Mandarin- and English-learning Infants' Self-Correction During Noun and Verb Matching: Implications for early word comprehension

by

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Abstract

Previous research has suggested that in early language acquisition English-learning infants more readily acquire nouns whereas Mandarin-learning infants have a tendency towards acquiring verbs (Tardif, Gelman, & Xu, 1999; Tardif, Shatz, & Naigles, 1997; Tardif, 1996; Chan, Brandone, & Tardif, 2009). The current study sought to analyze how these tendencies manifest in infants' self-corrective looking behavior after an initially incorrect word matching (e.g. looking at the object in a visually-displayed scene when the scene's verb was presented auditorily) by presenting sets of four "familiar" action labels, four "familiar" object labels, and their referents in a "preferential-looking" paradigm to 127 15-, 18-, and 24-month-old English- and Mandarin Chinese-learning infants. Overall, children in both language groups were faster to self-correct for nouns than they were for verbs (p<.001). No significant interaction was found between language and part of speech. Self-correction times did not present evidence of a tendency towards acquiring nouns and verbs on the part of English- and Mandarin-learning infants, respectively.

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The noun bias was previously thought to be a universal phenomenon observed in all children across languages and cultures (Gentner, 1982). The noun bias proposes that children are naturally disposed to map novel words as nouns rather than verbs and they therefore learn nouns before verbs. The idea of a universal noun bias was believed to be true; however, in the past two decades, new evidence has arisen suggesting that the noun bias may not indeed be universal. It has been observed in several studies that English-learning children have a tendency towards acquiring nouns in early language learning, whereas Mandarin-learning children have a tendency towards acquiring verbs (Tardif, Gelman, & Xu, 1999; Tardif, Shatz, & Naigles, 1997; Tardif, 1996; Chan, Brandone, & Tardif, 2009).

Tardif et al. (1997) studied noun and verb biases through caretakers' infant-directed speech. In this study, researchers visited participants (both American and Chinese families) in their homes where they recorded adult-to-child speech as well as children's spontaneous production of nouns and verbs. Adult-to-child speech was then coded for frequency of noun and verb use. English-speaking caretakers were observed to produce more nouns than verbs in their speech, whereas Mandarin-speaking caregivers produced more verbs than nouns. Both English-speaking caregivers and children produced more nouns than verbs; however, the caregivers did produce proportionately more verbs than the children. This disparity in verb production between English-speaking caregivers and children could support the theory of a universal noun bias. A bias would explain the high frequency of noun production despite the lack of an equal rate of noun input. However, the Mandarin-learning children's results challenge this theory. Mandarin-learning children both produced more verbs than nouns and produced more verbs than English-learning children produced. Given that Mandarin-speaking caregivers produced more verbs than nouns, Mandarin-learning children's higher production of verbs to nouns could be due to language input on the part of the caregiver.

Several other studies also support the finding of a preponderance of verbs in Mandarin-learning children's early language acquisition. For instance, Tardif et al. (1999) compared number of nouns and verbs used by English- and Mandarin-learning children in three different play contexts: book reading, mechanical toy play, and regular toy play. Again, English-learning children were observed to produce more nouns than verbs and Mandarin-learning children produced more verbs than nouns. In this study, the number of nouns and verbs produced by caregivers and children was found to be largely affected by context. Play with regular toys was associated with greater verb than noun production, but there was an even greater difference in verb and noun use observed in play with mechanical toys (this difference could be explained by the active nature of mechanical toys). Book reading, on the other hand, was largely dominated by nouns as observed with both English- and Mandarin-speaking caregivers as well as English- and Mandarin-learning children. In contexts with a visible action– in the case of this study, playing with regular or mechanical toys– English- and Mandarin- learning children were found to produce a larger amount of verbs.

Chan et al. (2009) reexamined the transcripts from the adult-child book reading sessions conducted by Tardif et al. (1999) in order to more accurately support the presence or absence of tendencies towards noun and verb acquisition in early language learning. Revisions to the coding included removing utterances that were unrelated to the book reading; examples of such utterances could be the child repeating after the caregiver or the caregiver giving an instruction to the child. The book used in the study was a picture book containing three different types of pictures: pictures of an agent, pictures of an object, and pictures of transitive actions. Researchers observed that English-speaking caregivers focused on the objects and agents in the pictures, whereas Mandarin-speaking caregivers focused on the actions; the children's results followed the same pattern. From this study, the researchers concluded that the verb and noun biases observed in English- and Mandarin-learning children were due to a combination of cultural preferences (e.g. what aspects of the story the caregiver and child focused on), characteristics of the languages, and the type of scene presented in the pictures.

What is the cause of these noun and verb tendencies? One reason behind Mandarin-learning children's preponderance of verbs could be the structure of the language itself. Mandarin is a pro-drop language– that is to say, pronouns and subjects in sentences are optional (Tardif et al., 1997). In Mandarin, speakers are able to drop verb arguments if they believe the listener will be able to infer the meaning from the context of the sentence. This ability to drop subjects and objects from a sentence means that a Mandarin-speaker could form a sentence that is essentially just composed of a verb. Verbs should thus be more frequent in Mandarin than in English (Imai et al., 2008). The way in which ideas are expressed in Mandarin may also contribute to its observed differences with English. Mandarin uses general nouns and specific verbs, whereas English uses specific nouns and general verbs (Tardif, 2006). For example, there are many different nouns for types of automobiles in English and just one verb (drive) to describe the associated action. This characteristic would lead to Mandarin speakers producing more verbs due to the greater variety in the lexicon, the same being true of English speakers and nouns. The natural placement of words in English and Mandarin could also affect the influence of caregivers' speech on language-learning children. It could be that English adult-to-child language naturally emphasizes nouns, whereas Mandarin adult-to-child language puts emphasis on verbs due to the different syntactic placement of nouns and verbs in English and Mandarin sentences (Tardif et al., 1997).

Syntactic bootstrapping offers another explanation for how Mandarin-learning children acquire verbs. The syntactic bootstrapping theory posits that children use the syntactic frames in which verbs are placed in order to infer their meaning (Gleitman, 1990). Lee and Naigles (2007) studied how syntactic bootstrapping occurs in Mandarin-learning children when they are provided with input potentially lacking syntactic frames (e.g. if a speaker drops the subject and/or object in a sentence). Lee and Naigles found that Mandarin-learning children changed their interpretation of a verb depending on the number of noun arguments (NPs) in the sentence. If there was one NP present, a child was more likely to interpret the verb as intransitive, whereas if there were two NPs present, a child was more likely to interpret the verb as transitive. These findings are interesting because Mandarin-learners were seen to use syntactic information that was not necessarily well-supplied in their language input in their early verb learning. The practice of syntactic bootstrapping could therefore be innate since Mandarin-learners displayed this behavior even without the input of syntactic frames from which to "bootstrap" (Lee & Naigles, 2007).

It is also possible that Western and Chinese cultures influence how language is acquired by children. Chan et al. (2009) found that while reading a book with their child, English-speaking caregivers tended to focus on focal objects and agents in pictures, whereas Mandarin-speaking caregivers focused on actions and relations that connected the different elements of a picture. This difference in focus could be explained by the cultural structure of Western and Chinese societies. Western society, an individualistic culture, focuses on individual aspects of a sentence– the objects and agents. Chinese society, an interdependent culture, focuses on the links between parts of a sentence– the actions that tie the objects and agents together. Culture would thus influence language use and production of nouns and verbs in English and Mandarin speakers.

The studies discussed present evidence for a tendency towards acquiring verbs in Mandarin-learning children; however, other studies have found evidence to counter this claim. Imai et al. (2008) argue against a tendency for verb acquisition in Mandarin-learning children, arguing instead for the universal noun bias initially proposed by Gentner (1982). In Mandarin Chinese, as previously discussed, verb arguments are often dropped in sentences if the speaker thinks the listener will be able to infer the arguments from context; verbs should thus be more frequent in Mandarin than in English, a language in which verb arguments are not dropped in the same way (Imai et al., 2008). In addition, Mandarin Chinese verbs are morphologically simplistic– that is to say, Mandarin-learning children don't need to learn inflectional forms of verbs, but rather only one form (Gentner, 1982). The researchers of this study sought to answer the question of whether children learning verb friendly languages such as Mandarin would more readily extend novel verbs to novel actions. Imai et al. (2008) studied novel noun and verb mapping in Mandarin-, Japanese-, and English-learning children; in the interests of the present study's focus, only the findings on Mandarin- and English-learning children will be discussed. Participants were presented with videos displaying novel actions and objects in conjunction with three different word types. Both novel noun and novel verb with arguments were presented in English and Mandarin. The third word type varied between languages: English-learning children were presented with a novel bare verb and Mandarin-learning children were presented with a bare word (a word whose structure could belong to either a noun or verb). Imai et al. (2008) found that English-speaking three- and five-year-olds successfully mapped novel nouns to novel objects. As for verbs, five-year-olds were successful in mapping verbs with arguments onto novel actions, but only performed at chance level for bare verbs. Three-year-olds performed at chance level for both verb types. Mandarin-learning children, despite what may be expected due to Mandarin's verb friendly nature, mapped novel verbs onto actions at a rate below chance level, a finding that was seen in both three- and five-year-olds. Mandarin-learners displayed a strong tendency to map novel words to novel objects, whether the novel word was presented as a noun, verb, or bare word. These findings clearly challenge the theory of a Mandarin tendency towards verb acquisition in opposition to a universal noun bias (Gentner, 1982; Tardif, 1996).

The preceding theories and evidence provide possible reasons behind noun and verb "biases" (as well as counterevidence against these biases), but do these biases imply a deficit in knowledge of the other word type? That is to say: do English-learning children with a "noun bias" have a lesser understanding of verbs compared to Mandarin-learning children with a "verb bias"? The present study sought to answer this question by analyzing, not how a child immediately matches a word to a scene, but how he or she self-corrects after realizing an initial incorrect matching. If a child incorrectly matches a verb-label to an object, but then corrects to an action, how quickly does this occur? By analyzing self-correction times, I may find patterns that imply a deeper understanding than is apparent from examining production alone. The current study used a mixture of the intermodal preferential looking paradigm (IPLP) and the "looking while listening" technique described by Fernald, Zangl, Portillo, and Marchman (2008).

In contrast to the MacArthur-Bates Communicative Development Inventory which is an off-line language measure (meaning language is measured after the initial language input), "looking while listening" is an on-line language measure; an infant's language is measured as he or she receives language input. In the "looking while listening" technique the participant's gaze patterns are videotaped and the eye movements are later coded for looking patterns (left, right, center, or away). Looking patterns are then aligned with specific auditory signals in order to match language cues with the looking patterns they elicited. The "looking while listening" technique therefore gives experimenters a much more nuanced look into infants' language acquisition than other research techniques (Fernald et al., 2008). The "looking while listening" method was integrated into this research through the coding of self-correction time. By using the "looking while listening" method in the present study, I was able to define self-correction as occurring after the auditory presentation of the target word, providing insight into how infants matched the target word to a visual stimulus.

Fernald et al. (2008) conducted a study using looking behavior to measure latency to switch from a distracter to a target stimulus. What I will call self-correction time in my study was called shift latency by Fernald et al. The researchers defined shift latency as a shift away from the distracter to the target visual stimulus that occurred after a critical point in the auditory stimulus. In the same way, I looked at self-correction which only occurred after the auditory presentation of the target word. Fernald et al. (2008) subtracted 200 ms from each participant's shift latency in order to take into account response time, including time to comprehend the auditory stimulus and disengage from the distracter (Hood & Atkinson, 1993). I decided to include this reaction time in the self-correction time as I consider reaction time to intrinsically be part of self-correction time; the time it takes to disengage from the distracter stimulus is part of the self-correction time as a whole. The following study's design was that of an IPLP study, while the data analysis more closely resembles that of a "looking while listening" study. Participants' matching of auditory and visual stimuli was measured through their total looking times, which were used to calculate their self-correction times. In a mode of analysis characteristic of "looking while listening" studies, however, looking behavior occurring only after the auditory presentation of the target word was used to calculate self-correction times in order to ensure that participants' looking behavior was in reaction to a comprehension of the target word.

In this research, I aimed to study, through analysis of self-correction times, the presence of a "verb bias" in early acquisition of Mandarin Chinese as compared to a "noun bias" in early acquisition of English. Based on research suggesting that Mandarin-learners have a preponderance of verbs in early language acquisition (Tardif, Gelman, & Xu, 1999; Tardif, Shatz, & Naigles, 1997; Tardif, 1996; Chan, Brandone, & Tardif, 2009), I hypothesized that I would find a significant interaction between part of speech and language such that Mandarin-learners would self-correct more quickly to target verbs over nouns and English-learners would self-correct more quickly to target nouns over verbs. Such results would suggest that Mandarin-learning children, in addition to acquiring more verbs in early language acquisition than English-learners, are also able to better realize their errors when incorrectly matching verbs to visual stimuli (the same being true of English-learning children and nouns).

Method

Participants

Participants (*n*= 127) were healthy, monolingual infants, carried to full-term, and learning either English or Mandarin Chinese. The participants were divided into three age groups: 15-, 18-, and 24-month-olds. The study was conducted in partner labs at the University of Michigan and at the Chinese Academy of Sciences. Research was done with English-learning participants at the University of Michigan and Mandarin-learning participants at the Chinese Academy of Sciences. English-learning participants were recruited from a participant database the lab shares with another research group affiliated with the University of Michigan and Mandarin-learning participants were recruited through emails and flyers which provided contact information for interested caregivers.

Procedure

Participants and their caregiver(s) were met outside the testing center by a research assistant (RA) and were then brought up to the study area which consisted of a playroom and an experiment room. The caregiver(s) and participant were first led to the playroom where an RA conducted Po familiarization with the participant while another RA administered surveys with and explained the study to the caregiver(s). The caregiver(s) and participant were then taken into the experiment room where the caregiver was asked to sit in a chair in front of the display screen with the participant in his or her lap. They were shown a short five-minute video displaying Po performing various actions on different objects. Caregiver(s) were asked to close their eyes and not communicate with the child while the video was played so as to not influence the participants' behavior. Participants were videotaped during the study and these videos were later coded by RAs to determine participants' looking behavior.

Materials

CDI. RAs administered the language appropriate (English or Mandarin Chinese) version of the MacArthur-Bates Communicative Development Inventory with the caregiver(s). The CDI was used to measure each participant's noun and verb vocabulary size. Depending on the age of the participant, the RA administered either the infant or toddler form. For infants, vocabulary was measured by whether the participant understood or understood and could say a word. For toddlers, vocabulary was measured by whether the participant could say a word.

Target words checklist. The target words checklist was administered in order to measure participants' knowledge of the study's target words as reported by their parents. Caregivers were asked whether their child understood each target word and then how much confidence they had in their answer. The results of the checklist could, in future analyses, be compared to participants' actual looking behavior in order to address the relationship between parents' reports and children's behavior. (See Appendix A for a copy of the English target words checklist.)

Po Familiarization

While one RA administered the surveys, the other RA played with the child. This play consisted of general play to help the child feel at ease and familiarization with the agent used in the study's video stimuli ("Po the Teletubby"). Familiarization lasted 5-10 minutes and consisted of playing with a small Po plush toy. The RA made Po interact with the child, making sure to use Po's name as an agent approximately 50 times and portraying Po as the actor in pretend scenarios (e.g. "Po's waving hello to you!" "Po wants to build a tower.") The RA also made sure to not use any of the study's target words during the play session. The goal of familiarization was for the participant to see Po not as an object, but as an agent performing actions. (See Appendix B for the English Po familiarization script.)

Stimuli

Video stimuli consisted of centering, silent salience, familiarization, and test trials. In addition to these trials, introductory trials were shown in the first block of the video. These introductory trials showed close-up and far away videos of Po waving at the camera while a female voice said, "Po! Po! Hi Po! Po!" Mandarin-learning infants were shown Mandarin stimuli and English-learning infants were shown English stimuli. The examples presented here will be of the English stimuli. A screenshot showing an example of a scene from both the English and Mandarin versions of the stimuli is shown in Appendix C.

Centering. Centering trials showed video of a laughing baby. These trials were placed in between every other type of trial in order to redirect participants' attention to the center of the screen. By redirecting attention I hoped to ensure that participants' looking behavior for a test trial was not influenced by their looking behavior from the previous trial.

Silent salience. In the silent salience trials the videos to be shown in that block's test trial were shown with no audio. The looking behavior from these trials was used to analyze the salience of each scene. Each participant's salience bias was then calculated from these looking times and used as a cutoff point to discard data gathered from scenes with high salience in the absence of auditory cues.

Familiarization. A video displaying Po performing a familiar action on a familiar object was shown in the center of the screen. While this video was shown, audio of a female voice was played which labeled either the object or action in the scene (e.g. "Sock!" "Kiss" "Touch!").

Test trials. Test trials consisted of two different videos shown on a split-screen. One video showed Po performing the familiar action from the preceding familiarization trial on a novel object and the second video showed Po performing a novel action on the familiar object from the familiarization. The aspect of the scene that was labeled in the familiarization was also labeled in the test trial (e.g. If "Sock!" was labeled in the familiarization, it was also labeled in the test). The location (right or left side of the screen) and the order of the tested words were counter-balanced across participants.

Scoring

Video coding. Videos of participants were coded by undergraduate RAs, at the level of video frames, for left, right, center, and away looking times. Using the coding program Supercoder, RAs marked the beginning and end of each trial as well as the start and end times of every left, right, center and away look. Videos were discarded if the child became overly fussy, either cutting the experiment short or making it impossible to discern eye gaze, or if the parent talked to the child, affecting the child's focus and gaze. In addition, individual trials were discarded if the participant displayed a salience bias (defined as over 80% of the looking time focused on one side) on the scene's corresponding salience trial. Coded looking times were processed to extract latency to correct to the target after an initial non-target look (i.e. how long it took a participant to self-correct after an incorrect first look).

Results

In this study, data from 127 participants was assessed: 54 English-learning participants from the University of Michigan and 73 Mandarin-learning participants from the Chinese Academy of Sciences. Each participant's self-correction time for every test trial was averaged to calculate mean time in milliseconds to correct to nouns and verbs (called noun and verb self-correction times). Proportion of self-corrections for each participant was also calculated by dividing total number of self-corrections by the total number of incorrect first looks, as only trials in which there was an incorrect first look presented the opportunity for self-correction to occur.

Data was analyzed using a repeated measures ANOVA (analysis of variance) with between-subjects factors of age group (15-, 18-, or 24-month-olds) and language (English or Mandarin) and a within-subjects variable of part of speech (noun or verb). A paired t-test was also used to analyze the difference between mean self-correction time and proportion for nouns and verbs.

Salience

Participants' salience bias was calculated for each group of test trials using looking behavior gathered from salience trials. A salience bias cutoff of .80 was used in order to minimize the effect of the video stimuli's salience on participants' self-correction. Salience bias indicates the extent to which a participant was biased toward one of the two videos played simultaneously during a salience trial; it is the proportion of time spent by a participant focusing on one side of the screen out of all sided looks during a trial. As such, salience bias is always at least .50 for all trials. After discarding data from all trials for which a participant's salience bias was over .80, data from 116 participants was left.

Descriptive Statistics

Mean values and standard deviations for self-correction proportion are found in Table 1 and Table 2. Mean values and standard deviations for self-correction time are found in Table 3 and Table 4. Figure 1 shows a visual representation of Mandarin- and English-learners' mean self-correction times for nouns and verbs.

Effect for Self-Correction Time

There was a significant main effect of part of speech such that, overall, participants had faster self-correction time for nouns than for verbs, $F(1, 59) = 17.78$, $p < .001$. The results of the paired t-test conducted on self-correction time for nouns and verbs indicate the direction of this effect, $t(64) = -4.36$, $p < .001$. The significant effect of part of speech on mean self-correction time across language and age can be seen in Figure 1 which shows that self-correction time for nouns was shorter than self-correction time for verbs. In addition, there was a significant interaction between age and language, $F(2, 59) = 3.16$, $p = .05$; although the gap between Mandarin- and English-learners' self-correction times at 15-months was quite small (with Mandarin-learners displaying a faster self-correction time), by 18-months the gap had widened with English-learners now displaying a faster self-correction time– this gap remained constant through 24-months. Figure 2 illustrates this interaction between age and language observed in mean self-correction time combined across nouns and verbs. A main effect for language approached significance, $F(1, 59) = 3.63$, $p = .06$, which suggests that English-learners, overall, tended to self-correct faster than Mandarin-learners.

Effect for Self-Correction Proportion

Interestingly, despite the significant effect of part of speech on self-correction time, there were no significant effects found for self-correction proportion. Additionally, there were no significant interactions observed for self-correction proportion. This suggests that, whereas faster self-correction times are seen for nouns compared to verbs, the number of times an infant self-corrects is not affected by part of speech.

Discussion

The intermodal preferential looking paradigm (IPLP) is a study method commonly used to investigate infants' early language acquisition. This study used the IPLP design to research English- and Mandarin-learning infants' knowledge of nouns and verbs. I used a method of analysis characteristically similar to the "looking-while-listening" paradigm (Fernald et al., 2008) to analyze participants' self-correction after the auditory presentation of each trial's target word.

Familiarization trials consisted of a video, shown at the center of the screen, of an agent ("Po the Teletubby") performing a familiar action on a familiar object while the name of either the action or object was auditorily presented in a female voice. In test trials, the preceding familiarization scene was then split into two scenes, one on each side of the screen. On one side Po performed the familiar action on a novel object and on the other side Po performed a novel action on the familiar object. Participants' looking behavior was interpreted as their matching the presented word with either the familiar action or object, depending on which scene they looked at in the split screen trial. Self-correction time was measured in milliseconds and was defined as the time from the beginning of an initial incorrect look to the beginning of a correct look. Self-correction proportion is the proportion of a participant's incorrect looks that he or she corrected; in other words, the number of self-corrected looks divided by the total number of incorrect looks.

There are several factors that may have affected the results discussed here. First of all, it is inherently difficult to collect a large sample of data when looking at self-correction times (Fernald et al., 2008). In order for data to be useable, the participant's first look must be to the non-target side and he or she must then correct his or her gaze to the target side before the end of the trial. Any trials for which the participant's first look was not to the non-target side must be discarded (i.e. target side looks). Then looking at all trials with an initial incorrect look, any trials during which the participant did not correct to the target side must be thrown out. These steps will have already greatly reduced the size of the data sample. Inability to self-correct could, arguably, be seen as the worst possible (i.e. longest) self-correction time. In this study, however, I was interested in participants' looking behavior for those trials in which there was self-correction, so eliminating data from those trials in which there was no self-correction does not negatively affect the discussed results. Salience of video stimuli must then be taken into account. In this study I used a salience bias cutoff of .80 to account for the salience of video stimuli. This salience bias cutoff, while necessary to improve the validity of the data, decreased the amount of useable data even further. The size of the data sample, therefore, may be a factor in this study's results. Results that appear insignificant may in fact be significant if a larger data sample were analyzed. That being said, I chose the salience bias cutoff of .80 on its merits of both eliminating data from any trials during which a participant was highly biased towards a particular side and leaving a relatively large amount of data to then analyze. One way to increase the amount of useable data in a study of self-correction is to have as many opportunities as possible in the study for a participant to self-correct. For this reason, each test trial in this study consisted of two 5-second repetitions of the same split-screen test. Self-correction time for each repetition was analyzed. I acknowledge that participants' learning may have affected their self-correction time for the second repetition. However, given the inherent difficulty in gathering an adequate amount of self-correction data, I think the benefits of an increased data sample size outweigh the possible confounding effects of the data gathered from second repetitions. An aim for future studies may be to increase number of test trials without repeating scenes and still including salience trials for each scene. This would most likely be difficult to accomplish without greatly lengthening the duration of the study, but would help to increase the validity of data gathered. Possible solutions could include spreading testing over multiple visits or dividing up the study with free play sessions.

Using participants' self-correction times for each trial, their mean self-correction time for nouns and verbs was calculated (simply referred to as "self-correction time" hereafter). A significant effect of part of speech was found for self-correction time such that participants, regardless of language and age, self-corrected faster for nouns than for verbs. In addition, the effect of language on self-correction time was found to be approaching significance, suggesting that, given a greater number of observations, a significant effect of language may emerge for self-correction time among English- and Mandarin-learners. From these results, one may conclude that, in terms of target word, nouns were easier to correct to than verbs for both English- and Mandarin-learning children. Along the same lines, the effect of language was nearly significant; a trend was observed in which English-learners displayed shorter self-correction times than Mandarin-learners. There was also a significant interaction between age and language for self-correction time: Although at 15-months English-learning infants' self-correction time was slightly longer than Mandarin-learning infants', by 18-months English-learners' self-correction time was shorter than Mandarin-learners', with a larger difference between self-correction times for the two languages. This difference in self-correction times was sustained through 24-months. Figure 2 displays how the two language groups seem to mirror each other in overall self-correction time as it changes with age.

These results do not support my hypothesis; however, they do offer new insights into early acquisition of English and Mandarin Chinese. I expected to find a significant interaction between part of speech and language for self-correction time, further supporting research proposing a tendency towards the acquisition of verbs on the part of Mandarin-learning children and nouns on the part of English-learning children (Tardif, Gelman, & Xu, 1999; Tardif, Shatz, & Naigles, 1997; Tardif, 1996; Chan, Brandone, & Tardif, 2009). There was no significant interaction between part of speech and language, but there was a significant effect of part of speech for self-correction time across language and age. This observation could be interpreted a few ways. First of all, mean self-correction time when correcting to nouns was significantly shorter than when correcting to verbs. This finding suggests that infants, regardless of age or language, have an easier time realizing when they have incorrectly matched a familiar noun-label to a familiar action as opposed to when they have incorrectly matched a familiar verb-label to a familiar object. The lack of significant effects for self-correction proportion may lead one to conclude that part of speech, age, and language do not affect whether an infant realizes his or her error and then self-corrects. The speed at which an infant self-corrects, however, is affected by part of speech and an interaction between age and language.

The overall findings from this study may challenge previous research refuting the theory of a universal noun bias as proposed by Gentner (1982). Current research proposes that in lieu of a universal noun bias, Mandarin-learning infants have a tendency towards acquiring verbs (Tardif, Gelman, & Xu, 1999; Tardif, Shatz, & Naigles, 1997; Tardif, 1996; Chan, Brandone, & Tardif, 2009). The lack of a significant interaction between part of speech and language indicate that Mandarin-learning infants did not self-correct to verbs more quickly than English-learning infants and English-learning infants did not self-correct to nouns more quickly than Mandarin-learning infants. Self-correction time could be interpreted as a deeper understanding of language. Being able to recognize one's mistake in matching a familiar noun-label to a scene containing a familiar action, for example, may uncover an understanding of language masked by an initially incorrect response. On the other hand, self-correction time might not be strongly linked with language comprehension. Those infants that had a higher number of self-corrections also, inherently, had a higher number of initially incorrect first looks. Those infants who displayed more correct first looks would, thus, also have fewer self-corrections. The data analyzed in this study comes from those participants who self-corrected and therefore might not have as strong language comprehension as those participants whose first looks were correct. Perhaps participants who had a higher number of correct first looks have greater language comprehension due to tendencies towards noun and verb acquisition. These tendencies would thus not be apparent in self-correction data which comes from children with weaker language comprehension. A direction for further research (which could also lend perspective to these results) would be to study the relationship between language comprehension and self-correction. The occurrence of self-correction may be an indication of lower language comprehension given that the participant's first look was not correct. On the other hand, ability to self-correct could indicate high language comprehension in that the participant was able to realize his or her mistake and then self-correct all within a five-second trial.

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Table 1

Mean proportion of self-corrections (and standard deviation)

	Part of Speech	
Age-Group	Noun	Verb
15-Month-Olds	.72 (.35)	.85 (.19)
18-Month-Olds	.73 (.32)	.81 (.23)
24-Month-Olds	.80 (.28)	.73 (.28)

Note: Values rounded to two decimal places

Table 2

Mean proportion of self-corrections (and standard deviation)

	Part of Speech	
Language	Noun	Verb
English	.76 (.34)	.80 (.23)
Mandarin Chinese	.76 (.30)	.79 (.25)

Note: Values rounded to two decimal places

Table 3

Mean self-correction time in ms (and standard deviation)

	Part of Speech	
Age-Group	Noun	Verb
15-Month-Olds	917.68 (497.67)	1313.74 (592.77)
18-Month-Olds	1006.44 (678.20)	1439.59 (682.83)
24-Month-Olds	970.14 (495.11)	1268.24 (448.20)

Note: Values rounded to two decimal places

Table 4

Mean self-correction time in ms (and standard deviation)

	Part of Speech	
Language	Noun	Verb
English	886.81 (549.45)	1271.33 (609.99)
Mandarin Chinese	1019.35 (549.51)	1298.09 (556.17)

Note: Values rounded to two decimal places

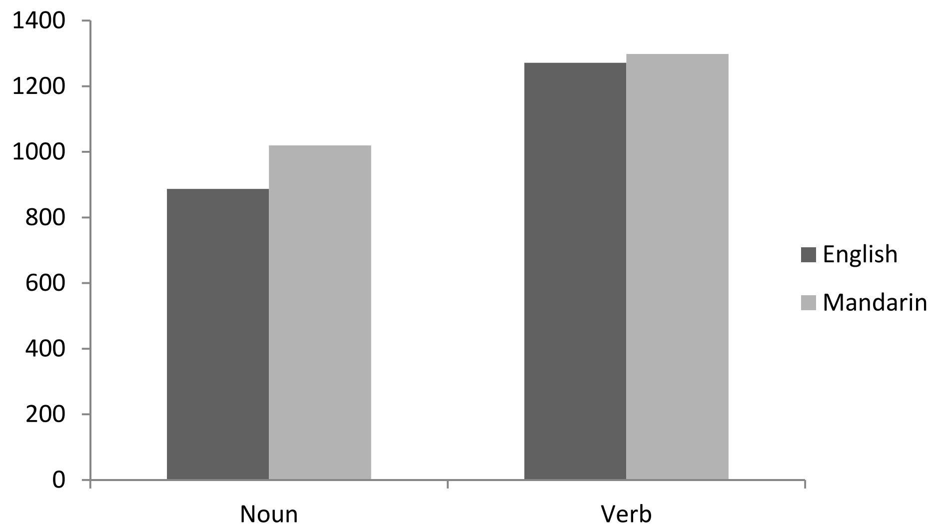

Figure 1.

Mean Self-Correction Time in ms

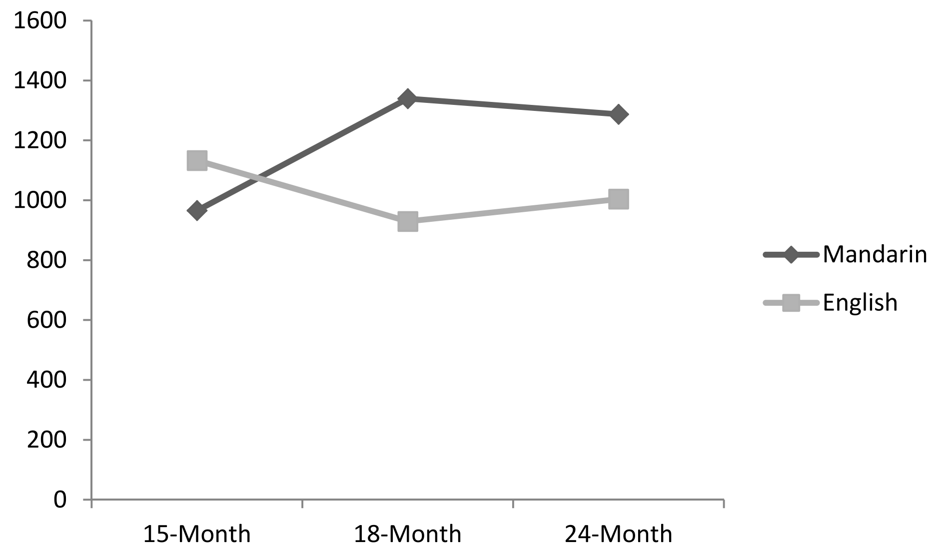

Figure 2.

Interaction Between Age and Language for Mean Self-Correction Time (ms) Combined Across Nouns and Verbs

Appendix A

Target words checklist

Po-RW Supplemental Vocabulary Checklist

Subject #:
Cond.:
Gen.:

	1) Does your child understand this word?		2) How much confidence do you have in your answer to Question 1?						3) Does your child say this word?		4) How familiar is your child with this object?					
	Yes	No	None 1	2	3	4	5	I'm Sure 6	Yes	No	Very Unfamiliar 1	2	3	4	5	Very Familiar 6
ball	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
balloon	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
banana	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
book	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
bottle	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
chair	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
shoe	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
sock	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

	1) Does your child understand this word?		2) How much confidence do you have in your answer to Question 1?						3) Does your child say this word?		4) How familiar is your child with this action?					
	Yes	No	None 1	2	3	4	5	I'm Sure 6	Yes	No	Very Unfamiliar 1	2	3	4	5	Very Familiar 6
bite	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
blow	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
hit	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
kick	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
kiss	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
ride	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
throw	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
touch	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

Appendix B

Po familiarization script

<u>Po Phrases</u>

Taboo Words:	ball	balloon	banana	book	bottle	chair	shoe	sock
	bite	blow	hit	kick	kiss	ride	throw	touch

Example "Po" Sentences

1. Look! It's Po!
2. Hi Po!
3. Po's eyes open and close.
4. What's Po doing?
5. Can you give Po a HUG? (**Do NOT say KISS**)
6. Where's Po's nose? (or other body part)
7. Po looks tired.
    8. Should we put Po to sleep?
    9. Let's put Po to sleep.
    10. Goodnight Po.
    11. Shh… Po's sleeping
    12. Let wake Po up.
    13. Wake up, Po!
14. Po's hungry.
    15. Can you feed Po?
    16. Po wants to eat.
    17. What do you think Po likes to eat?
18. Po wants to play with that too.
    19. Can Po try?
    20. Can Po have a turn?
21. Where's Po?
    22. Where did Po go?
    23. Can you find Po?
    24. There's Po!
25. Can you make Po jump?
    26. Can you jump like Po?
    27. Jump, Po!
    28. Po, jump!
29. Can you make Po sit?
    30. Po's sitting on the FLOOR. (**Do NOT say CHAIR**)
31. Po likes to dance.
    32. Can you make Po dance?

   33. Look at Po dance!
34. Po likes to play with these toys.
   35. Po likes to put these rings on her head.
   36. Put them on your head, Po!
   37. This is Po's favorite toy.
   38. Let's help Po play with it.
   39. Can you show that to Po?
40. (With toy phone) Hello? You want to talk to Po?
   41. Po, it's for you!
   42. Say "hi," Po!
43. Po's fun to play with.
44. Can you read a STORY to Po? (**Do NOT say BOOK**)
45. Can you make Po wave?
46. What's Po looking at? (show other toy)
47. This crayon is red like Po! (hold up red crayon)
48. Can you find Po's tummy? (or other body part)
   49. Po has a baby on her tummy.
50. Let's go find Po on TV!

Appendix C

Video stimuli visuals