

CAUSES OF THE NOUN BIAS IN EARLY
VOCABULARY DEVELOPMENT

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CAUSES OF THE NOUN BIAS IN EARLY
VOCABULARY DEVELOPMENT

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DEDICATION

This work is dedicated to my late grandmother, Emily A. (Marzano) Moore, “Moonie,” for her inspiration to explore and question.

In addition, I dedicate this paper to my fiancé, Brad Willis, who encouraged me to write a little every day, and to my family for their continued support.

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Causes of the Noun Bias in Early Vocabulary Development

INTRODUCTION

In comparison to adults, children exposed to English produce a much higher proportion of nouns than verbs during early language acquisition (Gentner, 1982; Fenson, Dale, Reznick, Bates, Thal, and Pethick, 1994). The reasons for the noun bias are not clear. Early studies of the noun bias claimed that it was a universal property of children and that the bias resulted from conceptual or perceptual predispositions (Gentner, 1982). More recent studies have questioned both of these claims. The results are controversial, but some researchers have claimed that the “noun-bias” may not be universal (Childers, Vaughan, and Burquest, 2007; Choi and Gopnik, 1995; Tardif, Shatz, and Naigles, 1997; Tardif, Gelman, and Xu, 1999). If the existence of a noun bias varies across languages, then the underlying mechanism cannot be a cognitive universal such as conceptual or perceptual predispositions. A popular alternative explanation is that mothers produce a larger proportion of nouns than verbs when speaking to young children. In other words, the frequency of nouns in the input influences young children to produce more nouns (Goldfield, 1993; Tardif, et al., 1999). Below, I examine data relevant to the above claims and present a study that addresses the conflicting results. Specifically, we examine whether children show a noun bias when the frequency of input is controlled. We also consider whether there are differences between comprehension and production in which class of words (nouns or verbs) is learned earlier.

Perceptual and Conceptual Predispositions

One possible cause of the noun bias is that children possess preexisting knowledge of the difference between concrete objects and activity, and that they acquire nouns before verbs because objects are easier to conceptualize than actions (Gentner, 1982). Gentner’s Natural

Partitions hypothesis assumes that objects, labeled with nouns, could be easier to conceptualize because they have clearer boundaries than actions, labeled with verbs. For example, different balls may vary in size, color, or hardness, but they are all round and clearly distinct from the ground they may lie on, the air they travel through when thrown, or the hands holding them. Consider, however, the verb *get*. Getting a book, getting the mail, and getting a present all involve somewhat different actions. Further, it is not clear at what point the "getting" begins and ends. When getting the mail, does the action begin when one walks toward the door and end when one returns with the mail, or does it only involve reaching one's hand toward the mail and removing the mail from the mailbox? Thus, the noun bias in early vocabulary development may be due to the conceptual ease of perceiving objects relative to actions. If this is the case, then the noun bias should exist cross-linguistically, because conceptual predispositions should be universal.

Is the Noun Bias Universal?

Children presumably have the same underlying cognitive architecture. Therefore, if conceptual predispositions underlie the noun bias, it should be universal. Whether or not the noun bias is universal, however, has been a controversial topic. Several studies have analyzed children's word learning over time to determine if a noun bias exists cross-linguistically (Gentner, 1982; Bornstein et al., 2004; Au, Dapretto, and Song, 1994; Choi and Gopnik, 1995; Childers, et al., 2007; Sandhofer, Smith, and Luo, 2000; Tardif, et al., 1997; Tardif, et al., 1999). Gentner (1982) was one of the first to claim that the noun bias is universal. She examined data from English, Kaluli, German, Turkish, Japanese, and Mandarin-speaking children and reported that children in all of these language groups showed a noun bias. In Gentner's hallmark study,

however, data was collected by many different researchers, for many different purposes, leaving some skeptical about the reliability of her findings. Several other studies have since attempted to determine if the noun bias exists in children cross-linguistically. More recent studies of Mandarin have not found a noun bias in the language development of young children (Tardif, et al., 1997, Tardif, et al., 1999), contradicting the findings by Gentner. Tardif and her colleagues have argued that word frequency in the input, rather than conceptual predispositions, underlies the noun bias, and their studies will be reviewed in greater detail later.

A few other languages are also said to lack a noun bias in early acquisition. For example, Choi and Gopnik (1995) found that Korean-speaking children (ranging in age from 14-22 months) produced more balanced numbers of nouns and verbs than children acquiring English. However, Au, et al. (1994) reported that both Korean and English-speaking children (ranging in age from 15-25 months) produced many more nouns than verbs, suggesting that Korean-speaking children do show a noun bias. These conflicting findings could either be due to the variety in children's ages at the time of the study or the way experimenters collected data. While Choi and Gopnik gathered their data from language samples and questionnaires (diary), Au, et al. developed a word checklist for parents to complete regarding which words their children were using. Language samples only provide a look at children's productive language at one point in time during a specific interaction, and the activities during the sample could lead to the appearance of a bias in word class (i.e., nouns or verbs). Checklists, however, require that parents recall words their children produce, and contain only a set number of words from each word category. Therefore, it is not surprising that different collection methods would lead to different findings in word frequency studies.

The noun bias has been examined in several additional languages. For example, Bornstein et al. (2004) examined the early vocabularies of children learning Spanish, Dutch, French, Hebrew, and Italian, as well as Korean and American English. These languages were studied because they varied cross-linguistically in morphology, noun position (saliency), frequency of word type use (nouns and verbs), and pragmatics. A maternal report instrument was used to determine the number of word types children from each language group were using. All of the children in the study were approximately 20 months old. In each language, mothers reported that their children produced more nouns than verbs or any other word category. Even in Korean, mothers reported that children produced significantly more nouns than verbs, confirming earlier work by Au et al. (1994) who also found a noun bias in Korean-speaking children using a parent report instrument; however, across all of the seven languages studied, the difference between the word categories was the smallest in Korean. It is important to note that each of the word checklists used in the Bornstein, et al. study contained more nouns than verbs. To address this, the authors used the proportion of words learned within each category (i.e., they compared the number of words (e.g., nouns or verbs) in each category with the number possible in that category for each language). In each language, children produced a greater proportion of nouns than verbs.

Checklists are often used because they are a convenient way to collect data on children's productive vocabularies, and they may allow for more comprehensive assessments of vocabulary. However, checklists typically contain words that children learn early. Further, most of the foreign language checklists, while not direct translations, are based on a commonly used English-language checklist. Thus, they generally contain more nouns than verbs; hence, children could show a noun bias due to the design of the instrument (if parents do not add words to the

list). A second kind of data is parental diaries. These instruments may be useful because they allow parents to create a catalogue of words their children use. These methods, however, assume that parents are consistent in keeping track of their children's productions or rely on parents to recall words their children use. In sum, cross-linguistic studies of the noun bias are inconclusive, due to conflicting results and differing methodologies. While some studies find that children from diverse language groups produce a noun bias, others do not. Although the jury is still out, if the noun bias is not universal, then conceptual/perceptual predispositions probably are not the cause. An alternative possible cause is frequency. We review the literature on frequency below.

Frequency

Another possible cause of the noun bias is word frequency. That is, children may acquire words that are most frequent in the input. At first glance, this argument seems to lack support because analysis of adult speech reveals that, in natural conversation, adults use verbs more frequently than nouns (Gentner, 1982). Therefore, if frequency is the primary influence on vocabulary development, one might expect children to produce more verbs than nouns. However, frequency may still play a role in language acquisition if adult speech directed to children contains more nouns than verbs. Gentner (1982) suggested that children may hear adults using more nouns than verbs in conversation. In fact, caregivers may use an unusually high proportion of nouns in their speech to children (Tardif, et al., 1999, Goldfield, 1993). Nouns may be especially easy to segment from utterances due to their high frequency of occurrence (Tardif, et al., 1999; Goldfield, 1993). Thus, when speaking to children, adults may label objects more frequently than actions. If this is the case, it is unclear whether children produce more nouns because they are easier to understand or because they hear them more often.

Several studies measure caregiver input to determine the role frequency plays in children's vocabulary acquisition. These studies ask whether either the raw frequency or the proportion of nouns or verbs in speech directed to children influences vocabulary composition. One major problem with interpreting the findings of these studies is the same as that for studies measuring the noun bias. Parental frequency is collected from language samples, but it is correlated with children's vocabulary composition, which varies depending on collection method. Differing collection methodologies make comparing studies with conflicting results difficult. Further, language samples may be collected in different contexts with children of varying ages, yielding confounding results across studies. Finally, several studies look at parental input to children but do not directly correlate word frequency with children's word productions (output); this makes it difficult to draw conclusions about the role of parental word frequency.

In addition to differing methodologies across studies of the noun bias, another factor to consider is whether a study has included information on both word types and tokens. *Types* refer to the variety of words produced or comprehended, while *tokens* refer to the number of times word types are produced. For example, mothers may produce a wider variety of noun *types* but more verb *tokens* to their children.

English

Most studies of word frequency and the noun bias have studied children acquiring English. While methodologies may vary across studies (i.e., by context, age, and gender), maternal input data is consistently collected through language samples. A review of the literature on maternal input suggests that English-speaking mothers either produce more noun than verb types (Choi, 2000; Choi and Gopnik, 1995; Sandhofer, et al., 2000; Tardif, et al., 1999)

or produce noun and verb types in equal numbers (Au, et al., 1994; Goldfield, 1993; Goldfield, 2000; Tardif, et al., 1997). On the other hand, English-speaking mothers tend to produce more verb than noun tokens in speech to their children (Au, et al., 1994; Goldfield, 1993; Goldfield, 2000; Tardif, et al., 1997). When context varies within a study, mothers tend to produce more nouns (types and tokens) during book-reading activities and more verbs (types and tokens) during active toy-play or physical play (Choi, 2000; Goldfield, 1993; Tardif, et al., 1999). The majority of studies suggest that English-speaking children hear a greater variety of noun types less frequently and a smaller variety of verb types more frequently. In other words, they hear more noun types and more verb tokens.

To determine whether input frequency is related to the noun bias, it must be correlated to children's output. Studies of children's output are typically reported for word types and occasionally word tokens. Like their mothers, English-speaking children overwhelmingly appear to produce more noun than verb types across ages (Au, et al., 1994; Bornstein, et al., 2004; Gentner, 1982; Goldfield, 2000; Goldin-Meadow, et al., 1976; Tardif, et al., 1997; Tardif, et al., 1999). Unlike their mothers, however, they also appear to produce more noun tokens than verb tokens (Goldfield, 2000; Tardif, et al., 1997). When both noun and verb type and noun and verb token frequency are equated in a task, English-speaking children still appear to produce more new nouns than verbs (Childers and Tomasello, 2002). In sum, English-speaking children hear more noun types than verb types and more verb tokens than noun tokens (although context affects frequencies). Children, on the other hand, produce more noun types and produce more noun tokens across contexts.

Mandarin

Frequency studies of Mandarin reveal somewhat different patterns. When maternal input from language samples is analyzed, results are mixed. While some studies find that Mandarin-speaking caregivers produce more noun types than verb types (Sandhofer, et al., 2000), others find the opposite to be true (Tardif, et al., 1997; Tardif, et al., 1999). Even though results about word types are inconclusive, Mandarin-speaking mothers do appear to produce significantly more verb tokens than noun tokens (Sandhofer, et al., 2000; Tardif, et al., 1997). Context appears to play a role in maternal input of word categories. While some studies utilize language samples and do not control context (Sandhofer, et al., 2000 used the CHILDES database), other studies carefully control context by utilizing specific toys that elicit talk about actions and books that elicit talk about objects (Tardif, et al., 1999). Under these controlled contexts, Mandarin-speaking mothers (like English-speaking mothers) used more verbs during free play with toys and more nouns during book-reading (Tardif, et al., 1999). Therefore, context may influence word frequency and have an impact on type and token analyses.

The effects of frequency on Mandarin-speaking children's vocabulary are, likewise, inconclusive. While some research findings suggest that Mandarin-speaking children produce more noun types (Gentner, 1982), other studies find that they produce significantly more verb types (Tardif, et al., 1997). Differences in findings may implicate the research methodologies used in the studies. In other words, context and/or age may again play an important role in children's productions of word categories. When data are analyzed by context, children produce more noun types during book-reading contexts and more verb types during toy-play (Tardif, et al., 1999). Another methodological difference concerns differing ways of analyzing data. For example, Tardif, et al. (1999) found that both English-speaking and Mandarin-speaking children produced more noun types than verb types when raw

frequencies are considered. When they instead used a ratio of Nouns/(Nouns + Verbs), Mandarin-speaking children were more balanced in their production of noun and verb types. Further, when the data excluded responses to maternal test prompts, the Mandarin-speaking children no longer produced more noun types than verb types. Therefore, analysis decisions affect frequency outcomes and the presence of a noun bias.

Korean

Frequency studies of maternal input to children indicate that Korean mothers produce either an equal number of noun and verb types (Au, et al., 1994; Choi, 2000) or significantly more verb than noun types (Choi and Gopnik, 1995) when interacting with their children. Again, context affected word frequency outcomes such that Korean-speaking mothers produced more noun types during a book-reading condition and more verb types during a toy-play condition (Choi, 2000). Korean-speaking mothers produced significantly more verb tokens in all interactions with their children (Au, et al., 1994; Choi, 2000; Choi and Gopnik, 1995).

Studies of children learning Korean have utilized parental checklists to collect data (Au, et al., 1994; Bornstein, et al., 2004; Choi and Gopnik, 1995). Maternal report suggests that children produce more noun types than verb types, despite efforts to account for biases on the checklists (Au, et al., 1994; Bornstein, et al., 2004). One study of Korean-speaking children utilized maternal checklists and revealed that Korean-speaking children tend to produce a ‘verb spurt’ around 20-months of age, followed by a ‘noun spurt’ shortly after (Choi and Gopnik, 1995). Such ‘verb spurts’ have not been reported for children acquiring English.

Italian

Parental input data for Italian speakers suggests that the number of noun and verb types do not differ significantly (Tardif, et al., 1997). Italian-speaking mothers, like speakers of many

other languages, produce significantly more verb than noun tokens in child-directed speech (Tardif, et al., 1997).

If input frequency accounts for vocabulary learning, Italian-speaking children might produce a more balanced number of word types. Results from output studies of children learning Italian, however, reveal that they tend to produce more noun than verb types (Bornstein, et al., 2004, Caselli, et al., 1995; Tardif, et al., 1997) and tokens (Tardif, et al., 1997).

Other Languages

In addition to the languages discussed above, the noun bias has been studied for a range of languages including Spanish, Dutch, French, Hebrew (Bornstein, et al., 2004), German, Japanese, Turkish, and Kaluli (Gentner, 1982). Results from these studies suggest that the noun bias exists cross-linguistically. Based on this diverse set of languages, some researchers have argued that the noun bias is most likely due to constraints on children's word learning and conceptual and perceptual predispositions (Bornstein, et al., 2004; Gentner, 1982).

Overall, input data varies cross-linguistically in complex ways. Table 1 presents a summary of cross-linguistic frequency data and the potential effects of type/token frequencies on vocabulary learning. Cross-linguistic variation results from several differences between studies. First, some studies include proper nouns in the noun category or auxiliary verbs in the verb category, while others do not. Second, as discussed earlier, the context of data collection varies. Third, differences in results may also be due to ways in which word frequencies are analyzed; some count only word types and not tokens while others count both types and tokens, making comparisons across studies difficult. Fourth, the way the data was collected (i.e., parent report vs. checklist vs. language sample) could account for discrepancies across studies. While results vary somewhat, there is one overall trend: although the frequency of noun types produced by

caregivers varied cross-linguistically, most caregivers tended to say more verb tokens than noun tokens. This being the case, we might expect children to produce more verbs cross-linguistically because they are hearing verbs more frequently in child-directed speech; however, this is not the case. Rather, children from many languages tend to produce more nouns. Few studies of the noun bias have controlled word frequency, which makes it difficult to compare input frequency with children's vocabulary development. The present study controlled word frequency by teaching children an equal number of nouns and verbs and presenting them equally often over varied exposures. If noun and verb frequencies are equal, the presence of a noun bias would suggest that nouns are easier to learn due to innate conceptual or perceptual predispositions.

Sentence Position

Claims that the noun bias is a universal in language acquisition for all children is often challenged by studies using cross-linguistic data from languages whose sentence structure highlights verbs (presented in salient utterance-final position). Mandarin, Korean, and Italian are often chosen when varying sentence position because they are pro-drop languages. Pro-drop languages are hypothesized to encourage the production of more verbs than nouns because they allow for the subject (noun) to be dropped from the sentence. Studies of these languages help contribute to the frequency and noun bias question because speakers of these languages produce more verb types; therefore, the absence of a noun bias would imply that frequency plays an important role in language development.

Ngas

Nigerian Ngas, is a pro-drop language that is syntactically similar to Mandarin input and contains repeated, monosyllabic verbs (Childers, et al., 2007). In Ngas, verbs are inflected differently

than in English; the main verb is produced with changes in intonation to mark differences in the verb form. Children hear the main verb in a single form repeated across contexts (i.e., aspect and person) with changing intonation. In Ngas culture, toddlers spend more time with their mothers (children are carried on their mothers' backs), enabling the child to see more actions with perhaps fewer opportunities spent labeling objects (Childers, et al., 2007). Maternal report of Ngas-speaking children reveals that children tend to produce equal numbers of noun and verb types across ages, but that they comprehend more verbs than nouns (Childers, et al., 2007). Because Ngas-speaking children do not show a noun bias, the importance of syntax and frequency in vocabulary acquisition is supported.

Comprehension and Production

Though children *produce* more words for objects, they may show less of a noun-bias in comprehension. American mothers tend to prompt children to produce nouns more often than verbs (Goldfield, 1993; Tardif, et al., 1999) and this could cause the appearance of a noun bias. Because it is easier to assess the words that children produce, far more research exists on their productive vocabularies than on their receptive vocabularies. Furthermore, children's comprehension of nouns is much easier to assess than comprehension of verbs: noun comprehension requires recognition of a static object, while verb comprehension may require recall of an action or recognition of a moving stimulus. By two years of age, children appear to comprehend nearly the same number of nouns that they produce (Goldin-Meadow, Seligman, and Gelman, 1976). The ratio for verbs, however, is nearly three comprehended for every one produced. Therefore, the lag between production and comprehension is much greater for verbs than for nouns (Goldin-Meadow, et al., 1976). Similarly, Childers and Tomasello (2002) reported that when taught new words, children produced more of the nouns, but comprehended equal numbers of nouns and verbs. Thus, in early vocabulary development, children may show a noun bias in production, while it is possible that they do not comprehend more nouns than verbs.

Longitudinal Studies

Almost all studies of the noun bias have been snapshots of children at one point in time. Discrepancies in cross-linguistic studies of the noun bias may be an artifact of how the noun bias changes with age because different studies test children at different ages. However, because there is so much variability in the ages at which children acquire language, a longitudinal study is needed one to gauge whether vocabulary composition changes with age, and at what ages children begin to look more balanced in their knowledge of nouns and verbs.

The present study examines the rate at which children acquire novel nouns and verbs when frequency is controlled. Children heard an equal number of novel nouns and verbs over several months. One other study taught children novel words in order to determine the effects of different presentation schedules on their ability to acquire the new words (Childers and Tomasello, 2002). Unlike our study, children were divided into groups, with one group learning novel nouns and the other group learning novel verbs. The study was not designed to look at the noun bias; therefore, children were not taught both word categories. The children in the Childers and Tomasello study were also only followed for a short period of time when they were approximately 2½ years-old. Our study spanned 1½ years, which enabled us to study how children learn novel nouns and verbs over time.

Summary

Any conclusions about the mechanism underlying the noun bias would be controversial due to discrepancies in the methodologies of existing studies. While naturalistic methods (i.e., language samples or checklists) of collecting data on children's vocabularies might seem ideal, they do not lend

themselves to controlling word frequency. Mothers may produce a greater number of words in a certain category (i.e., nouns or verbs) to their children depending on the context or depending on cross-linguistic differences. In order to assess whether frequency or conceptual predispositions are critical in determining what words are learned in the input, it is important to control the frequency of nouns and verbs. Naturalistic data collection methods also do not enable us to determine when children acquire certain words. Both language samples and checklists look at the proportion of nouns and verbs in a child's vocabulary at a particular point in time. However, to determine whether nouns or verbs are easier to learn, one must teach novel words to children and watch word knowledge emerge over time. The present study controlled word frequency of an equal number of novel noun and verb types and tokens in order to assess production and comprehension and to determine whether a noun bias exists in comprehension.

METHOD

Participants

Twenty-six children (16 males, 10 females) participated in the present study with their parents. Children came to the lab monthly as part of a larger study. For the present study, children were seen bimonthly from 12 to 30 months of age, for a total of ten sessions. Sixteen (62%) of the children were first born or had no siblings in the same household. Nine (35%) of the remaining children were second born and one child was fourth born. One of the children was African-American, six (23%) were of various racial and ethnic combinations, and 19 (73%) were Caucasian. The socioeconomic status and educational levels of the parents of the children in this sample varied widely, and three of the children came from single-parent households most of the time they were participating in the study.

Participants were recruited through responses to advertisements in parent magazines and a weekly circular. Names, phone numbers, and birth dates of children were collected and parents were contacted when the children were between six and eight months of age, that is, prior to ages when language delays might be noticed. Children exposed to a second language on a regular basis were not enrolled in the study. Eventually, however, three children were exposed to a second language on a regular basis due to childcare arrangements.

Materials

Six objects, for which the children did not yet have names (as confirmed by their mothers), were chosen for the study. Four uncommon, household objects were included in the study (tire pressure gauge, shuttlecock, swim goggles, and swim nose plugs), and two whimsical objects were created for the study (a t-pipe with fluffy balls attached at the ends and a shoe tree covered with hair and eyes). Half of the novel object names and half of the novel action names contained sound combinations that are permissible in English and the other half contained sound combinations that are not permissible in English. The objects are presented in Table 2.

Procedure

All of the children were taught twelve novel words using the six novel objects. Six of the words were names for the objects presented in noun syntax and six of the words were names for actions that were taught with the objects and presented in verb syntax. The examiner gave a novel object to the child to explore. The examiner then took the object back and named it six times (e.g., *See this? This is a wug.*) and demonstrated the action while labeling the act six times (e.g., *I can svit it!*). She then gave the object to the child to explore and attempt the action.

Sessions were videotaped and all child and examiner utterances were transcribed. The following measures were collected during each of the ten sessions.

Baseline

Children's spontaneous productions of the novel nouns and verbs were recorded as baseline productions if they occurred before any of the experimenter's labels.

Imitation

If the child reproduced the examiner's label immediately after it was presented, the response was recorded as an imitation by the examiner.

Spontaneous Production

Spontaneous word production was assessed by giving the child each novel object and recording if the child produced the corresponding object and action labels before being asked.

Prompted Production

After showing the object to the child, the experimenter took it back and asked the child to name it. Then the experimenter performed the action and asked the child what she (the experimenter) had just done. Responses were recorded by the examiner.

Comprehension

To assess comprehension of the novel nouns, the children were seated at a table with the examiner. Four of the novel objects were placed behind a cardboard screen so the children could

not see the objects. The screen was decorated with dinosaurs to hold the child's attention. The examiner told the children to find one of the objects ("Find me the wug"). She then moved the screen, and the child chose an object from the array. Every two turns, familiar objects (e.g., a toy truck, a fake flower, a cup, a sock) were placed behind the screen, and the child was asked to find one of the familiar objects. This was done to maintain the child's attention during the task, and also to prevent children from randomly selecting objects. If the child became restless, he/she was instructed to hand the objects to a puppet (e.g. a rabbit or Ernie).

Verb comprehension was assessed by handing the child an object and asking him/her to perform one of the novel actions. Comprehension of verbs was assessed not only on the actions paired with the original object, but also on non-paired objects to see if understanding of the verb generalized to the new objects or if the children only associated the action with a particular object. Half of the time, the experimenter asked for the action with the object with which it had been taught and half the time with an object on which the children had not seen the action performed. For example, a child might be asked to *doke a fiffin*, when he/she had been taught *doke* with a *zwiebel*.

In addition to the tasks described above, each session also contained additional activities as part of a larger study. These activities were interspersed between the tasks described for the present study. Each session began with a period of free-play, which was followed by the baseline and imitation tasks. Next, the children participated in a picture-naming task followed by a labeling task with familiar objects as part of another study. Children then completed the spontaneous and prompted production as well as the comprehension tasks to conclude the session. Sessions typically lasted between 1-2 hours.

RESULTS

The coding scheme we used to analyze the children's production and comprehension of the novel words is presented below. After coding responses on all production and comprehension measures, we performed statistical tests to determine whether children exhibited any biases for nouns or verbs in production and/or comprehension across development.

Coding Schema

The data were coded so a score could be entered for each of the four dependent measures for nouns and for verbs for every child at each age. For the baseline, imitation, prompted, and spontaneous production tasks, the children were given a score of 1 if they attempted or successfully produced the target word. They were credited with an attempt if they produced the vowel or uttered appropriate consonants. The children were given a score of 0 if they did not say anything or if an utterance did not approximate the object or action label. For noun comprehension, scoring was based on object selection. If the child did not choose an object or chose an incorrect object, he/she was given a score of 0. A score of 1 was given if the child chose the correct object. During the verb comprehension task, the child was handed an object by the examiner and asked to perform an action. The child was given a 0 if he/she did not attempt to perform an action or did not perform a clear approximation of the requested action. A score of 1 was given when the child approximated or correctly performed the requested action. It was additionally noted if the child performed the original action that was paired with an object when an alternative action was requested, though if this occurred, the child was given a score of 0.

To address our experimental questions, we calculated a mean score for each child across

trials and ages for nouns and verbs in each experimental task. We used ANOVA tests to compare performance for nouns and verbs. Below, we present those findings for each of our measures.

When frequency of presentation of novel nouns and novel verbs is controlled, will children learn the nouns more quickly than the verbs?

Production Measures

Repeated measures multivariate analyses of variance (ANOVA) were used to analyze each production task across all ages. The dependent variables in our study were: baseline, imitation, spontaneous and prompted production, and comprehension. The independent variables were part of speech (nouns and verbs), age (in months), and gender (male or female).

Baseline Production

The children in our study first produced nouns at baseline at 18 months of age, followed by verbs at 22 months of age. After this point, children tended to produce more verbs than nouns. Using Wilk's Lambda to determine significance, the repeated measures ANOVA revealed that for baseline production, the main effects of part of speech (nouns or verbs), $F(1, 19) = 7.67, p = .012$, and age, $F(1, 13) = 4.49, p = .01$, were significant. Furthermore, the interaction between part of speech and age was significant, $F(1, 13) = 4.01, p = .015$. We examined the differences between nouns and verbs at each age using paired t-tests. The difference between nouns and verbs for baseline production was significant only at 24 months ($t(24) = 2.55, p = .018$) and approached significance throughout the remainder of the study. Results for the baseline task are shown in Figure 1.

Imitation

Children imitated their first verbs as early as 12 months of age and nouns at 14 months of age. The repeated measures ANOVA revealed that for imitation, the main effects of part of speech, $F(1, 19) = 15.73, p = .001$, and age, $F(1, 11) = 7.18, p = .002$, were significant. Furthermore, the interaction between part of speech and age, $F(1, 11) = 9.73, p = 0.000$, was significant. Paired t-tests revealed that the difference between nouns and verbs for imitation became significant at 18 months ($t(25) = 3.07, p = .005$) with the children producing significantly more *verbs* than nouns at all ages with an exception at 28 months of age (20 months: $t(23) = 3.80, p = .001$; 22 months: $t(24) = 2.34, p = .028$; 24 months: $t(24) = 3.38, p = .002$; 26 months: $t(23) = 3.96, p = .001$; and 30 months: $t(22) = 4.3, p = .000$). Results for the imitation task are shown in Figure 2.

Spontaneous Production

Visual inspection of the data revealed that children produced nouns first at 16 months of age, with verbs following by 18 months of age. While children produced small numbers of nouns before the verbs for the spontaneous production task, the differences between noun and verb production at early ages were not significant. The repeated measures ANOVA revealed that for spontaneous production, the main effects of part of speech, $F(1, 18) = 23.53, p = .000$, and age, $F(1, 12) = 5.93, p = .004$, were significant. Furthermore, the interaction between part of speech and age, $F(1, 12) = 4.7, p = 0.01$, was significant. Paired t-tests revealed that the difference between nouns and verbs for the spontaneous production measure became significant

at 22 months ($t(24) = 2.15, p = .042$) and remained significant throughout the remainder of the study (24 months: $t(24) = 3.16, p = .004$; 26 months: $t(23) = 3.58, p = .002$; 28 months: $t(22) = 2.52, p = .02$; and 30 months: $t(22) = 2.54, p = .019$). Beginning at 22 months, verb production significantly exceeded noun production. Results for the spontaneous production task are shown in Figure 3.

Prompted Production

Children varied a great deal on when they began to respond to prompts for the names of the novel objects and actions. Visual inspection of the means for prompted production revealed that children produced their first verbs in response to a prompt as early as 12 months of age, while they did not produce nouns in response to prompts until 20 months of age. The repeated measures ANOVA revealed that for prompted production, the main effects of part of speech, $F(1, 18) = 6.86, p = .017$, and age, $F(1, 10) = 5.44, p = .007$, were significant. The proportion of correct responses for both nouns and verbs increased with age. Although children produced more verbs than nouns when prompted at every month, this difference only reached significance at 30 months of age ($t(22) = 3.01, p = .006$) because the numbers produced in the earlier months were small. None of the interactions between the variables reached significance. Results for the prompted production task are shown in Figure 4.

Item Analysis

When the mean number of correct responses was calculated for each item across ages, analysis of the words used in the study revealed that there were differences between the stimuli. For example, visual inspection of the means revealed that *vlad* was consistently produced the

least across all tasks and all ages, while *doke* was produced consistently more often. Overall, the items that were preferred or avoided could not be explained by the phonological makeup of the words. Other items had the same CVC structure as *doke*, but were not preferred, and the same CCVC structure of *vlad*, but were not avoided. The children produced more verbs than nouns even though there were an equal number of nouns and verbs with phonologically permissible English sequences and an equal number of non-English phonology words. Children did simplify the words containing consonant clusters (e.g., deleting a consonant sound: vrue → vu; producing an easier consonant in the cluster: vrue → vwue), but the phonological complexity did not prevent them from learning the referents of the words. Overall, the increase in verb productions was never due to one particular word such as *doke*. While there are item effects, it is not the case that just one or two verbs are driving the effect across the board. Further analysis of the items and words is necessary to determine why particular words/items were more salient.

Are there differences between comprehension and production in which class of words (nouns or verbs) is learned earlier?

Comprehension Measures

A summary of the comprehension results is presented in Table 3. Although the noun and verb comprehension cannot be compared directly due to task differences, there does not appear to be any evidence of a noun bias in comprehension. Using Wilk's Lambda, we conducted an ANOVA with age (3 groups: 12 – 16 months (Group 1); 18 -22 months (Group 2), and 24 – 30 months (Group 3) on the proportion of nouns comprehended. We utilized age groups to increase statistical power. The repeated measures ANOVA revealed a significant main effect of age, $F(2,19) = 7.06, p = .005$.

We ran follow-up *t*-tests at each age to determine if performance on the noun comprehension task improved with age. Post-hoc tests indicated that performance between age Groups 1 and 3 ($t(21) = 3.39, p = .003$) and Groups 2 and 3 ($t(20) = 2.56, p = .019$) differed from one another significantly. Therefore, as age increased, children performed better on the noun comprehension task. Post-hoc analyses indicated that performance at individual ages within groups did not statistically differ from chance until 30 months of age.

A repeated measures ANOVA for verb comprehension across the three age groups revealed a main effect of age, $F(2,13) = 44.45, p = .000$. Post-hoc analyses show that verb comprehension overall improves with age. The 18 – 22 month olds performed better than 12 – 16 month olds ($t(19) = 4.9, p = .000$), and 24- to 30-month olds performed better than 18 -22 month olds ($t(14) = 3.06, p = .009$). However, verb comprehension did not strongly generalize to new action-object pairings. Results of follow-up *t*-tests indicated that children in each age group performed much better when they were tested with a verb paired with its original object (e.g., *doke the zwiebel*) than when it was paired with a different object (e.g., *doke the fiffin*; 12-16 month-olds: $t(22) = 8.72, p = .000$; 18-22 month-olds: $t(18) = 12.15, p = .000$; 24-30 month-olds: $t(17) = 20.26, p = .000$). The advantage for original action-object pairings will be addressed in the discussion. Refer to Table 3 for a summary of the comprehension results.

DISCUSSION

Most of the literature on American children's early vocabulary composition reports a noun bias. Our findings were at odds with those studies. In the present study, children tended to produce more verbs than nouns on all dependent measures. While children began to produce nouns earlier than verbs on the baseline and spontaneous production tasks, the trend did not continue, and the children quickly began producing many more verbs than nouns.

Comprehension tasks were not directly comparable due to overall task differences; however, the children do not appear to comprehend the nouns at a younger age than the verbs. Below, I return to the major questions of the study and discuss factors that may have contributed to the observed results.

If frequency of presentation of new nouns and verbs is controlled, will children learn the nouns more quickly than the verbs?

When frequency of input of novel nouns and verbs is controlled over time, there does not appear to be evidence of a noun bias. Although children spontaneously produced more nouns than verbs in the earliest months of the study, these differences were not significant because the numbers of words produced were small. Other studies of children learning English have reported a clear noun bias. Several factors may play a role in our results.

Verb Types

The types of verbs we selected may have impacted which category of words was learned first. In this study, all of the verbs were clear actions with defined beginning and end points (e.g., flipping a shuttlecock with one finger). Verbs can be divided into those that have clear actions associated with them (e.g., *jump*) and those that require knowledge of the performer's goals (e.g., *go*) (Huttenlocher, Smiley, and Charney, 1983). The former types are easier to perceive because only one action type is present during the learning situation (i.e., it is obvious when *jumping* begins and ends, but *go* may include a string of actions). Studies that have examined both types of actions find that while verbs encoding goals are produced more frequently (e.g., *go*, *get*, *make*, *do*, etc.), children tend to demonstrate comprehension of the

observable actions first (Huttenlocher, et al., 1983). Therefore, the verbs chosen for our study may have been salient due to their observable nature.

Coding Scheme

Perhaps the absence of a noun bias is related to our coding scheme. We believe that the way we coded our data best reflects children's knowledge of the novel words. However, if we adopted a more stringent production criterion, we did find a noun bias. We recoded the data taking the accuracy of words produced into account. We coded children's productions with a score from 0-3. A child who did not produce any response was given a 0. If the child produced a word that was not the target, he/she was given a score of 1. Producing an approximation of the target word (uttering the vowel and a consonant) resulted in a score of 2, and accurate productions of the target words resulted in a score of 3.

When we coded children's productions in this way, we found that children appeared to show a noun bias in production. This was because they produced the nouns more accurately despite their more numerous attempts to produce the verbs. This had the effect of inflating the noun scores. It is not clear why children's verb productions were less accurate despite their more numerous attempts. When we analyzed the articulatory complexity of the words, we could not identify a reason for why this might have been the case. There were an equal number of nouns and verbs that contained complex consonant clusters and one versus two syllables. This is a point that requires further examination.

Previous literature does not report information on children's accuracy of productions. Perhaps one factor contributing to reports of a noun bias in the literature is that in studies using speech samples, researchers might be more likely to give children credit for nouns when

transcribing because these were produced more accurately. It is not clear, however, whether nouns and verbs differ in accuracy in natural speech.

Frequency of Emerging Words vs. Preexisting Vocabularies

Only one other study that we know of teaches new nouns and verbs, such as in our study, where the emergence of word meanings in children's vocabulary can be measured (Childers and Tomasello, 2002). By teaching words in both syntactic categories while controlling frequency, one can assess whether one class can be learned more easily. Analysis of the emergence of new words enables us to determine which class of word is learned first because children are hearing both categories of words (nouns and verbs) at the same time and with the same frequency.

Our study began with novel words, which enabled us to look at how the knowledge of the meanings of the words developed over time. In doing so, we found that children did not appear to have a conceptual predisposition to learn the names of objects. Rather, this study demonstrates conditions under which children show a clear verb bias.

Longitudinal Study

Most studies of the noun bias have only observed children's word learning at one point in time. In other words, there have been few longitudinal studies of the noun bias. Because most past research has been conducted at only one point in time (and usually with small N's), drawing conclusions about vocabulary composition over time is difficult. Longitudinal studies enable us to examine word learning over time to determine whether a bias and the factors contributing to it may be consistent across all of development or whether it is only present early in word learning. In our study, children demonstrated early production of nouns in the baseline and spontaneous

production tasks; however, their productions of the verbs quickly surpassed the noun productions.

Types vs. Tokens

The present study controlled both type and token frequencies of nouns and verbs. Input frequency and the relationship with word learning is complex. If the frequency of word tokens determined vocabulary composition, then children would produce more articles, pronouns, and prepositions because these words are used most often (Goodman, Dale, and Li, in press). Cross-linguistically, however, children tend to produce content words (nouns and verbs) the most. Therefore, overall, word tokens do not seem to predict acquisition (refer to Table 1), but tokens within a syntactic category may impact development (Goodman, et al., in press). This indicates that the number of word types may be more influential in word learning than the frequency of word tokens.

Natural vs. Experimental Environments

Many studies of the noun bias collect data from a child's natural environment, where it is difficult to control the likelihood of production of nouns versus verbs. Many factors, such as context, may influence frequency in natural environments (Goldfield, 1993; Tardif, et al, 1999). Mothers tend to prompt for object names more than action labels, which results in the appearance of a noun bias (Goldfield, 1993; Tardif, et al, 1999). In order to control frequency, it is necessary to teach children unfamiliar words whose input frequency can be controlled in order to observe the emergence of comprehension and production of words of various syntactic categories. The lack of control of these factors may account for the noun bias that is so often

observed in studies. When we instead look at the emergence of individual words whose frequency of presentation has been controlled, verbs appear to be learned earlier. These findings must be qualified by the fact that the experimental task involved play (rather than book-reading). However, they suggest that, in prior studies, the frequency of noun and verb prompts in the input contributed to the noun bias in American children.

Sentence position

The way nouns and verbs are highlighted within a sentence may also impact word learning in children. We typically think of nouns as highlighted in English because they occur in sentence final position and receive the greater stress (Bornstein, et al., 2004 and Gentner, 1982), while pro-drop languages such as Mandarin and Korean, have a syntax which allows for the subject of the sentence to be dropped. Furthermore, verbs tend to occur in sentence-final position. This leaves a sentence structure that highlights the verbs. Cross-linguistic studies of pro-drop languages have reported that children who speak these languages do not show a noun bias during word learning (Choi, 2000, Choi and Gopnik, 1995, Sandhofer, et al., 2000, Tardif, et al., 1997, and Tardif, et al., 1999).

When we analyzed the syntactic frames used in our study, we found that the experimenter unknowingly highlighted both nouns *and* verbs. In ongoing research in our lab, we are coding the syntactic frames of all utterances produced by the experimenter containing the novel nouns and novel verbs. Data analyzed to date (12 children) shows that she presented the nouns in utterance-final position 96% of the time, and in isolation 1% of the time. The experimenter highlighted the verbs, however, by presenting them either in isolation (55%), utterance-final position (10%), or medial position followed by an unstressed pronoun (e.g., *doke it*; 16%). Brent

and Siskind (2001) have reported that hearing words in isolation, rather than hearing the word within sentences, predicts children's ability to learn words faster (Brent and Siskind, 2001). This suggests that hearing words presented in isolation may aid in vocabulary acquisition, because this structure is more salient to children. We do not know whether mothers may similarly highlight verbs in natural environments or if the frequency of highlighting verbs in natural speech increases with age. While American mothers tend to prompt more for nouns in these environments, more work is necessary to determine whether they highlight verbs in child-directed speech.

Are there differences between comprehension and production in which class of words (nouns or verbs) is learned earlier?

The children in our study did not learn nouns earlier than verbs in either comprehension or production tasks. While there was no clear noun bias in our comprehension data, our comprehension tasks for nouns and verbs are not directly comparable. Superficially, the noun comprehension task could be easier because it involved recognition of the item (children were required to choose the item named from a field of four). The verb comprehension task required the children to recall the action named and perform the action on the item presented. On the other hand, using an array of four items in the object array may have been hard for such young children. However, children of similar ages have performed this task with pictures (Goodman, McDonough, and Brown, 1998). Still, the lack of an advantage for nouns seems clear despite task differences. More research is required to develop a method of measuring the comprehension of nouns and verbs in ways that are directly comparable. Further, as previously discussed, the items chosen for the study appeared to impact the noun comprehension results.

Children seem to be more likely to choose an object they prefer (e.g., *bik*) than the object requested by the experimenter. Further analysis of item preferences is necessary to better understand the results of the noun comprehension task.

There are few other studies that examine the noun bias in comprehension. English-speaking children, ages 14-26 months, were found to comprehend and produce more nouns than verbs (Goldin-Meadow, et al., 1976). English-speaking children, ages 28-31 months, learning novel nouns and verbs appear to comprehend nouns and verbs equally well. In a study by Childers and Tomasello (2002), children were divided into two groups and taught either novel nouns or verbs. To assess comprehension of nouns, the examiner showed a child the set of novel objects and asked him/her to choose one of the items (recognition). To assess comprehension of verbs, the examiner showed a child the novel objects and asked the child to choose the item that performed the verb's action (e.g., "Show me the one that dacks."). Assessment of comprehension revealed that the children from the noun and verb groups appeared to comprehend nearly equal numbers of nouns and verbs (Childers and Tomasello, 2002).

Comprehension by Ngas-speaking children (ages 12-31 months) was assessed using maternal report of comprehension for nouns and verbs (Childers, et al., 2007). Parents reported that children comprehended proportionally more verbs than nouns (proportion of nouns comprehended to total nouns and vice versa for verbs), with no difference in production. The Ngas speaking culture also tended to place greater emphasis on verbs than nouns (Childers, et al., 2007). Therefore, prior studies of comprehension do not resolve whether there is a noun bias in comprehension. Very young English-speaking children tend to comprehend more nouns than verbs when sampling their pre-existing vocabularies early in language development; older English-speaking children tend to comprehend the same number of nouns and verbs when taught

novel words; and parents of children who speak Ngas tend to report that their children comprehend more verbs than nouns across ages. Future work is necessary to develop ways of collecting both noun and verb comprehension data on children cross-linguistically in order to measure the potential presence of a noun bias.

CONCLUSIONS

When frequency of presentation of novel nouns and verbs was controlled over exposures, children did not show a noun bias in early word learning. From very early ages, children demonstrated the ability to produce both nouns and verbs. In the baseline and spontaneous production tasks, the children produced nouns before verbs; however, the children quickly began to produce the verbs more frequently than the nouns in all production tasks. Thus, despite the small number of noun productions very early in word learning, children ultimately exhibited a verb bias in production when taught novel nouns and verbs whose input frequency was controlled.

How do we reconcile these findings with previous reports that American children's early vocabularies contain a larger proportion of nouns than verbs (Bornstein, et al., 2004; Gentner, 1982; Goldfield, 2000; Goldin-Meadow, et al., 1976; Tardif, et al., 1997; and Tardif, et al., 1999)? In studies of parental input, mothers have been found to produce more noun types than verb types to their children (Choi, 2000; Choi and Gopnik, 1995; Goldfield, 1993; Sandhofer, et al., 2000; Tardif, et al., 1999). While mothers may produce more verb tokens overall, the children are hearing a wider variety of noun types. This could lead to the noun bias in American children because mothers spend more time labeling different objects while they frequently use the same verbs. Therefore, children may hear a relatively small number of verbs repeatedly,

while being introduced to a wider array of nouns overall. When the number of nouns and verbs is controlled, as in the present study, children do not learn more of the nouns than the verbs. The types of verbs that mothers produce in natural environments (i.e., words for observable actions vs. words for goal-directed actions) and the number of verbs produced in isolation should also be considered. Further research is required to determine the types of verbs mothers are using in natural child-directed speech and how they highlight verbs in natural contexts.

As discussed earlier, prior studies used different data collection methods from one another and from the present study. The ways in which data is collected may impact the observed frequency with which caregivers use nouns and verbs and whether or not children show a noun bias. In our study, we directly controlled word frequency and taught children completely novel words. The noun bias has implications for the ease of learning nouns, but few previous studies actually looked at the emergence of word meanings in children. Rather, they established what proportion of children's vocabularies consisted of familiar nouns and inferred that the composition of the vocabulary reflected the ease of learning a particular part of speech. In the present study, we were able to track how children learn words initially, as opposed to tracking usage of already familiar words.

In addition to the lack of a noun bias in our production data, the children in our study likewise did not show a noun bias in comprehension. During the verb comprehension task, children demonstrated learning of the object-action pairings. Their performance on the verb comprehension task, however, showed that they did not generalize verb meanings to alternative objects consistently by 30 months of age. These results were not surprising, considering that the input never provided examples of the verbs with other objects; children may not have realized that the verb allows other objects. Olguin and Tomasello (1993) reported that children do not

generalize the syntactic form of new verbs. For example, if they hear a new verb in a verb-patient utterance, they will not generalize it to a subject-verb-patient form and vice versa.

Similarly, they may stick close to their input in generalizing verb meanings.

In sum, our findings suggest that the noun bias that has been so pervasive in studies of American children may be an artifact of how mothers use language rather than a conceptual predisposition. Mothers tend to produce more nouns types than verbs types in natural environments and this may play an important role in what words children learn. Further, the verbs produced most frequently tend to encode goals rather than observable actions (Sethuraman and Goodman, 2004). While many other contributing factors to language acquisition were not considered in this study (i.e., intonation, context, cultural differences), it is likely that a combination of these input factors is responsible for the noun bias observed early in the development of English-speaking children.

REFERENCES

- Au, T.K., Dapretto, M., & Song, Y. (1994). Input vs. constraints: Early word acquisition in Korean and English. *Journal of Child Language*, **33**, 567-582.
- Bornstein, M., Cote, L., Maital, S., Painter, K., Park, S.Y., Pascual, L., Pecheux, M.G., Ruel, J., Venuti, P., and Vyt, A.. (2004). Cross-linguistic analysis of vocabulary in young children: Spanish, Dutch, French, Hebrew, Italian, Korean, and American English. *Child Development*, **75**, 1115-1139.
- Brent, M.R., Siskind, J.M.. (2001). The role of exposure to isolated words in early vocabulary development. *Cognition*, **81**, 33-44.
- Caselli, M.C., Bates, E., Casadio, P., Fenson, J., Fenson, L., Sanderl, L. & Weir, J. (1995). A cross-linguistic study of early lexical development. *Cognitive Development*, **10**, 159-200.
- Childers, J.B. and Tomasello, M. (2002). Two-year-olds learn novel nouns, verbs, and conventional actions from massed or distributed exposures. *Developmental Psychology*, **38**, 967-978.
- Childers, J.B., Vaughan, J., and Burquest, D.A. (2007). Joint attention and word learning in Ngas-speaking toddlers in Nigeria. *Journal of Child Language*, **33**, 199-225.
- Choi, S.. (2000). Caregiver input in English and Korean: Use of nouns and verbs in book-reading and toy play contexts. *Journal of Child Language*, **27**, 69-96.
- Choi, S. and Gopnik, A.. (1995). Early acquisition of verbs in Korean: A cross-linguistic study. *Journal of Child Language*, **22**, 497-529.
- Fenson, L., Dale, P.S., Reznick, J.S., Bates, E., Thal, D., & Pethick, S.J. (1994). Variability in early communicative development. *Monographs of the Society for Research in Child Development*, **59**, (5, Serial No. 242).
- Gentner, D. (1982). Why nouns are learned before verbs: Linguistic relativity versus natural partitioning. In S.A. Kuczaj (ed.), *Language development (Volume 2): language, thought and culture*, 301-334. Hillsdale, NJ: Lea.
- Goldfield, B. (1993). Noun bias in maternal speech to one-year-olds. *Journal of Child Language*, **20**, 85-99.
- Goldfield, B. (2000). Nouns before verbs in comprehension vs. production: The view from pragmatics. *Journal of Child Language*, **27**, 501-520.
- Goldin-Meadow, S., Seligman, M.E., and Gelman, R. (1976). Language in the two-year old. *Cognition*, **4**, 189-202.

- Goodman, J. C., McDonough, L. & Brown, N. (1998). The role of semantic context and memory in the acquisition of novel nouns. *Child Development*, **69**, 1330-1344.
- Goodman, J.C., Dale, P.S., and Li, P. (In press). Does frequency count? *Journal of Child Language*.
- Huttenlocher, J., Smiley, P., and Charney, R. (1983). Emergence of action categories in the child: Evidence from verb meanings. *Psychological Review*, **90**, 72-93.
- Olguin, R. & Tomasello, M. (1993). Twenty-five-month-old children do not have a grammatical category of verb. *Cognitive Development*, **8**, 245-272.
- Sandhofer, C.M., Smith, L.B., and Luo, J. (2000). Counting nouns and verbs in the input: Differential frequencies, different kinds of learning. *Journal of Child Language*, **27**, 561-585.
- Sethuraman, N. & Goodman, J.C. (2004b) *Learning to generalize verbs to new syntactic environments*. In E.V. Clark (Ed.) Online proceedings of the 32nd session of the child language research forum (pp. 78-87). Stanford, CA: CSLI Publications. <http://www-csli.stanford.edu/pubs>.
- Tardif, T., Shatz, M., and Naigles, L. (1997). Caregiver speech and children's use of nouns versus verbs: A comparison of English, Italian, and Mandarin. *Journal of Child Language*, **24**, 535-565.
- Tardif, T., Gelman, S.A., and Xu, F. (1999). Putting the "noun bias" in context: A comparison of English and Mandarin. *Child Development*, **70**, 620-635.

FIGURES

Figure 1

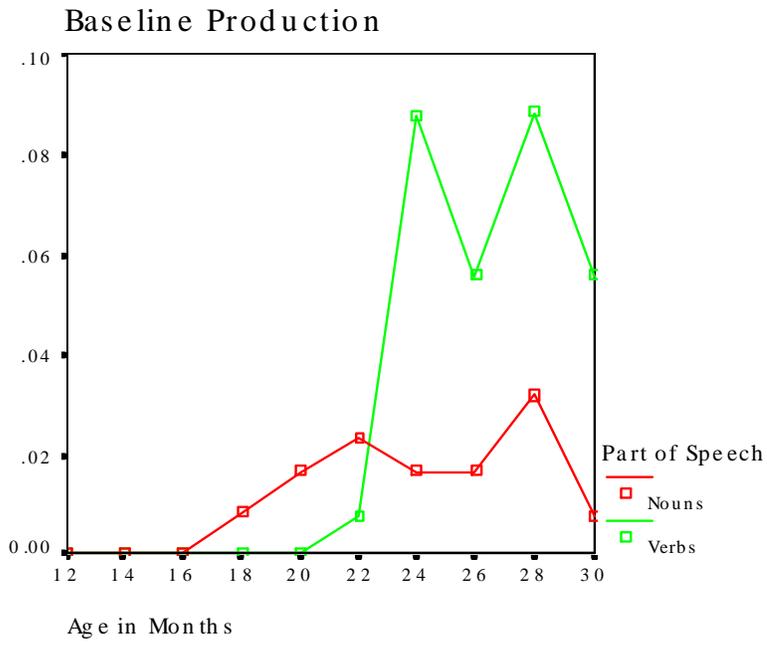


Figure 2

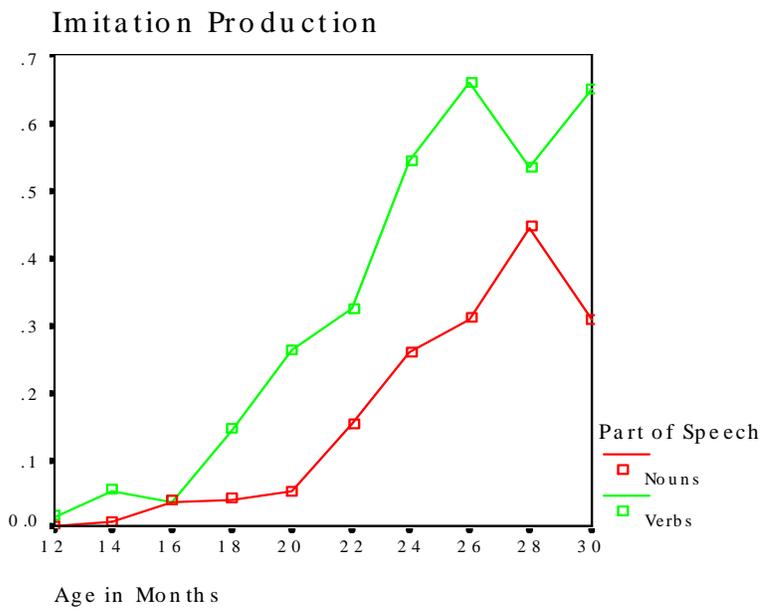


Figure 3

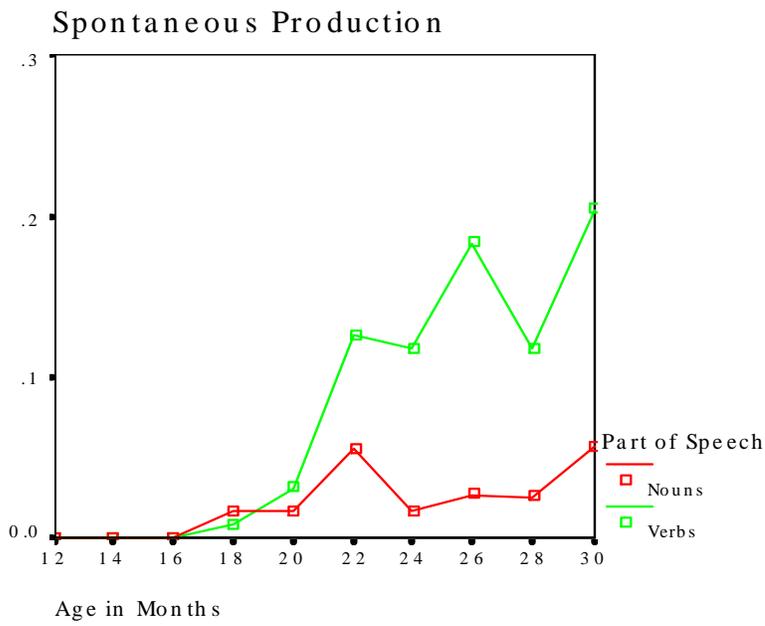
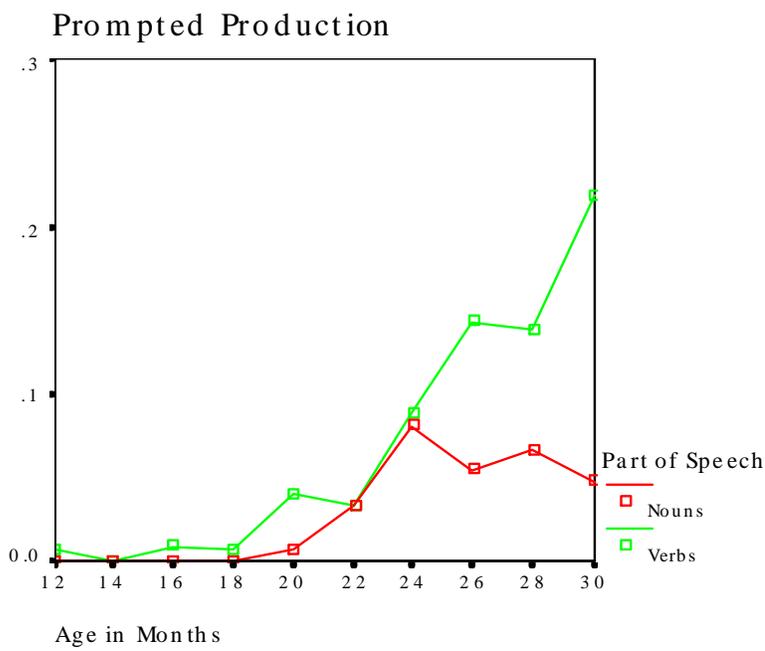


Figure 4



TABLES

Language	Input		Vocabulary Composition	
	<i>Types</i>	<i>Tokens</i>	<i>Types</i>	<i>Tokens</i>
English	Nouns/Equal	Verbs	Nouns	Nouns
Mandarin*				
Gentner, 1982			Nouns	
Sandhofer, et al., 2000	Nouns	Verbs		
Tardif, et al., 1997	Verbs	Verbs	Verbs	Verbs
Tardif, et al., 1999	Verbs		Nouns/Equal	
Korean	Verbs/Equal	Verbs	Nouns/Equal	
Italian	Equal	Verbs	Nouns	Equal

Table 1: Cross-linguistic data on frequency of input (caregivers) and vocabulary composition (children)

*Note: Due to similar findings across studies of English and Korean, individual studies were not reported. Because findings on Mandarin are conflicting, individual studies are reported.

Novel Noun	Object	Novel Verb	Novel Action
Bik	Tire Pressure Gauge	Chlapate	Pulling pressure meter in and out of the tire gauge
Fiffin	T-Pipe with Fluffy Red and Blue Cotton Balls	Vrue	Holding t-pipe with two hands and pushing out from forehead
Pwat	Swim Goggles	Kooble	Holding goggles up to eyes with two hands
Wug	Shuttlecock	Svit	Flipping shuttlecock with one finger
Zwiebel	Shoe Tree with Eyes, Fluffy Ball Nose, and Fur	Doke	One-handed tap on stomach with body portion of shoe tree
Vlad	Swim Nose Plugs	Gutch	Using both hands, holding nose plugs up to nose and bringing back down

Table 2: Novel nouns and verbs with the actions they denote

Age (Months)	Noun Comprehension Total	Verb Comprehension Total	Verb Comprehension (Original Pairs)	Verb Comprehension (Generalized Pairs)
12-16 Months	0.23	0.21	0.37	0.06
18-22 Months	0.26	0.39	0.66	0.14
24-30 Months	0.32	0.51	0.83	0.19

Table 3: Average scores for comprehension of novel nouns and verbs