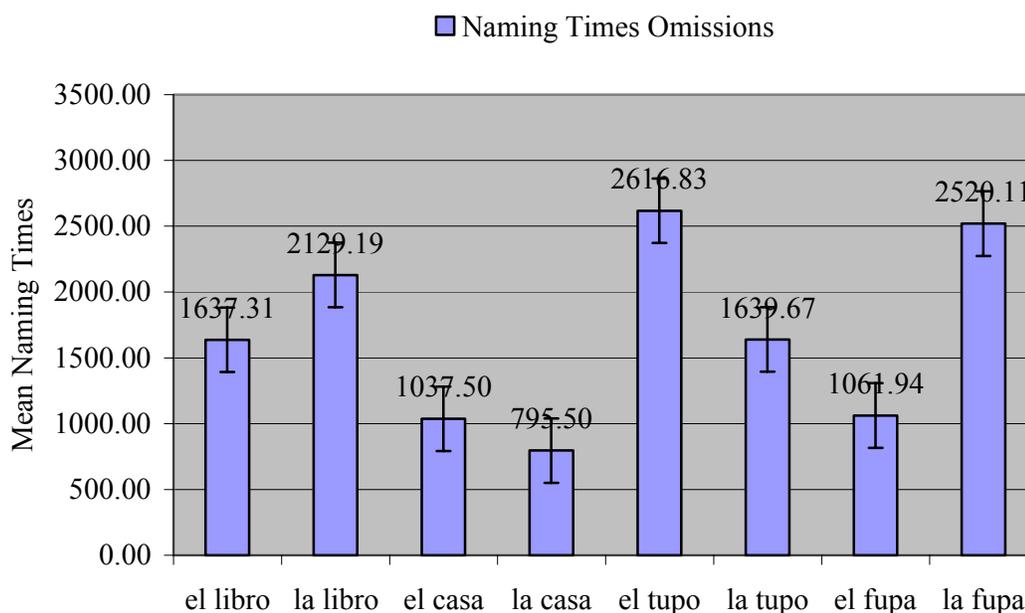
Figure 4.10: Mean production latencies (in ms) for article omissions.

The ANOVA showed a significant main effect of Stem (F (1, 2) = 545.62, p < 0.003).

Children overall were slower to produce masculine stems compared to feminine stems.

4.3.5.2.3 Discussion

The production latency data, though small in sample size, seem to complement

the results of both the article omissions analysis and the analysis of exact repetitions in

the accuracy analysis. Children overall are slightly faster to produce the article with

masculine stems than with feminine stems. Upon first glance, this finding suggests that

masculine morphology is more efficient than feminine morphology; however, recall that children made more exact repetitions of incongruent sequences beginning with the feminine determiner (la_o) than they did of incongruent sequences beginning with masculine determiners (el_a). In fact, the only significant contrast in the production analysis was for stems preceded by masculine articles such that children made significantly fewer exact repetitions of *el_a* than they did of *el_o.* In the naming latency analysis, children are faster to produce incongruent sequences preceded by the feminine determiner (la_o) than they are to produce incongruent sequences beginning with the masculine determiner (el_a). This is true for non-words but not for words. When the masculine stem is a real Spanish word in an incongruent sequence, it is produced as slowly as an incongruent sequence with a feminine word. In the absence of lexical familiarity, the feminine determiner appears to be the locus of the facilitation while the masculine determiner followed by a feminine stem proves more difficult to process as evidenced by slower naming times. In fact, children are by far the fastest in producing masculine non-words preceded by gender incongruous feminine determiners. Producing words appears to be costlier in terms of processing speed than producing non-words. This is somewhat surprising given that both familiarity and morphophonological regularity appear to affect accuracy in terms of article omission and repair rate in a facilitatory manner. Nevertheless, it does suggest that the system is affected by morphophonological patterns made readily observable by the lack of lexical familiarity. In the absence of an accessible lexical entry, the system uses morphophonological surface features alone and the data suggest that this strategy is more efficient if not more accurate

than retrieval of familiar lexical entries, especially those marked by masculine morphophonology.

The lack of variability shown in naming times for exact repetitions of words makes interpretation somewhat challenging; however, a clear pattern emerges for non-words that is worth noting in comparison to the naming latencies for article omissions as well as the patterns of accuracy shown in the production analysis. When children produced the article in an exact repetition of a non-word, they were faster in the feminine congruent condition (la fupa) than in the masculine congruent condition (el tupo). If the incongruent conditions are considered, we see that children not only produced more exact repetitions of incongruent sequences preceded by the feminine determiner (la tupo) than incongruent sequences preceded by the masculine determiner (el fupa), they also were faster to repeat sequences beginning with *la* than they were to repeat sequences beginning with *el*. Conversely, when children omitted the article in these conditions, they were slower to omit *la* than *el* and were likewise less likely to omit *la* when it was followed by a masculine stem than they were to omit *el* followed by a feminine stem. This is true for both words and non-words. In the accuracy analysis, children overall omit *el* more often than they omit *la* and naming times are overall slower when they omit *la* than when they omit *el*. This pattern was shown to be significantly affected by children's high omission rate with masculine words. In fact, when children omit the article, they are significantly slower overall in processing masculine stems.

These findings suggest that indeed processing speed as well as accuracy is influenced by morphophonological regularity and distributional patterns as is the

organization and retrieval of lexical items reflected in the differential effects shown for lexical status and gender in the data. When children produce an article with the stem, feminine morphophonology is more easily and efficiently processed than masculine morphophonology as evidenced by faster naming in conditions where a feminine article precedes the stem. The data suggest that the locus of the facilitatory effect is the phonological encoding of the gender of the article, especially in cases where there is no cue from lexical familiarity; however, in cases where children omit the feminine article it takes them longer to do so. It could be the case that activation levels throughout the system are modulated by connection strength where strength is defined by the regularity of morphophonological and distributional patterns across the gender system and that the organization of this network affects the speed and timing of retrieval and encoding processes. If this is the case we would expect to see evidence that masculine morphology on the stem also produces a slowdown in naming times and this is precisely what can be seen in the omission data. Children overall are slower when they omit the article with masculine stems than with feminine stems. This effect is most clearly observed in the difference in naming times for masculine versus feminine words. Children are an average of 967ms slower when they omit the article with masculine stems than they are when they omit the article with feminine stems. This finding suggests that the high rate of article omission noted in the accuracy data for masculine words not only reflects difficulty in lexical retrieval processes but that the relative ease or difficulty of the process is a function of activation strength as measured by the regularity of patterns across the morphophonology of the gender system.

As discussed in Section 2.1.2, feminine determiners in Spanish are characterized by overall higher frequency syllable structures than are the masculine determiners. This high frequency syllable structure coupled with the fact that the feminine determiner participates in more regular patterns than does the masculine determiner results in a facilitatory effect for production of *la* compared to *el*. It is also possible that the syllable frequency of stems contributes to observed differences in naming times. Recall from Chapter 1 that a syllable frequency effect is found in Spanish in both comprehension as well as production for both words and pseudowords. High frequency syllables in onset position result in faster naming times relative to low frequency syllables for native Spanish speakers (Alvarez, Carreiras and Taft, 2001; Carreiras and Perea, 2004). To consider the possibility that syllable frequency is responsible for the advantage evidenced for feminine morphology of the stem, the frequency of the first syllable in onset position for each experimental item was calculated as well as the syllable's total frequency of occurrence summed across positions. The frequency counts were taken from a syllable frequency dictionary created as a result of analysis of the production of native Spanish-speaking children between 4th and 6th grades (Justicia, Santiago, Palma, Huertas and Gutiérrez, 1996). Data for two syllables, one feminine non-word (chorga) and one masculine non-word (cherpo) were not available and thus excluded from the calculation of the averages seen in Table 4.9.

Table 4.9: Average syllable frequencies for masculine and feminine stems for both words and non-words. F1 = frequency of the syllable in word initial position. TF = Total frequency of the syllable summed across all possible positions.

Syllable Frequency					
Masculine	F1	TF	Feminine	F1	TF
Word_o	1592	3806	Word_a	2107	4261
NW_o	1070	2053	NW_a	514.6	1242
Average	1331	2930		1311	2752

As can be seen in Table 4.9 above, both the average frequency of the syllable in onset position as well as the average total syllable frequency for both masculine and feminine stems does not vary greatly. It does appear, however, that the masculine non-words were inadvertently biased with respect to the frequency of the initial syllable such that the average frequency for masculine stems is over twice that of the feminine stems for non-words. Upon the notion that higher frequency syllables in onset position facilitate naming for adult native speakers, we would expect children to make more exact repetitions and to be faster in conditions where the average frequency of the initial syllable of the stem is higher based on the premise that this should make processing easier as well as allow quicker access to the mental syllabary. Thus, children should be faster and produce more exact repetitions of masculine non-words than of feminine non-words. This appears to be the case with the incongruent conditions for non-words, since children are slower and produce fewer exact repetitions of *el fupa* than of *la tupo*; however, this pattern does not hold for the congruent conditions. While children produce

more exact repetitions of masculine stems preceded by masculine articles (*el tupo*), they are slower to do so relative to production of feminine stems preceded by feminine articles (*la fupa*). Additionally, children omit more articles with masculine words than feminine words and naming times are slower for masculine versus feminine stems overall. Based on these findings, phonology can be ruled out as the most adequate account for the pattern of results across the data, thus lending additional evidence that the results reflect the workings of the processing mechanism responsible for coordinating information for the production of gender agreement within the determiner phrase.

In the next chapter the child data will be compared to adult performance patterns. Before undertaking this comparison, the materials necessary for the supporting structure to bridge the gap between the two populations will be provided. The data presented in the next section do just that by determining the comparability of the data for children exposed to both Spanish and English to that of the monolingual Spanish-speaking population.

4.3.5.3 Analysis of MacArthur CDI Spanish vocabulary

In this section the results of a structural analysis of the Spanish-English bilingual child's Spanish lexicon based on the actual words produced by the children in the experiment are presented. Recall from Chapter 1 that a similar pattern is shown for monolingual Spanish-speaking adults and Spanish-speaking children with respect to the distribution of regular and irregular nouns across the gender system. The comparative analysis revealed that overall, there are slightly more masculine than feminine nouns in the Spanish lexicon with feminine regular nouns outnumbering masculine regular nouns

and masculine irregular nouns outnumbering feminine irregular nouns. The difference

between masculine regular and irregular nouns is negligible whereas the difference

between feminine regular and irregular nouns creates a significant gap. Table 1.2 from

Chapter 1 showing the results of the analysis of the nominal distributional patterns of the

nouns included on the MacArthur CDI Spanish vocabulary checklist norm-referenced for

monolingual Spanish-speaking children is reproduced here as Table 4.10.

Table 4.10: Distributional analysis of nouns included on the Spanish CDI.

	Masculine	Feminine	M-F Difference
Regular	101 (28%)	151 (41%)	-49
Irregular	83 (23%)	18 (5%)	64
R-I Difference	18	133	
Totals	184 (54%)	169 (46%)	15

Data for 17 of the 18 children who participated in the experiment were available for

analysis of the distributional patterns present in the Spanish nouns that this particular

group of children is reported to produce. The 17 children included in this analysis

produced a total of 3147 Spanish nouns. The distribution of regular and irregular nouns

across genders is shown in Table 4.11. The percentages are based on the total number of

nouns produced by the entire group.

Table 4.11: Distributional analysis of regular and irregular nouns across genders for the total number of Spanish nouns produced by 17 out of 18 children per parental report on CDI.

	Masculine	Feminine	M-F Difference
Regular	866 (27%)	1321 (42%)	-455
Irregular	749 (24%)	211 (7%)	538
R-I Difference	117	1110	
Totals	1615 (51%)	1532 (49%)	83

Comparison of the patterns shown for the bilingual children participating in the experiment with those of monolingual Spanish-speaking children revealed a very similar pattern of results. Interestingly, despite the varying degrees of difference between Spanish and English vocabulary size reported for the 17 bilingual children, the overall pattern shows that they are sensitive to grammatical gender and distributional patterns of the language in much the same way as monolingual children exposed to only Spanish as reflected in the nouns they produce. This last piece of evidence provides the structure to support comparison of the patterns shown in the child production data to that shown for the Spanish-speaking adults who participated in the experiment and by extension, to adult processing models in general. Before comparing the results of the child experiment with those of the adult experiment, the cumulative results of the child experiment will first be summarized and discussed in the next section.

4.3.6 General discussion

Table 4.12 summarizes the results of the analysis of child productions as well as

the findings from the analysis of child production latencies presented in previous

sections.

Table 4.12: Summary of results for the child experiment across all dependent measures
for each of the experimental manipulations. RT = Reaction Time.

Dependent Measure	Lexical Status	Congruity	Gender
Exact Repetitions		Stem x Article	
Article Repairs		Stem x Article	Lexical Status x Stem
Article Omissions		Stem x Article	Lexical Status x Stem Main effect of Article Feminine match better than masculine match
RT Exact Repetitions	Main effect--trend		Stem--trend
RT Omissions			Stem

The data suggest that when Spanish-speaking children produce an article that is an

exact repetition of the stimulus, meaning (i.e., a lexical entry) is not relevant. Rather, it

appears that the relevant information is extracted from the regularity of surface patterns

in the article/ stem sequence resulting in a productive advantage for feminine

morphosyntax of the article. Interestingly, when the cues to gender are concordant, the

expected advantage for feminine morphophonology is not visible. Children do appear to

have some sort of gendered frame for both masculine and feminine noun phrases;

however, the masculine frame appears to be weaker. The masculine determiner is both

difficult to say (because it does not conform to the dominant CV pattern) and does not

reliably predict the gender of the upcoming stem while the feminine article does.

Therefore, the masculine article/noun dependency relies on verification of gender via the

morphophonology of the stem; whereas, the feminine frame can be verified as soon as the

child hears the feminine article. Despite the fact that the exceptional pattern of agreement

shown in the sequence *el_a* is more frequent than that of the sequence *la_o*, children

nonetheless, repeat *la_o* more often than they do *el_a*. It therefore appears that the

developing production system weights regularity of structures higher than frequency of

structures.

When children encounter incongruous article/stem sequences, they both detect

and repair the apparent "violation" according to the most frequent distributional patterns

of the language, *el_o* for masculine and *la_a* for feminine respectively. In order to make

the repair, access to grammatical gender features specified with individual words is not

necessary; nevertheless, when they encounter familiar words, children attempt to retrieve

those representations stored in memory. The child system is less robust in nature than the

adult system and thus affects of morphosyntactic regularity across the gender system are

more readily observable. The data suggest that the child's ability to successfully produce

the corrected article/stem sequence is dependent upon characteristics of the gender

system whose patterns of morphosyntactic regularity affect organization of the system

and processing in such a way that subsequently results in processing ease that allows for

the realization of the article repair. The results suggest that regularity of patterns and

consistency of form are easier to process than are irregular patterns demonstrating greater

variability. The system appears to exploit these surface features to both retrieve and

produce familiar words as well as unknown nonsense words, thus lexical familiarity is only facilitatory when the lexical item conforms to regular morphophonological patterns. When it does not, the overall difficulty and complexity of retrieving variable masculine forms early in production planning results in an increase in article omissions as well as a decrease in article gender repairs.

The main effect of lexical status predicted by all three accounts was not shown across the data; however, the expected interplay of morphosyntactic regularity of feminine versus masculine gender and word and non-word production consistent with the input-based account was observed. Overall, children omit *la* less frequently than they omit *el,* corroborating the notion that feminine morphophonology is more regular, consistent across forms and thus easier to produce compared to masculine morphology. The high rate of omissions in the incongruent condition for feminine non-words (el_fupa) relative to the omission rate for feminine words (el_casa) can be accounted for in terms of familiarity and regularity. In the absence of familiarity, the system's use of available morphosyntactic cues and reliance on regularity becomes apparent. The system's inefficiency in organization and processing of the more variable, atypical forms of the masculine gender system results in article omission. A similar pattern is seen for masculine words. The variability of masculine morphophonology makes lexical retrieval more difficult for masculine words than for feminine words. Additionally, the masculine determiner is low in predictive power and is more difficult to produce than the feminine determiner. The lexical retrieval component appears to be responsible for the overall high rate of omissions for masculine words relative to masculine non-words while the

strength of the feminine determiner in terms of regularity decreases the size of the gap between masculine congruent and incongruent conditions for both words and non-words.

Interestingly, article omission rate and article gender switch rate are influenced in a similar manner suggesting that the patterns of child response reflect the workings of one underlying processing mechanism. In fact, there is a curious interplay between switch rate and omission rate. An increase in article omission necessarily results in fewer opportunities for switching the gender of the article and conversely, high rates of article gender switching will result in a lower article omission rate. It is highly informative to observe the principles that govern the trade-off patterns. For example, children omit the masculine determiner with feminine non-words with greater frequency than they do with feminine words. When they produce the masculine article in these conditions, however, they do so with a similar frequency, 55% and 50% respectively. The differential treatment of feminine words and feminine non-words is clarified in the patterns of article gender switches. While children omit the masculine article with feminine non-words, they switch the gender of the article with feminine words. With masculine real words, children omit the article more often in the incongruent condition *la_o* than they do with masculine non-words; thus, they are shown to repair the gender of the article with greater frequency with masculine non-words than with masculine words. This pattern fits well with a processing account of determiner phrase production that provides for the influence of language-specific morphosyntactic statistical co-occurrence patterns found in the input the child receives. The relative variability or regularity of these patterns affects processing in such a way that difficulty in processing increases as a function of increasing

morphosyntactic variability which in turn decreases the available resources for processing

at other stages throughout the system as evidenced by the differential pattern of results

found, in particular, across the article omissions and article gender switches.

Organization and processing of morphophonological regularities found across genders is

much easier than is organization and processing of patterns that do not display such

features. Feminine morphophonological patterns quickly activate their corresponding

features while masculine patterns are weaker and potentially more slowly activated. The

results of the naming latency analyses corroborate this notion as evidenced by the fact

that children are overall slower when they omit *la* than they are when they omit *el*;

whereas, in cases where they produce *la* they are faster than when they produce *el*. This

is true even in cases where the morphophonological features of the stem do not match the

gender of the feminine determiner. It could be the case that feminine features are more

efficiently activated in the lexicon as a result of similarity and regularity of features

shared across items, while the variability of features shared across masculine items makes

activation and retrieval processes more difficult and less efficient resulting in slower

naming times than items marked with feminine morphology. Processing speed is also

shown be slower for masculine words than for feminine words when the article is omitted

and children omit more articles with masculine words than they do with feminine words.

The overall pattern of results for the child data substantiate the hypothesis that

young Spanish-speaking children produce noun phrases in a manner that reflects the use

of input statistics, specifically, the ease of accessing and retrieving morphophonologically

regular feminine forms that engage in predictable regular distributional patterns and the

relative difficulty of accessing and retrieving morphophonologically variable masculine forms that participate in fewer predictable regular distributional patterns. Indeed, it appears that input statistics such as morphosyntactic regularity permeate the entire system, affecting organization and retrieval of both familiar words the child knows as well as production of unfamiliar nonsense words.

Processing speed and efficiency appear to be affected by the interaction of both familiarity and morphophonological regularity; however, before reaching any definitive conclusions with respect to the developmental nature of the processing model that appears to be in effect for the children in this experiment, the results of the child data will be compared with those found in the adult experiment. The ways in which the patterns of results differ is equally as informative as the ways in which they are similar and the combined results from both populations will provide a more complete picture of the workings of gender agreement within the noun phrase for production. In Chapter 5 the results for both children and adults are compared and the implications for a developmental production processing model are discussed within the framework of adult processing models as well as previous findings in the domain of grammatical gender processing.

CHAPTER 5   GENERAL DISCUSSION AND CONCLUSIONS

The goal of this dissertation was to provide evidence for a developmental

processing account of young Spanish-speaking children's production of gender

agreement within the noun phrase. Chapter 3 described the results of the experiment with

Spanish-speaking adults and Chapter 4 followed with the patterns shown for Spanish-

speaking children tested within the same paradigm. In order to complete the construction

of a bridge spanning the gap between performance patterns shown for these populations,

adult and child data must meet. In this chapter the building materials gathered in these

two experiments will be brought together to form a complete structure providing

evidence for a developmental processing model. Section 5.1 thus compares and discusses

the overall pattern of results for both children and adults. Section 5.2 attempts to situate

the bridge within the broader theoretical landscape, revisiting the question of gender

processing within adult production models and Section 5.3 follows with a discussion of

the potential implications of the findings reported in this dissertation in terms of the

broader issues of developmental processing models, bilingualism, language impairment

as well as adult processing and production of grammatical gender.

5.1 Comparison of adult and child data

Establishing a developmental processing account of Spanish-speaking children's

noun phrase production requires evaluating the form of the child utterance with respect to

that of the adult speaker, making a reasonable assumption that the child system is less

robust than the adult system and thus operates with less efficiency than does the adult

system. Where both child and adult speech demonstrate similar patterns, we can imply

that a similar architecture is in place. Where child speech differs from the child's own

demonstrated comprehension as well as from adult speech, developmental processing

structures are implied. The most frequently-occurring structures in a language are not

necessarily the easiest in terms of complexity and ease of processing; thus, strong

corroborating evidence for a processing account is also shown when the form of the child

utterance differs with respect to the distribution or frequency of structures across the

language. Table 5.1 provides a summary of the results for child productions, child

naming latencies as well as adult naming latencies.

Table 5.1: Summary of results for both child and adult experiments for all three
experimental manipulations. RT = Reaction Time. The child RT data for Exact
Repetitions and Omissions represent a small sample size and thus are shown below in
gray.

Dependent Measure	Lexical Status	Congruity	Gender
Exact Repetitions		Stem x Article	
Article Repairs		Stem x Article	Lexical Status x Stem
Article Omissions		Stem x Article	Lexical Status x Stem Main effect of Article Feminine match better than masculine match
RT Exact Repetitions	Main effect--trend		Stem—trend
RT Omissions			Stem
RT Adults	Main effect	Stem x Article	Stem Feminine match better than masculine match

In the following sections child processing patterns observed in Experiment 2 will

be compared to those shown for adults in Experiment 1. Section 5.1.1 focuses on the

effects of lexical status, congruity and gender on processing speed. Conclusions drawn from the child naming latency data are tentative given the small sample size and the somewhat unstable nature of child naming times in general; however, they do offer some interesting insight and thus will be considered in the discussion. First, the naming latency data for child exact repetitions will be compared to that of the adults, given that these data reflect processing speed for article production for both children and adults. The results of the naming latency data for child article omissions are then compared to the adult naming times. Lexical status, congruity and gender manipulations not only influence child processing speed but also child accuracy in noun phrase production. Section 5.1.2, therefore discusses the comparability of child and adult data with respect to child production accuracy as it is in this domain that child performance most closely parallels that of adult performance.

5.1.1 Production latency data

5.1.1.1 Exact repetitions

Lexical status is posited to exert a facilitatory effect on all accounts of noun phrase production as a function of retrieving familiar entries stored in memory. This notion is supported by the finding that adults are overall slower to produce sequences with non-words than with words. When children produce an article, however, they are overall slower to produce sequences with words than with non-words. This finding suggests that coordinating an article with a word is more costly in processing speed than producing an article with a non-word, perhaps due to the fact that retrieval processes are still under development. Oddly, no clear effect of congruency is identifiable in the

naming latency patterns for words in exact repetitions. It could be the case that when children produce the article with a familiar word, the overall complexity of the task renders any potential distinguishing effects such as morphophonology undetectable.

While the difficulty of retrieving lexical entries and coordinating them with an article for production results in very little variability in naming times across conditions for words in the child exact repetition data, some interesting patterns emerge in the results shown for non-words in comparison to the adult naming times for non-words. For example, when children produce an article with a non-word, they are slower in the masculine congruent condition (el tupo) than in the feminine congruent condition (la fupa). Adults are also slightly slower in masculine congruent versus feminine congruent conditions and this difference is even greater for naming times for masculine versus feminine words. With respect to non-word production in incongruent sequences, children and adults demonstrate opposite patterns. While children are faster to produce incongruent sequences with the feminine article (la_o) than they are to produce incongruent sequences beginning with the masculine determiner (el_a), adults display the opposite pattern. As discussed in Section 3.4.7, this pattern for adults can be accounted for by considering the frequency of distributional patterns as well as the relative strength or weakness of morphophonological patterns as a function of regularity across forms within the nominal gender system. Despite the fact that *el_a* is the most frequently occurring exceptional agreement pattern, children, nevertheless take longer to produce *el_a* than when they produce the less frequent pattern *la_o*. Either *el* is more difficult to retrieve than *la* or more difficult to produce or both. The effect of article gender on

utterance onset time is clearer in the child data than in the adult data, but the effect, though perhaps more subtle in nature can be observed in the longer naming times for masculine versus feminine congruent conditions in the adult data. It is also possible, however, that this difference is due to the morphophonology of the stem. Adults show a very definitive effect of the morphophonology of the stem with significantly slower naming of masculine versus feminine stems respectively. Oddly, children are slightly slower to produce exact repetitions containing a feminine stem than they are to repeat sequences with masculine stems. This pattern reversal could be in part due to the small sample size and instability of child naming times as well as the distinct speed advantage children demonstrate in the masculine incongruent sequences for non-words (la_o) as a function of morphophonological regularity of the feminine determiner.

5.1.1.2 Article omissions

The possible contribution of the feminine article to the facilitatory effect of masculine stems on naming latencies for exact repetitions is supported by the naming latency data for article omissions. When children omit an article with a word, the pattern shown for exact repetitions is reversed, with children overall slower to produce masculine stems compared to feminine stems. This finding is consistent with the fact that adults are slower to produce masculine stems than they are to produce feminine stems. In addition, the expected effect of lexical familiarity that was not shown in the naming latencies for exact repetitions resurfaces in the naming latencies for article omissions. As with the adults, children are faster to produce words than non-words when they omit the article. Note that lexical familiarity results in an increase in processing speed in an asymmetrical

pattern across words and non-words, but morphophonological regularity or lack thereof, affects processing patterns across the board for both words and non-words.

In summary, the differential patterns shown across child naming latencies for exact repetitions and article omissions appear to reflect the independent contribution of article gender and stem morphophonology. When children are able to coordinate articles with stems, the combined complexity of the task of lexical retrieval and article retrieval processes results in an overall decrease in processing speed relative to non-words. It is perhaps the increased level of complexity that obscures any distinguishable pattern for the production of words relative to non-words. Omitting the article, on the other hand, reduces complexity in such a way as to allow for the observed effects of lexical familiarity as well as stem morphophonology that are not visible when children produce the article. If omitting the article does in fact decrease complexity and consequently increase processing efficiency as appears to be the case, it is feasible that it is this increase in processing efficiency that makes the child article omission data more comparable to the adult data for both naming latencies as well as production accuracy. Indeed, the results of the child article omission rate analysis are most consistent with the patterns shown in the adult naming latency data.

5.1.2 Accuracy data

5.1.2.1 Article omissions

As discussed in the previous section, child naming latencies for article omissions demonstrate a pattern similar to that shown for adult naming latencies. The naming latency data for omissions along with the pattern of results shown in the analysis of

children's article omissions most closely resemble the patterns shown in the adult naming latencies. In order to assess the relationship between the patterns shown in the adult naming latency data and those demonstrated in the child omission rate data, the group item means for both sets of data were converted to z-scores as shown in Figure 5.1.
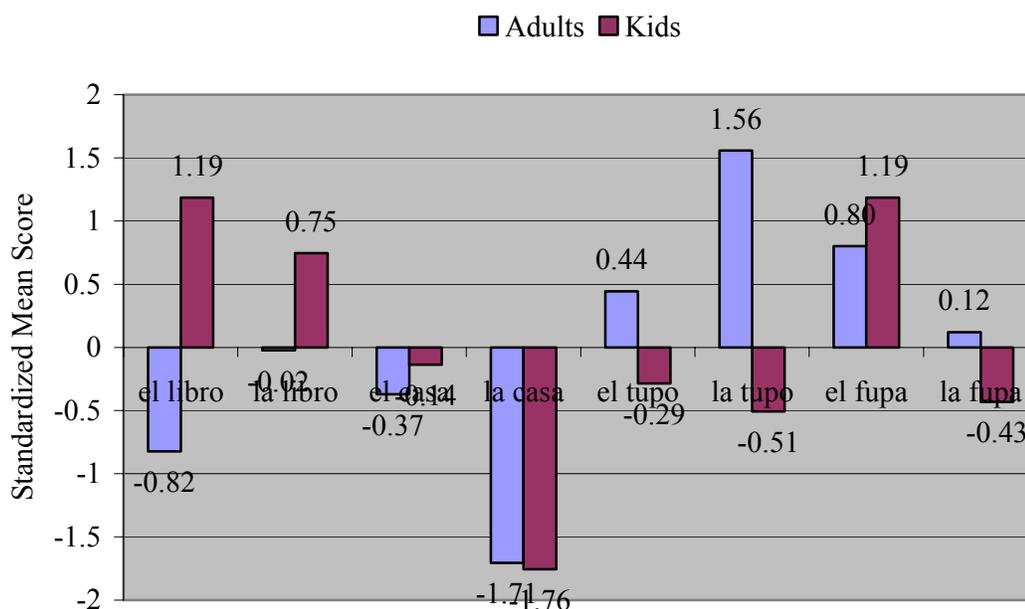
Figure5.1: Standardized means for adult naming times and child article omission rate for all eight experimental conditions.

A Pearson correlation addressed the relationship between the adult data ($M = 377.40$, $SD = 65.15$) and the child omission rate data ($M = .29$, $SD = 0.07$). For an alpha level of .05, the correlation between the child and adult data was found not to be statistically significant, r (6) = 0.29, p < .20 (two-tailed).

As can be observed in Figure 5.1, it appears that the non-significant correlation is driven by the difference in performance for adults in children on masculine stems. Where adult and child response patterns diverge seems to reflect developmental aspects

in child processing; thus, the relationship between adult and child performance on masculine versus feminine stems was assessed using separate Pearson correlations. First, the relationship between adult naming latencies for masculine stems ($M = 369.19$, $SD = 64.80$) and child omission rate for masculine stems ($M = .32$, $SD = 0.06$) was evaluated. For an alpha level of .05, a negative correlation approaching significance was found r (2) $= -0.92$, p $< .10$ (two-tailed). This indicates that the patterns shown in the child and adult data for masculine stems are negatively related and suggests that the source of the non-significant overall correlation is in fact the differential performance patterns shown for adults and children on masculine congruent words and masculine incongruent non-words. Using a Pearson correlation, the relationship between adult naming latencies for feminine stems ($M = 358.61$, $SD = 69.03$) and child omission rate for feminine stems ($M = .28$, $SD = 0.09$) was ascertained. For an alpha level of .05, a positive correlation approaching significance was shown r (2) $= 0.94$, p $< .10$ (two-tailed).

A facilitatory effect of congruency can be observed for both adults and children with feminine stems; however, the divergent patterns shown for adults and children on masculine congruent words and masculine incongruent non-words suggest the development of processing strategies. Overall, children omit fewer articles in the feminine congruent condition (la_a) than in the feminine incongruent condition (el_a) and adults are likewise faster in the congruent versus incongruent feminine conditions. With masculine stems, however, differential effects emerge between the groups with children demonstrating slightly greater accuracy in the incongruent condition (la_o) relative to the congruent condition (el_o) and adults showing the expected congruency

effect evidenced by a slowdown in naming times for the incongruent condition (la_o) compared to the congruent condition (el_o). This pattern mirrors the above-mentioned patterns shown in the child production latency data for exact repetitions showing that children are not only slightly more accurate in the masculine incongruent condition with the preceding feminine determiner but are also faster relative to the masculine congruent condition. The strength and reliability of the feminine determiner for children is also observed in the production latencies for omissions where children are slower when they omit *la* with masculine words than they are when they omit *el* with masculine words.

For children, it seems clear that congruency in terms of converging syntactic and morphophonological cues to gender present in the determiner/stem sequence is affected by the regularity of feminine versus masculine morphosyntax in the noun phrase, specifically with respect to the determiner. However, the advantage of feminine morphophonological patterns is not constrained to the determiner nor does it appear to be specific to a developmental pattern shown only for children. This is evidenced by the fact that children omit fewer articles in feminine congruent sequences compared to masculine congruent sequences and that adults are faster to produce feminine congruent sequences relative to masculine congruent sequences. In fact, the apparent processing disadvantage for masculine morphophonology is reflected in overall slower production of masculine versus feminine stems. Strikingly, this is true for both children and adults and the pattern holds for both words and non-words. Not only does children's speed suffer on masculine stems relative to feminine stems, but their accuracy does as well. This pattern, however, is conditioned by lexical status such that children omit articles more frequently

with masculine words than non-words. With feminine stems, however, children omit the article equally as often for words and non-words. The asymmetrical effects shown for lexical status in the child article omission data are more global in nature for the adults as evidenced by overall faster naming times for words versus non-words.

The fact that similar patterns are shown for performance on stems marked with masculine morphophonology for both words and non-words for adults and that this pattern is similar for children suggests that the affect of morphophonological regularity across the gender system in noun phrase production is not merely a developmental phenomenon but characterizes the adult production system as well. The finding that this pattern is dependent upon lexical status for children provides evidence for a developmental aspect of processing related to differential storage and retrieval of lexical items across the gender system. Within the adult system, lexical familiarity results in an increase in processing speed; however, the facilitatory effect appears to be constrained to speed as it does not diminish the effects of morphophonological regularity of gender features shown in the similar patterns evidenced for both words and non-words. Masculine morphology is more costly in processing speed than is feminine morphology overall and this is true for both Spanish-speaking adults and children. The adult system is able to compensate for the variability of the masculine gender system when producing words that correspond to actual entries in the speaker's lexicon that have been well-practiced as evidenced by the overall increase in speed for producing words versus non-words. Children, on the other hand, are unable to sufficiently compensate for the difficulty and variability of the masculine gender system if they must additionally retrieve

a lexical entry from memory. Lexical familiarity in the initial stages is only an advantage

when familiar lexical items demonstrate morphophonological regularity. It thus appears

that children's development of lexical retrieval abilities is facilitated by the regularity and

consistency of patterns across the feminine gender system; nonetheless, just as with the

adults, access and retrieval of lexico-syntactic information stored with words is not the

necessary and sufficient condition for successfully producing a gendered article for

production with a gender-marked stem. This conclusion is further bolstered by the

patterns shown in the child article gender switches.

5.1.2.2 Article gender repairs

Children demonstrate remarkable accuracy overall producing very few errors in

article gender consistent with findings with respect to the morphosyntactic development

of young Spanish-speaking monolingual children (Hernández-Pina, 1984; López-Ornat,

1997; Mariscal, 2009). In fact, children make far fewer errors in article gender than they

do repairs of article gender. The patterns that emerge from their article gender repairs

mirror those found for their article omissions with respect to the interaction of lexical

status and stem gender. As was noted in the article omission data, the affect of lexical

familiarity on children's ability to repair the gender of the article is modulated by the

morphophonological patterns that demonstrate regularity and consistency of form. As

was the case with the adults, masculine morphophonology proves overall more difficult

for children; however, this effect is not localized to the stem as is the case with adults, but

rather affects processing of both the article and the stem in a manner that results in a

trade-off between article omission and article repair rate. This trade-off pattern is

governed by the relative efficiency or difficulty in processing which is affected by the regularity or variability of morphophonological patterns. Children repair the gender of the article more frequently with feminine words than with masculine words while with non-words, children make more article repairs with masculine stems than with feminine stems. Again, lexical familiarity is only advantageous when feminine morphophonology is involved. The additive facilitative effects of lexical familiarity and regularity in these cases counteract the difficulty of encountering the masculine determiner in the incongruent condition (el casa) enabling the switch to repair the gender of the article. Lexical familiarity with masculine words, however, works in the opposite direction such that having to locate an actual entry in the lexicon that is in addition marked with variable less predictable morphophonology makes processing more difficult and less efficient. Children compensate in these cases by omitting the article and thus fewer opportunities for switching are observed. In the absence of lexical familiarity, the combined effects of morphophonological regularity on the article and stem become evident. Children demonstrate a clear preference for the feminine determiner across the data set and it appears to be the case that encountering feminine morphophonology on the determiner increases processing efficiency in such a way that even when the following stem is incongruent, children are able to make more exact repetitions of the sequence resulting in fewer omissions compared to incongruent sequences beginning with the masculine determiner. Additionally, children are faster to produce sequences beginning with *la* than they are to produce sequences beginning with *el* overall. It is this apparent processing advantage coupled with the disadvantage of the masculine determiner that accounts for

the reversal in article gender repairs for non-words. Children consequently repair the gender of the article more frequently with masculine non-words than with feminine non-words.

5.1.3 Summary of findings

The findings across both experiments are most consistent with the input-based account of noun phrase production. As predicted on this account, the data for both Spanish-speaking children and adults provide evidence that morphophonological regularity across the gender system influences speed and efficiency of processing involved in the production of noun phrases in Spanish. This is shown in increased naming times for masculine morphology versus feminine morphology for adult speakers. In addition to speed and efficiency, morphophonological regularity affects accuracy and efficiency of the less robust child system whose organization and workings are still undergoing development. Lexical status is an advantage for both adults and children; however, the pattern of results cannot fully be accounted for on a strictly lemma-based account. Likewise, the fact that morphophonological regularities across the gender system affect the pattern of results for both words and non-words for children and adults rules out a strictly frame-based account. With adults, the advantage of lexical status is in overall speed and processing efficiency; however, across the board adults are slower on masculine morphophonology than feminine morphophonology. Children are also sensitive to morphophonological patterns and it is the relative regularity or variability in patterns that appear to dictate ease and efficiency of processing when encountering both words and non-words. Children's difficulty with masculine words relative to both

feminine words and masculine non-words seems to reflect the development of lexical

retrieval processes and suggests that these processes are governed by

morphophonological regularity as shown in the adult data. Additional evidence for a

developmental processing model is found in the comparative analysis of gender

congruency effects in the child versus the adult data. Adults demonstrate sensitivity to

the frequency and regularity of co-ocurrence patterns in the Spanish language producing

the more frequent exceptional agreement pattern *el_a* with greater speed than *la_o*. We

would thus expect similar patterns to be shown in the child data; however, the opposite

pattern emerges. Children are much quicker to omit the masculine determiner than they

are the feminine determiner, even in incongruent conditions. This pattern of results

corroborates the notion that morphophonological patterns permeate the processing

system, and that the more variable masculine versus feminine morphophonology results

in processing difficulties. Additionally, the findings suggest that in the initial stages of

development the determiner is an important cue to gender for productivity as well as stem

morphophonology. Coordinating determiners and stems is a complex task for the

Spanish-speaking child's system and the efficiency of the system is a function of the

asymmetrical patterns of regularity found across the feminine and masculine gender

systems. For both children and adults, it is the morphophonological patterns of the

system that govern patterns of noun phrase production and not lexical status. This is

further supported by the fact that children repair the gender of the article for both non-

words and words. If determiner retrieval and access to grammatical gender were

dependent upon accessing lexical entries, this should not be the case. It thus seems

necessary to revisit the question of where gender is stored and how it is accessed and retrieved for noun phrase production. The implications of these findings will be discussed in the next section within the context of adult models of production as well as findings from gender processing research.

5.2 Where is gender now?

The controversy within the domain of gender processing has centered around three major issues: (1) the variable contribution of phonological and syntactic information in the production of gendered noun phrases, (2) the distinction between the processing of closed-class and open-class elements and by extension (3) the distinction between gender selection and determiner selection processes. The majority of the research in this area has been conducted within the picture-word interference paradigm. Recall from Chapters 2 and 3 that within this paradigm subjects name pictures with auditory or written distractor nouns whose presentation is titrated with respect to the presentation of the target picture. Distractor nouns are typically either congruent or incongruent with the pictured noun's gender. A congruency effect has been demonstrated for speakers of Dutch and German such that subjects are significantly faster to name pictures when the gender features of the noun and the distractor are congruent compared to naming times with incongruent distractors (Schriefers, 1993; Schriefers and Teruel, 2000). This effect has been shown to disappear when subjects name pictures with bare nouns compared to when determiners are required (LaHeij, Mak, Sander, and Willeboordse, 1998). The gender congruency effect is said to reflect competitive processes in gender selection during lexical retrieval of the target noun. The results

across languages, however, have challenged this interpretation. For example, no gender

congruency effects have been demonstrated for Spanish, Italian, French and Catalan

within the same paradigm for either bare noun naming or determiner phrase production

(Costa, Sebastián-Gallés and Caramazza, 1999; Miozzo, Costa and Caramazza, 2002;

O'Rourke, 2007). Given that phonology plays a role in the selection of the determiner

form to variable degrees, the lack of a gender congruency effect in these languages has

been interpreted as a reflection of time course differences in gender selection and

determiner selection processes. Determiner selection in Romance languages is posited to

occur later than in Germanic languages (Miozzo and Caramazza, 1999). When

determiners are used as distractors rather than nouns, the congruency effect reappears and

is shown for speakers of Spanish, French and German. Based on these findings, the

nature of the gender congruency effect has undergone revision, invoking the distinction

between closed-class and open-class vocabulary proposed within the speech error model

of adult production. Determiner features are said to either facilitate naming times or

produce a slowdown by means of activation levels. When determiner features are

congruent with the to-be-named picture's determiner features, access and selection of the

noun's gender during lexical retrieval processes is facilitated. In cases where the

determiner features are incongruent with the target noun's determiner features, the

selection of gender features of the target noun are not primed and naming times are

slower (Alario, Ayora, Costa and Melinger, 2008). These findings seem to corroborate

the notion that closed-class elements such as determiners and inflectional elements are

features of syntactic frames that are thus indirectly selected as an automatic byproduct of

lexical selection processes, specifically access and retrieval of the noun's lemma representation. If this is exclusively the case, determiner selection and noun phrase production should be dependent upon processes of lexical retrieval and grammatical information stored with lemma representations and results across languages should conform to this basic pattern. However, even when a gender congruency effect is shown across Romance and Germanic languages, subtle differences in the pattern of results for Germanic relative to Romance languages are noted (Alario, Ayora, Costa and Melinger, 2008). Additionally, it is unclear why a differential pattern is shown across languages when noun distractors are used compared to results with determiner distractors.

There is evidence, however, to suggest the possibility that predictable distributional patterns across the gender system as well as regular morphophonological surface features could play a role in noun phrase production and thus potentially account for discrepant results across languages. Adult Spanish speakers have been shown to demonstrate sensitivity to the gender of determiners and to use such features in predicting the gender of the upcoming noun (Wicha, Bates, Moreno and Kutas, 2003). When the determiner presented is incongruent with the upcoming noun's gender processing is disrupted significantly more than when both determiner and noun are congruent. In gender priming studies, subjects are faster to name the pictured noun when a gender congruent article is presented just prior to the picture compared to when a gender incongruous article is presented (Bentrovato, Devescovi, D'Amico and Bates, 1999; Jescheniak, 1999). Note that within the picture-word interference paradigm, subjects name pictures that correspond to existing words in the language. When both adults and

children are exposed to auditory sequences from a language they do not know, both populations have been shown to utilize the surface cues available in gender and case-marking features to learn a gender paradigm (Gerken, Wilson and Lewis, 2005; Richardson, Harris, Plante and Gerken, 2006). Their success in doing so is dependent upon the number of converging surface cues provided in the stimulus consistent with findings from the gender priming studies referenced above. Based on this evidence, lexical status, congruity and gender were manipulated in the current experiment to ascertain the degree to which a child's production of gender in the noun phrase is affected by these factors.

The purpose of Experiment 2 with Spanish-speaking children was to establish the developmental nature of gender production and thus Experiment 1 with Spanish-speaking adults provided the basis for comparison of child and adult performance patterns. This experiment addressed the question of whether grammatical gender for adult Spanish speakers is exclusively stored and necessarily accessed via retrieval of individual lexical items or whether grammatical gender can be produced using the morphophonological regularity of surface features thereby bypassing access of gender features proposed to be stored with words. In order to assess both possibilities, lexical status, congruity and gender were manipulated within an elicited imitation paradigm in which Spanish-speaking adults repeated simple determiner-stem sequences with masculine and feminine words and non-words that were either gender congruent or gender incongruent with the preceding determiner. The results challenge previous findings that gender is stored and accessed via lemma-level representations. The evidence suggests that the contribution of

lexical status for adult Spanish-speakers is primarily that of processing speed. Spanish-speaking adults are overall faster to produce determiner-stem sequences with words than they are with non-words; however, they are also overall faster to produce masculine versus feminine stems and this is true for both words and non-words. Converging cues result in an overall advantage relative to the conflicting cues of incongruent sequences, consistent with the findings from picture-word interference studies where determiners are distractors as well as determiner gender priming studies (Alario, Ayora, Costa and Melinger, 2008; Bentrovato, Devescovi, D'Amico and Bates, 1999; Jescheniak, 1999). However, in addition to a gender congruency effect shown for incongruent versus congruent sequences overall, adults in the current study were shown to be faster in feminine congruent versus masculine congruent conditions and importantly, this is true for both words and non-words. The asymmetrical effects for feminine versus masculine morphology cannot be attributed to either lexical frequency or syllable frequency of onset and are present for both adults and children alike.

There are, however, some important methodological differences that could have allowed for the observation of morphophonological effects that have not been noted in previous research, in particular within the picture-word interference paradigm. The elicited imitation task is a commonly-used methodology for assessing children's language development; however, it is rarely used with adults. The elicited imitation task differs in important ways from the picture-word interference paradigm that is traditionally implemented in gender processing studies with adults. One basic difference is that in the picture-word interference task adults name pictures while in the elicited imitation task

implemented in this study, children and adults repeated an auditory stimulus presented

without a visual cue to the semantics of the target stimulus. Both tasks necessarily

involve a certain degree of overlap in comprehension and production processes. In the

picture-word interference task auditory or visual distractor words are presented in

combination with pictures. Differences in processing a visual versus an auditory stimulus

could contribute to different patterns of results found across studies and languages for the

gender congruency effect, especially with respect to the detection of phonological effects

(Alario, Ayora, Costa and Melinger, 2008; Jescheniak, Schriefers, Hantsch, 2001).

Picture naming is said to necessarily proceed via access to conceptual representations

which precedes retrieval of lexical representations (Kroll and Tokowicz, 2001). The

elicited imitation paradigm, however, involves a greater overlap in comprehension and

production processes. Subjects do not have the advantage of a visual cue to semantic

representations and must map the auditory signal onto lexical representations via

phonological processes for recognition and access to proceed. It could be the case that

the findings of both experiments are partially the result of the overlap of these processes.

In spoken word recognition, there is evidence for some degree of temporal overlap in

phonological and syntactic processes (Rodriguez-Fornells, Schmitt, Kutas and Münte,

2002) and distractor words invoke phonological effects in the picture-word interference

paradigm. Taken together, these findings provide evidence for the notion that an auditory

stimulus activates corresponding morphemes in the production lexicon (Levelt, Roelofs

and Meyer, 1999). While this could be the case or at least a component in accounting for

the effects of morphophonology observed in the present experiments, it is important to

note that the effects shown with both adult and child Spanish-speakers cannot be accounted for solely on the basis of phonology or lexical frequency, but rather demonstrate an overall sensitivity to distributional patterns and the regularity of the morphophonological features specific to the Spanish gender system. Nevertheless, it might be possible to rule out effects that could be due strictly to phonological processes by testing adults and children on plural noun phrases rather than singular noun phrases as was done in the experiments reported here. In Spanish, the form differences between masculine and feminine definite singular determiners are neutralized in the plural. Additionally, the surface regularity of the co-occurrence patterns between typical masculine and feminine nouns and their respective plural determiners is equalized as can be seen in Example 6.

(6) a. el$_{masc, singl}$ libro$_{masc, singl}$ → los$_{masc, pl}$ libros$_{masc, pl}$

   the   book   → the   books

   b. la$_{fem, singl}$ casa$_{fem, singl}$ → las$_{fem, pl}$ casas$_{fem, pl}$

   the   house   → the   houses

If phonological similarity is at issue rather than morphophonological regularity of patterns across the system, the asymmetrical performance between masculine and feminine morphophonology shown for both children and adults in the current study should not be observed when plural forms are used. Additionally, if children's primary difficulty with the masculine definite singular determiner is articulatory ease based on phonological properties alone, the facilitatory effects shown for the feminine singular definite determiner should not be evidenced given that in the plural form, both

determiners demonstrate consonant-vowel syllable structure, the most frequent syllable structure in the language. In addition, both determiners in the plural provide an equal advantage of consistency of form in that the last two phonemes of the masculine and feminine determiners, /os/ and /as/ respectively, are repeated in the last two phonemes of the stem. If, on the other hand, the underlying mechanism responsible for the processing patterns shown for the children and adults in this study operates off of statistical analyses of the input and is sensitive to the regularity of distributional and morphophonological patterns across the gender system, similar results should be found for the plural and singular forms respectively.

Where is gender now? If the results of the experiments with Spanish-speaking children and adults described in this dissertation tap real language processes, it can be concluded that gender is not a feature stored exclusively with lemma representations of individual words. The findings for both adults and children suggest that even the existing words of the language stored in the Spanish-speaker's lexicon are organized with respect to the morphophonological patterns across the Spanish gender system. These patterns are not lexically specific, but affect processing and production of nonsensical words that conform to morphosyntactic features of the Spanish gender system as well. It could be that gender is in fact the byproduct of statistical analyses of the input and the subsequent extraction of generalizations across the system, the efficiency of which is affected by the regularity of features across the set. There is certainly evidence in the syntactic persistence literature to support the existence and priming of abstract syntactic frames. For example, subjects who repeat a particular structure and then are subsequently asked

to describe a picture, demonstrate a tendency to use the structure of the prime in describing the picture rather than another equally adequate structure (Bock, 1986). Structural priming effects have been shown to be independent of effects of repetition of individual lexical items as well as conceptual features such as event structure (Bock and Loebell, 1990; Hartsuiker, Bernolet, Shoonbaert, Speyboeck and Vanderelst, 2007). Similar effects have also been shown for young children (Conwell and Demuth, 2007). Equally robust effects have been found for priming between comprehension and production when subjects listened to rather than repeated the prime sentence (Bock, Dell, Chang and Onishi, 2007). On this account, hearing a noun phrase stimulus as was the case in the experiments described in this study should have primed an abstract noun phrase structure; however, the gender component complicates the issue. It could be the case that the facilitatory effects shown when a prime or distractor determiner's features are concordant with those of the target noun's determiner are due to the activation of an abstract gendered noun phrase frame. It is thus this activated representation that would be posited to speed up utterance onset time in congruent versus incongruent conditions as a function of overlapping representations. Likewise, when a gender incongruent determiner is presented, it would be expected to activate an abstract gendered noun phrase frame whose gender features do not converge on those of the target noun, thus slowing down utterance onset times.

The questions raised by the findings of the current study remain to be explored in future research. Clearly noun phrase production for a language with grammatical gender such as Spanish involves multiple factors. The findings of these experiments with

Spanish-speaking adults and children seem to clearly suggest that noun phrase production does involve lexical retrieval processes if a representation exists, but that accessing gender stored with lexical representations is not obligatory. In addition, the results suggest that the manner in which these representations are retrieved and produced is subject to language-specific patterns across the gender system and that even very young children learning to produce noun phrases in Spanish are subject to these constraints.

5.3 Conclusions

As outlined in the introductory chapter, the primary purpose of this dissertation was to establish a processing account for young children's coordination of lexico-syntactic information at the word level with phrasal frame construction involved in the production of noun phrases. Grammatical gender is said to be the interface between syntactic information stored with the lemma of individual words and grammatical encoding processes at the sentence level given that it is necessary for the encoding of agreement; thus, Spanish, a language with grammatical gender, was chosen as the language of the study. The experiments detailed in Chapters 3 and 4 manipulated lexical status, congruity and gender in an elicited imitation task designed to address three proposed accounts for how Spanish-speaking children produce gender agreement within the noun phrase: (1) Children retrieve gender stored with individual lexical items, (2) children produce gender based on predictable morphophonological surface patterns, and (3) children exploit input statistics, producing noun phrases in a manner that reflects the regular morphophonological surface features and distributional patterns of the feminine gender system as well as the variable morphophonological surface features and

distributional patterns of the masculine gender system. This section attempts to associate

the findings in this dissertation with broader issues as previewed in the introductory

chapter. These issues include developmental production processing models,

bilingualism, language impairment as well as adult models of production and the

processing of grammatical gender.

5.3.1 A developmental processing account

There is a long-standing tradition in the study of child language acquisition to

assess a child's linguistic competence based on the well-formedness of the child's

utterance; however, research has also shown that both typically-developing children as

well as children with language impairment demonstrate sensitivity to complex linguistic

features such as functional elements even when their speech nonetheless is characterized

by their omission (Gerken, Landau and Remez, 1990; McNamara, Carter, McIntosh and

Gerken, 1998; Fernald and Hurtado, 2006). There is a growing body of research that

suggests that this apparent gap between what the child knows and what the child says

reflects not deficient linguistic knowledge, but rather development of the system that

recruits the words the child knows and the procedures necessary to coordinate utterances

in a manner that matches the complexity of the child's comprehension in production.

The majority of the research in this domain has been carried out in English or Dutch and

provides evidence that children produce slips of the tongue in a similar manner as adults

as well as develop lexical retrieval skills, sentence planning skills and the ability to

monitor and self-correct their own utterances (Jaeger, 1992; Stemberger, 1989; Gerken,

1992; Dapretto and Bjork, 2000; Gershkoff-Stowe and Smith, 1997; Wijnen, 1990;

Wijnen, 2007; Rispoli and Hadley, 2001; McKee and Iwasaki, 2001). Nevertheless, research with young Spanish-speaking children has continued to focus on the acquisition of the determiner phrase as a functional category as well as gender agreement principles that govern the relationship between nouns and their determiners and adjectival modifiers. The child's progress in these areas has typically been evaluated on the basis of production patterns demonstrated in spontaneous speech. Meanwhile, the research on determiner phrase production and gender processing in the adult psycholinguistic literature has continued to focus on the storage, access and retrieval of gender features in the time course of production planning processes.

The findings in this dissertation bridge the gap between child and adult research, providing evidence that young Spanish-speaking children are not only faced with the task of learning gender categories and functional categories, but that they additionally must learn to recruit such knowledge in coordinating the production of gendered articles and stems. The manner in which they do so is very similar to the processing patterns shown for adult Spanish-speakers. Taken together, the results of both studies demonstrate that determiner phrase production for both Spanish-speaking adults and children is driven by statistical co-occurrence patterns of the language, specifically the morphophonological properties of surface features across the gender system. Masculine morphophonological gender patterns are more costly in processing speed for adults; however, for children both speed and accuracy suffer as a result of encountering masculine morphophonology in the determiner phrase. While this effect is localized to the morphophonological marking of the stem for adults, processing of both masculine determiners and stems is adversely

affected for children. The patterns shown for both children and adults reflect the contribution of lexical status; however, differences in processing patterns across both populations suggest the presence of a developmental component. Adults process and produce words more quickly than they do non-words; however, the pattern of results across genders is similar for both words and non-words with longer utterance onset times for masculine stems compared to feminine stems. These findings suggest that the storage and retrieval of lexical entries is driven by morphophonological regularities of surface patterns across the gender systems. A similar pattern emerges from the child data; however, the child system is much less efficient in lexical retrieval processes, specifically with words marked with masculine morphophonology. When processing difficulty increases as a result of encountering masculine morphophonology, the efficiency of the developing system is compromised and the system compensates for this added complexity as has been demonstrated in prior research with Japanese and English speaking children (Mckee and Iwasaki, 2001; Boyle and Gerken, 1997; Gerken, 1991). Sometimes this strategy involves the omission of the article altogether while other times the strategy invokes the ease and regularity of the feminine gender systems as evidenced by the fact that children produce fewer omissions and more exact repetitions in incongruent sequences preceded by the feminine determiner. Adults, on the other hand, demonstrate a pattern consistent with both morphophonological regularities and frequency of distributional patterns across the Spanish nominal gender system with faster naming times in incongruent sequences preceded by masculine determiners compared to utterance onset times for incongruent sequences preceded by feminine determiners.

These combined results provide clear evidence for a developmental processing account of noun phrase production by young Spanish-speaking children.

5.3.2 Bilingualism

There is an entire area of research dedicated to the study of how the organization and processing of language is affected by learning more than one language. There is ongoing debate with respect to the degree to which systems for the languages one knows are autonomous or necessarily overlap (Costa, Kovacic, Franck and Caramazza, 2005; Kroll and Stewart, 1994; Kroll and Tokowicz, 2001; Kupisch, 2007; Barreña, 1997). The research in this domain has capitalized on typological differences across languages such as grammatical gender. For example, determiners in German encode both gender and case while in Italian they are gender but not case-marked. The Italian system is binary (masculine, feminine) while German has three genders (masculine, feminine, neuter). Selection of the appropriate determiner form is phonologically conditioned in Italian whereas in German this is not the case. The differing complexity of the systems across languages is said to be responsible for the fact that determiners appear earlier in the speech of monolingual Italian children than they do in the speech of monolingual German children. Additionally, the quantity of determiners in child speech increases more quickly for Italian children compared to German children. Kupisch (2007) analyzed the noun phrase production of 4 German-Italian bilingual children between 1;4 and 3;0 and compared developmental patterns to those shown for monolingual speakers of each language. The findings show that bilingual German-Italian children are slightly delayed in the onset of article production in Italian compared to monolingual Italian children;

however, a facilitatory effect of exposure to Italian is observed such that bilingual children begin producing determiners in German at an earlier age than age-matched German monolingual peers.

A longitudinal case study of noun phrase production of a Basque-Spanish bilingual child between the ages of 1;6 and 3;6, however, showed that the developmental patterns demonstrated in the speech of the bilingual child paralleled those shown for monolingual children of each language (Barreña, 1997). This is quite impressive given the degree to which structure diverges between Basque and Spanish, most notably in headedness (pre-nominal versus postnominal determiner placement) and gender agreement between nouns and adjective (obligatory in Spanish but not in Basque).

The experiments described in this dissertation with both Spanish-speaking adults and children corroborate Barreña's (1997) finding that bilingual children follow a similar trajectory as that of monolingual children in each language. When corpus data for adult monolingual Spanish speakers were analyzed with respect to the distributional patterns of nouns across genders, slightly more masculine versus feminine nouns were noted overall (Teschner and Russell, 1984). Feminine regular nouns far outweighed feminine irregular nouns in the corpus while this difference was shown to be negligible for masculine nouns. Masculine irregular nouns were more numerous overall than feminine irregular nouns in the corpus. When the set of nouns included on a developmentally-normed vocabulary checklist for Spanish-speaking monolingual children between 16 and 36 months was analyzed in the same manner, the distributional pattern shown for adult monolinguals was also observed in the child corpus. Additionally, the nouns produced

by 17 of the 18 children who participated in the present study were analyzed with respect to nominal gender distribution. The pattern demonstrated for the children in the experiment was almost identical to the distributional patterns shown for both monolingual Spanish-speaking adults and children. This is particularly strong evidence given that the children who participated in the experiment showed varying degrees of dominance in English and Spanish as well as differential language exposure patterns within a wide age range (2;0 to 4;0).

It could be argued, however, that while vocabulary composition is comparable across populations, processing patterns are not; however, the results indicate that processing patterns for the Spanish-English bilingual children who participated in this study are quite similar to those shown for adult Spanish-speakers. The overall results suggest overwhelmingly that this is an accurate assessment; however, evidence to the contrary was observed in the article gender switch analysis for a small subset of the children. Five of the 6 children responsible for the entire set of article gender errors evidenced in the data were English dominant. The children in this group were also on average 4-6 months older than the average age of the group as a whole. Curiously, children in this group produced more errors in feminine congruent conditions than in masculine congruent conditions. The extant evidence afforded by the results of this dissertation is insufficient to account for the patterns in this small sample; however, the questions raised by these results warrant further research as understanding the differential effects of age of acquisition, language exposure and dominance on processing patterns has implications for the delineation of language difference from language disorder.

Making this distinction is of growing importance and urgency as the Hispanic population continues to grow in the US and young Spanish-speaking children enter English-dominant schools across the nation. The odds that the young bilingual child will flourish rather than slip through the cracks in US schools can be markedly improved by endeavors to ascertain the effects of exposure to more than one language as well as efforts to detect language impairment in the early stages of development.

5.3.3 Spanish-speaking children with SLI

Children with specific language impairment characteristically demonstrate deficiency with respect to the production of grammatical morphemes such as determiners and inflectional elements (Leonard, 1989; 1992). Additionally, children with SLI are said to demonstrate difficulty with word learning skills (Alt, Plante and Creusere, 2004; Kiernan and Gray, 1998). There is debate with respect to the underlying mechanism responsible for the patterns shown in the speech of children with SLI; however, the predominant explanatory model posits that children's failure to produce grammatical morphemes is due to a general cognitive processing capacity deficiency that makes it difficult to perceive unstressed elements and subsequently map their form to function (Leonard, 1989; 1998). The majority of research in this domain has focused on the production of verb morphology by English-speaking children but has slowly expanded to determiner production in Spanish, Italian and French in addition to English (Leonard, Eyer, Bedore and Grela, 1997; Leonard, Bortollini, Caselli, McGregor and Sabadini, 1992; Le Normand, Leonard and McGregor, 1993; Restrepo and Gutierrez-Clellan, 2001). Research with both Italian and English-speaking children provides evidence that

children with SLI do, in fact, perceive some grammatical morphemes and are sensitive to the presence of grammatical determiners relative to ungrammatical morphemes in determiner position (Bortolini, Caselli and Leonard, 1997; McNamara, Carter, McIntosh and Gerken, 1998; Gerken and McIntosh, 1993). Research with Spanish-speaking children has produced controversial results with respect to production of article gender errors and article omissions. Anderson and Souto (2005) found that article gender errors for Spanish-speaking children with SLI did not differ significantly from gender errors in the typically-developing group while article omission rates were higher for the SLI group than the typically-developing children. Restrepo and Gutierrez-Clellan (2001), on the other hand, showed that Spanish-speaking children with SLI not only produce reliably more article gender errors but that they additionally omit significantly more articles than do the typically-developing children. The patterns evidenced suggest that children with SLI are sensitive to morphophonological regularity across the Spanish gender system reflected in the fact that children omitted the feminine definite determiner less frequently than the masculine definite determiner and committed more article gender errors resulting in the substitution of masculine for feminine forms relative to substitutions of feminine for masculine forms. Differential exposure to Spanish and English has been posited as a contributing factor to the discrepancy observed in the patterns of results observed across studies (Anderson and Souto, 2005). Nevertheless, a comparison of specific errors found in the speech of typically-developing age-matched peers and very young Spanish-speaking children to errors noted in the speech of children with SLI demonstrate an overlapping pattern that reflects the predictability and regularity of the nominal

distribution across the gender system in Spanish. It could be the case that when children either encounter unfamiliar words or are faced with deficiencies in processing capacity, they compensate by analyzing the morphophonological features of the unfamiliar or nonsense word and utilizing the most regular frequent distributional patterns across the system for productivity of the determiner-noun sequence.

The results of the elicited imitation experiment with Spanish-English bilingual children, suggest that this may very well be the case. While the current study population was restricted to children who had not been previously diagnosed with language disorder, the findings indirectly contribute to a better understanding of performance patterns for children who have been diagnosed with language impairment. Prior research has provided solid evidence that both typically-developing children and children with SLI are sensitive to grammatical morphemes such as determiners in perception but nevertheless fail to produce them. This study takes a step beyond previous research in testing children within an experimental design that provides the opportunity to observe the relative independence or interaction of lexical status, gender as well as congruity within a paradigm that selectively decreases or increases the difficulty of processing as a function of the combination of these factors and additionally allows for the comparison of modifications in imitation to a specific target utterance. The findings across both adult and child Spanish-speakers establish a developmental account of determiner phrase production, an essential step in understanding the developing mechanism responsible for article production and gender agreement within the determiner phrase. The system in place for the young children in this study is characterized not only by developmental

processing difficulties as evidenced by article omission rate, but the results further show

that processing difficulty or relative ease is a function of the morphophonological

regularity of distributional patterns across the Spanish gender system. Both adults and

children are sensitive to these linguistic properties of the language; however, while

masculine morphology adversely affects both speed and accuracy for Spanish-speaking

children, it is restricted to an overall slowdown in utterance onset times for adults.

Strikingly, the extent of the advantage shown for real Spanish words is processing speed

with faster production of words versus non-words. While children demonstrate greater

accuracy and speed on feminine words than masculine words and likewise make

significantly more article gender repairs with feminine words relative to feminine non-

words and masculine words, they suffer in accuracy and speed with masculine words to a

greater extent than with masculine non-words. The combined results suggest that gender

is not stored with individual words and that lexical retrieval is driven by

morphophonological regularity across genders in such way that masculine forms are less

efficiently processed and retrieved than feminine forms that demonstrate regularity and

consistency across forms. This is true for both children and adults. These results are

particularly relevant to findings in the domain of language impairment suggesting that

children with SLI demonstrate deficiencies in word learning skills, especially in light of

the traditional account of gender as a lexically-specified feature stored with the lemma

representation of individual words. The findings in this dissertation suggest that lexical

deficiencies in the form of underspecified or incorrectly assigned gender cannot fully

account for patterns of determiner phrase production for either typically-developing

Spanish-speaking children or for children with specific language impairment. There is

some evidence that the performance of English-speaking children with SLI in picture

identification is affected by semantic similarity of the candidates presented as possible

responses. While this finding is outside the scope of the current study, it is nonetheless

germane to the overall assessment of the developing processing mechanism. It could

prove to be potentially informative to test Spanish-speaking children within a design that

manipulates both gender congruency and semantic similarity. Based on the results of the

current study, independent effects would be predicted for words compared to non-words

since representations for words should contain semantic information and no entry should

be available for a non-word; however, differential results should still be evidenced for

gender if indeed gender is a function of morphophonological regularity rather than lexical

specificity. A logical first next step, however, would be to test Spanish-speaking children

with SLI within the same paradigm as that used to test the typically-developing adult and

child Spanish-speakers in the current study.

5.3.4 Adult processing models and grammatical gender

      Just as there are debates among acquisitionists regarding the nature of the learning

mechanism underlying the child's acquisition of language-specific syntactic features,

there are controversies among theorists who concentrate on the processing models that

explain how adults produce even the most simplistic of syntactic structures. Efforts to

span the rift that has traditionally separated child acquisition and adult processing models

have resulted in work towards a developmental model for child production. The

beneficial outcome of dialogue between the two areas of research is not unidirectional in

nature as research with children holds the potential to inform adult processing models as well.

The results of the experiments in this dissertation designed to investigate the development of production processes involved in the successful coordination of lexico-sytactic features such as grammatical gender with their correct gendered determiners speak to the controversial issue in adult processing models with respect to the location, storage and retrieval of gender features during noun phrase production. Central to this debate is the locus of the gender congruency effect found with noun distractors for Germanic but not for Romance languages and shown to varying degrees for both Germanic and Romance languages using determiner distractors. Gender on some accounts is said to be lexically-specified and obligatorily accessed and selected via processes of lexical retrieval when it is necessary for grammatical encoding processes (Levelt, Roelofs and Meyer, 1999). Based on the high correspondence between phonological features and gender assignment in many languages as well as the availability of phonological information in TOT states, alternative accounts suggest that gender is accessed via the lexeme or phonological representation of words (Caramazza, 1997). Studies conducted within the picture-word interference paradigm have attempted to clarify the time course and availability of gender in the production of noun phrases; however, accounting for results across languages that invoke to varying degrees phonological and syntactic information in determiner form selection has proven difficult at best.

While the experiments with adults conducted within the picture-word interference paradigm typically manipulate the congruity of gender and number features of a distractor, the experimental design of this dissertation takes a step towards clarifying the issues central to the gender processing debate by manipulating congruity in addition to gender and importantly, lexical status within the elicited imitation paradigm. The findings with both adults and children in this dissertation challenge the notion that gender is exclusively a feature of lemma representations stored with individual words as predicted by the lemma-based account. The results also suggest that successful selection and production of a gender-marked determiner is not necessarily an automatic byproduct of lexical selection processes that are said to guide the selection of appropriate syntactic frames.

Language-specific phonological properties have been proposed to contribute to crosslinguistic differences in effects of gender congruency across studies in the adult literature. While the patterns shown in both the adult and child data in this dissertation corroborate the notion that a language-specific processing strategy is involved in determiner phrase production in Spanish, the findings neither support a strictly phonological or morphophonological strategy nor do they support a strictly lemma-based account, but rather demonstrate the combined influence of lexical familiarity and morphophonological regularity as predicted on the input-based account. Taken together, the pattern of results elucidates the nature of a language-specific processing strategy which, contrary to findings in the adult literature, is not the result of varying degrees of interaction between phonological and syntactic processes per say but rather is based on

the extraction and use of morphophonological regularities in surface features across the gender systems. The fact that words are produced overall faster than non-words for adults in the study suggests that this processing strategy is an intrinsic characteristic of the Spanish-speaker's system both shaping the organization and storage of words in the lexicon and allowing for efficient retrieval of their representations relative to the production of non-words. The article gender switching patterns for Spanish-speaking children observed in the results provide strong supporting evidence for the morphophonological component of determiner production. Impressively, children produce significantly more article gender repairs than they do article gender errors overall and spontaneous corrections are observed in children as young as 24 months. Crucially, children's repairs are not exclusive to words for which a lexical entry exists in the lexicon. Children make article gender repairs with both words and non-words and they do so in a manner that reflects the processing ease of feminine morphophonological patterns across the Spanish gender system.

Overall, there is scarce research with Spanish-speaking children investigating the architecture of the developing production system and even less is known about the processing mechanisms in place for developing bilingual children. Much remains to be explored and clarified in this domain as well as in the domain of adult gender processing. This dissertation takes an important first step in bridging the gap between Spanish-speaking child acquisition and adult performance patterns and processing models providing some valuable insights into the workings of the underlying mechanism responsible for the production of gender agreement within the determiner phrase as well

as in how this particular line of research might be further pursued and extended to the

domain of child language impairment.

APPENDIX

ITEM LISTS

List A1	Condition	List B1	Condition
el libro	WSMAM	el viento	WSMAM
la crepo	NWSMAF	la pacho	NWSMAF
la vaca	WSFAF	la bolsa	WSFAF
la lipa	NWSFAF	la fupa	NWSFAF
el fupa	NWSFAM	el bapa	NWSFAM
la queso	WSMAF	la libro	WSMAF
la torta	WSFAF	la gorra	WSFAF
el cherpo	NWSMAM	el crepo	NWSMAM
la bapa	NWSFAF	la tolpa	NWSFAF
el gorra	WSFAM	el casa	WSFAM
la viento	WSMAF	la oso	WSMAF
la buepo	NWSMAF	la tupo	NWSMAF
el pacho	NWSMAM	el flebo	NWSMAM
el pato	WSMAM	el globo	WSMAM
el bolsa	WSFAM	el vaca	WSFAM
el chorga	NWSFAM	el rulla	NWSFAM
la rana	WSFAF	la chancla	WSFAF
la palta	NWSFAF	la chorga	NWSFAF
la flebo	NWSMAF	la cherpo	NWSMAF
el cama	WSFAM	el torta	WSFAM
el oso	WSMAM	el techo	WSMAM
el resplo	NWSMAM	el buepo	NWSMAM
la disto	NWSMAF	la resplo	NWSMAF
el chancla	WSFAM	el rana	WSFAM
el tolpa	NWSFAM	el lipa	NWSFAM
la rulla	NWSFAF	la nupa	NWSFAF
el horno	WSMAM	el queso	WSMAM
la casa	WSFAF	la cama	WSFAF
el nupa	NWSFAM	el palta	NWSFAM
la globo	WSMAF	la pato	WSMAF
la techo	WSMAF	la horno	WSMAF
el tupo	NWSMAM	el disto	NWSMAM

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