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Sentence Interpretation Strategies in Monolingual English Preschool Children

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Speech Language and Hearing Science Departmental Honors Thesis

University of Colorado Boulder

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Abstract

Through the manipulation of the syntactic cue of word order and the semantic cues of noun animacy and noun size order, this study explores how different cue strength affects a child's interpretation of a sentence. Subjects included 36 children [Mean age=50.72 mo.; SD=7.3 mo.]. A sentence interpretation test was administered to participants who would choose the "doer" of the sentence. Significant main effects were observed for word order, animacy, and size-order, including a significant interaction between animacy and size order. In addition, the Peabody Picture Vocabulary Test, 4th edition (PPVT™-4) was administered to participants to determine their vocabulary level. Results show that preschool children use a combination of syntactic and semantic cues to interpret sentences. Interestingly, age and vocabulary are not correlated with children's use of syntactic and semantic cues. A future study, with younger participants to distinguish when the shift from semantic dependence to syntactic dependence occurs, is warranted.

Children have the ability to develop language in a seemingly effortless manner in their first few years of life. Previous studies indicate that young children rely on a combination of semantic-based world knowledge and syntactic knowledge to comprehend sentences. Children tend to shape their utterances based on the relevant cues of their language, despite how different languages can be from one another. For example, English-speaking children will eventually learn the word order of English sentences; word order is the most dominant cue in the English language. Yet Italian-speaking children eventually become more dependent upon animacy. No two languages are alike, and depending upon the language, there is often more than one cue associated with interpretation of a sentence, so the cues that are imitated will vary according to which cues are more important in a language. While children are developing a more robust understanding of the rules governing their language they, use world knowledge to fill the gap in interpretation. Still little is known about the specific comprehension strategies that young English speaking children use, and how these strategies contribute to the development of sentence interpretation.

This study examines how syntactic and semantic cues that are present in sentences affect children's interpretation of the meaning of sentences. Specifically, the effects of word order (a syntactic cue), animacy (a semantic cue) and conceptual size of an item (a semantic cue) on determining the doer of the action in sentences such as, "*The bear pushes the mouse*" are examined. Word order is the syntactic cue that adult English speakers overwhelmingly rely upon during sentence interpretation, but English-speaking children do not depend on this cue alone. In English, the canonical word order is noun-verb-noun (e.g., NVN; *The lion chases the rabbit*). Other word orders (e.g., noun-noun-verb and verb-noun-noun) are perceived as incorrect. The semantic cues manipulated in this study were noun animacy (e.g., animate vs. inanimate; bear vs.

house) and noun conceptual size (e.g., large vs. small animals; bear vs. mouse). These semantic cues rely upon meaning-based interpretation rather than syntactic, or structure information. In order to understand which variables children base their comprehension of a sentence upon, the semantic and syntactic cues were combined into twelve different possible cue pairings, each making up a sentence. This study was designed as a way to address if monolingual English preschoolers rely upon syntactic or semantic cues to interpret sentence meanings in different cue environments. In addition to exploring cue dependence, this research hopes to discover when the shift towards syntactic dependence, used by English speaking adults, takes place by looking at our subject's age and vocabulary levels. This research is essential in furthering the understanding of how children *develop* strategies to understand sentences. Because different languages vary in cue dependence, the results of this study will be used as a basis for comparison to the sentence interpretation skills of Cantonese-English bilingual speaking children. This comparison will give us insight into how a bilingual child's interpretation techniques differ from the skills of a monolingual child. We can use this insight to help monolingual, and bilingual children learn how to properly interpret English sentences based upon valid cue use.

Background

Sentence interpretation research has matured a great deal over the past few decades. What follows is an overview of the progression of relevant sentence interpretation studies and their relation to the current study on monolingual English sentence interpretation. While there are considerable variations across these studies, they all have contributed crucial information on how to effectively collect sentence interpretation data. More importantly, the combination of results has contributed to our current understanding of sentence interpretation and shaped the research questions upon which the present study is based.

It would be remiss to discuss how children comprehend or process the meaning of a sentence without explaining the competition model (MacWhinney, Bates, and Kliegl, 1984). The central idea of the competition model is that different cues “converge, compete, and conspire” during the sentence interpretation process (Bates, Devescovi, & D’Amico, 1999, p. 70). Converging cues come together to create a new interpretation that would not have otherwise been found through the use of each cue independently. Cues compete by working against each other, but only the most valid or logical cue would be relied upon in this instance. Conspiring cues work against each other, the resulting ambiguity often resulting in new interpretations. Bates and MacWhinney have coined the term “cue validity”, which refers to the phenomenon of listener tendency of focusing on cues that are more frequent and reliable (Bates et al., 1999, p.70). The strongest cue or combination of cues will then shape an individual’s comprehension of the overall sentence (MacWhinney et al., 1984). Essentially, two individuals, one a native speaker and one a non-native speaker, could interpret the meaning of the same sentence in two very different ways if they were relying upon different cues. This “cue validity” is seen across languages; whichever cue is the most frequently associated with the correct interpretation of the sentence would naturally be relied upon (Bates et al., 1999).

The idea that sentence interpretation strategy follows a developmental pattern has been brought up in many of the following research projects. Children have been recorded as using a multitude of semantic and syntactic cues prior to shifting to a dependence on the most valid cue used in their languages. In English the syntactic cue of word order is the eventual “most valid” cue that children shift to. Their initial sentence interpretation is characterized by the use of multiple cue types both semantic and syntactic. I will expand upon this idea further in the discussion of the related literature.

The following studies were chosen as a basis for the current study because they all use some form of sentence interpretation tasks. Each experiment also explores different cues and cue strengths in regards to sentence interpretation. Despite varying on many levels, the experimental design used in the current study was developed as a result of many of these past designs. Parts were modeled directly from previous research studies, and parts were developed as a response to lacking areas in previous research. MacWhinney, Bates, and Kliegl (1984) explored the relative cue strengths of word order, word agreement, noun animacy, and stress across English, German, and Italian. The experimental process used sentences in each language appropriate for the subject and varied them each by one of the cues. The manipulation of animacy *within* sentences in this particular study formed the foundation for sentence interpretation methodology and was used to study the relationship between animacy cues and the agent. Word order was considered to be the most significant factor effecting English speakers interpretation, followed by agreement and animacy. Agreement was the most significant factor influencing Italian speakers followed by animacy and finally word order. Animacy was the most significant factor effecting German speaker's sentence interpretation, followed by agreement and word order. Across languages, the strength of each cue is clearly solidified by the age of 20, which was the average age in MacWhinney et al. (1984).

Bates, MacWhinney, Caselli, Devescovi, Natale, and Venza (1984) conducted a study in the same year involving native English speaking and native Italian-speaking children. The children were read sentences varying in word order, stress, and animacy. Animacy was varied within sentences as well as across them. Other factors of interest included vocabulary level and age. The experimenter would read the sentences to the child in the child's native language. The child was then requested to act out the scene with toys corresponding to the two nouns used in

the sentence. English speaking 2.5 year olds were significantly influenced by word order and the interaction between word order and animacy. Italian 2.5 year olds were significantly influenced by animacy. These results indicated that even the youngest age group of children, aged 2.5 years, still showed a “language-specific difference” in their interpretations of sentences (Bates et al., 1984 p. 346).

Liu, Bates, and Li (1992) examined the cue transfer differences in Chinese-English bilinguals and English-Chinese bilinguals, ranging in age from 19-44 years old. Subjects included seventeen early Chinese-English bilinguals. Nine subjects identified as late Chinese-English bilinguals and eight identified as late English-Chinese bilinguals. The monolingual control groups consisted of eight monolingual English speakers and eight monolingual Chinese speakers. The bilingual subjects were asked to fill out a language history questionnaire in order to gain a more comprehensive view of their experience with the two languages. The sentence interpretation task required that the subjects listen to pre-recorded English and Chinese sentences. The subject’s task was to respond to the 54 test sentences verbally by identifying the noun they believed to be the subject. The variables manipulated in the sentence interpretation task included the language in which the sentences were presented, animacy of the first and second nouns, and the ordering of the two nouns and one verb in each sentence. Animacy was varied within sentences as well as across them. An example of a NVN, AI (animate/inanimate) sentence is “The horse kicking the carrot” or “Xiaoma ti luobo” in Chinese. The example above featured an NVN and animate/inanimate noun orderings, but VNN and NNV were also used as well as animate/animate and inanimate/animate noun orderings. The data showed that late bilinguals, both English-Chinese and Chinese-English, who had acquired their second language after the age of sixteen, have tendencies towards forward transfer. Forward transfer is the use of

native language cues in the interpretation process of a different language. In the case of late English-Chinese bilinguals, syntactic cues common in English were used frequently to interpret Chinese sentences, resulting in a different interpretation than was intended. This forward transfer is essentially the application of the cues used in the subjects native language to the second language acquired later in life. Cues that have been used by a speaker starting at a younger age, and for a longer duration of time than the later learned language, would naturally be applied to that language. Interestingly, early bilinguals' transfer strategies were shown to have much more variability than late bilinguals' and include backwards transfer. Backwards transfer is simply the use of cues from their second language in the interpretation of their native language.

Li, Bates, and MacWhinney (1993) examined how word order, noun animacy, and three Chinese grammatical markers affect the manner in which Mandarin Chinese speakers aged 22 – 44 interpret the meaning of four different types of Chinese sentences. The three Chinese grammatical markers are the passive marker *bei*, the object marker *ba*, and the indefinite marker *yi*. Mandarin Chinese sentences typically follow a SVO construction, but other constructions are found in the language as well. Because of this, Chinese sentence interpretation is dependent on a variety of different cue strengths. To test these different cues and their relative strengths, Li et al. (1993) constructed sentences with varied cues. Sentences were composed of two nouns and one verb. Animate versus inanimate nouns were paired in sentences of varying types: simple transitive no marker, indefiniteness markers, object marker, passive marker. The first noun could be animate and the second inanimate or vice versa. Other sentences contained two animate nouns. The subjects were asked to identify the “actor” or “doer” in the sentences by pushing one of two buttons corresponding to two pictures representing the two nouns in their current sentence.

Li et al.'s results show a significant main effect of animacy and word order. The effect for animacy indicated that noun animacy is a strong cue for Mandarin speakers. Word order, much the same in English, is relied upon to a large extent as well. SVO is the more common Mandarin construction pattern. The results of the word order test sentences support the idea that participants would treat the noun preceding the verb as the subject. There was also a significant interaction between the variables of animacy and word order. The timing aspect of the experiment is interesting as well. The timing results indicate that when both nouns are animate response times were significantly slower. Faster response times were reported for sentences with an animacy cue, meaning one of the nouns was animate and the other was not. Normal NVN sentence structures also facilitated faster response times most likely due to the NVN structure seeming most logical. Overall the timing aspect of the experiment indicates that when a cue is present, it speeds up processing time. When two cues are present and they are conflicting, reaction times are slower.

Berger, Wulfeck, Bates, and Fink (1996) took an in-depth look at the different cues used by monolingual English speaking children to identify the agent in a simple sentence. Processing times associated with different cue use was also examined across different ages. Word order, agreement, and animacy (within sentences) were the cues manipulated across 162 sentences. Subjects were asked to listen to the 162 sentences and identify the object or animal presented on the computer screen that "did" the action by pressing a button below the picture. Interpretation techniques were recorded in this manner as well as processing times. Berger's results indicate that across age groups, the first noun in NVN sentences was interpreted as the agent, and the second noun in VNN sentences was interpreted as the agent. Interpretations of NNV constructions were less consistent across age groups. The youngest age group, seven and eight

year olds, did not possess the second noun strategy that the older children used for their interpretation. These results are consistent with the findings in studies by Bates et al. (1987) and MacWhinney et al. (1984) in that younger children have less concrete syntactic, or word order, cue dependence when compared to older children and adults. Berger's study does delve into young child sentence interpretation, however they do not focus their study on the shift towards syntactic cue use.

Bates, Devescovi, and Amico (1999) compared sentence interpretation performance in English and Italian speakers in a series of experiments. In the first experiment, word order was manipulated within relative clauses and the main clause. In the second experiment, agreement was varied within relative clauses and the main clause. The sentences involving variations in word order used "criminal" verbs in order to ask the subjects simply to pick which person is the bad guy, or "report which of the three characters in a given sentence committed the crime in question" (Bates et al., 1999 p.77). The subjects included native English or native Italian speaking college students. The results of the word order portion of Bates' study is consistent with English speakers relying upon word order cues to a much stronger degree than native Italian-speakers. The sentences testing variations in agreement show that native Italian speakers consider subject-verb agreement to be a frequent and reliable cue. Based on the results in Bates' (1999), English speakers do not consider subject-verb agreement to be a strong cue guiding their sentence interpretation.

The findings from Bates (1999) were important in that it successfully tested which cues are important in each language through the simple manipulation of certain possible sentence interpretation cues. Bates also reestablished the fact that adult English speakers rely on word order over other cues. Due to the older age of the subjects, Bates has not addressed the transition

to cue-validity reliance. Bates' study does not delve into the transition that children make from world knowledge reliance to syntactic cues (in English). This lack of information prompts the question; is the age at which cue shifts occur consistent across languages? Because of the different syntactic and morphological components of other languages, differing cues are seen to vary in strength across different languages. A strong cue in one language, for example word order in English, may not be relevant in another language. Italian uses morphological markers. Is one of these cues easier for children to rely upon earlier? Since the competition model's unveiling in the early 1980's, research in the field of sentence interpretation has expanded considerably and has begun to explore these ideas further.

Evans (2002) examined the stability and consistency of comprehension strategies used by English-speaking children with specific language impairment (SLI) (aged 6;8 to 8;5) and by their age-matched typically developing peers. Typically developing children switch from a reliance on world knowledge to a cue based comprehension system at around three to four years of age. Prior to this shift children employ a variety of different comprehension techniques, including "[attending] to the object mentioned" in a sentence, interpreting the "child as agent", and using world knowledge (Evans 2002, p. 96). Evans' (2002) 54 test sentences varied in construction as follows: NVN, NNV, or VNN. Noun animacy was a secondary variable manipulated within the sentences. The first noun was animate and the second inanimate: A/IA. Or the first noun was inanimate and the second animate: IA/A. Or both nouns were animate: A/A. Similar to Li et al.'s study, the subjects were asked to identify the "actor" or "doer" in each sentence. In the first condition, children simply pointed to the picture corresponding to the "actor". The second, experimental, condition required children to push a button corresponding to one of two pictures

presented on a computer screen. In both conditions the two pictures presented with each sentence represented the two nouns in each sentence.

The results of Evans study showed that typically developing English-speaking participants showed a heavy reliance upon word order and were not affected significantly by a switch from pointing to button pushing in most of the conditions. The 7-8 year old typically developing subjects had more variety in their interpretation of NNV sentences than the 9+-year-old group. Typical-developing participants also showed a significant main effect in animacy, whereas the children with SLI showed a significant main effect in both word order and animacy but not for experimental condition of switching to using a button box instead of pointing to the picture, which is an additional processing demand. While Evans (2002) did identify techniques used by typically-developing children as well as children with SLI, the older typically-developing children have much more solidified comprehension techniques, i.e. a dependence on syntactic word order cues, compared to the younger group of typically-developing children. The SLI group were less consistent in the cues they followed when processing demands increased, i.e. using the button box instead of pointing. Evans study in particular helped in formulating the question of; when do children shift from a dependence upon world knowledge to a reliance on syntactic cues typically used by English speakers?

Borovsky, Elman, and Fernald (2012) used eye-tracking techniques to gain a closer analysis of reaction time for anticipatory sentence interpretation in 3-10 year olds, as well as adults. This study entailed the subjects being asked to interpret the ending of a sentence, instead of its grammatical components. The study focuses on vocabulary skill being an implication of sentence interpretation techniques in children rather than age of the subject. The subjects consisted of adults between 18 and 28 years of age and children between 3 and 10 years of age.

The sentences did not vary in constituent ordering, but instead manipulated the agent and action across eight sets of four sentences. Four pictures were presented with each sentence; a target related picture (object), an agent related distractor, and action related distractor, and an unrelated distractor. Subjects were asked to either point or click on the “the picture that goes with the sentence”, or “sentence final object”. Borovsky et al. (2012) analyzed the time it took for each age group to fixate on to the target and found that there was a strong positive correlation between an advanced vocabulary for a child’s age and their fixation time. These children with advanced vocabularies also had a higher number of target fixations. The results suggest that children with higher vocabularies can more quickly identify the target, or process the sentence.

The idea that vocabulary level might be an indicator for sentence interpretation strategy was drawn in part from Borovsky et al.’s study. This concept was applied to the current monolingual study through the prediction that children with a higher vocabulary level would utilize more advanced sentence interpretation skills. While the procedure and purpose of the two studies vary considerably, the idea of using vocabulary level as an indication of advanced sentence interpretation skills remains the same.

In summary, previous research focused primarily upon discovering which cue was most dominant in a language by displaying different competing cues in their sentences. Limitations of this previous method are that competing semantic cues have not been explored. Previous studies have neglected to focus on which cues children use as they move through language development (i.e. syntactic, or semantic use of world knowledge). Strategies used by young children still learning language are not understood well because previous studies have focused on older age groups of children. The current study was developed in response to the lack of research in this particular branch of sentence interpretation research and addresses interactions between semantic

cues and focuses on a much younger age group. The procedures used in the current study were based off of a multitude of other studies and modified to fit our current cue variables. These studies very clearly establish word order as the dominant cue for English speaking adults and older children alike. While this dependence on syntactic cues by adult English speakers is widely accepted, the transition to this syntactic reliance is not addressed. There has not been an experiment shaped around the cues young English speaking children's revert to when multiple semantic cues are present in addition to syntactic cues. There has not been an exploration of how vocabulary level and age relate to the semantic cues young children rely upon when the two differing semantic cues (noun animacy and conceptual noun size-ordering) occur simultaneously. Previous research has also neglected to analyze how these specific semantic cues, in combination with syntactic cues, can affect the overall sentence interpretation strategies of preschool children. The current study explores these avenues of thought.

The Current Study

The current research project is designed to study how word order, animacy, and size order cues affect sentence interpretation in monolingual English speaking preschool children, aged 3 to 5 years old. In this study, how children figure out the doer of an action is examined. Do they rely on syntactic cues, semantic cues, or both types of cues to interpret sentences? Specifically, I examine three variables that are present in sentences: word order (syntactic cue), animacy (semantic cue), and conceptual size (semantic cue). Word order cues are simply the structure of the sentence; Noun-Verb-Noun (NVN), NNV, or VNN. In English, NVN (e.g., *The bear chases the rabbit*) is an acceptable sentence structure whereas the other two sentence types are not. Animacy cues are cues that indicate whether or not the nouns in the sentences are animate or inanimate. Different from the sentences in Bates et al (1984) that used one animate

noun and one inanimate noun (e.g., *The girl kicks the ball; the ball kicks the girl*), the sentences in this study contain two animate nouns (e.g., *The bear chases the rabbit; the rabbit chases the bear*) or two inanimate nouns (e.g., *The leaf chases the desk*). Size order cues are whether the two nouns in each sentence are ordered *large small* or *small large*. For example, in the sentence, *the bear chases the rabbit*, the nouns are in large small size order; bear is large, and rabbit is small. In the sentence *Chases the leaf the desk*, the nouns are in small large size order; the leaf is small and the desk is large.

I hypothesize that word order cues for NVN sentences will most strongly influence subject's sentence interpretation (i.e., select the first noun as the doer), and that less familiar structures, VNN and NNV, will have inconsistent responses and result in a higher dependence on semantic cues. I anticipate that animacy cues, specifically inanimate nouns, will result in more inconsistent noun choice due to unfamiliarity to inanimate nouns performing actions, i.e. "The cup the truck bumps". It is possible that size order cues will most significantly influence subject noun choice in sentences containing less familiar cues like VNN, NNV, and inanimate nouns. I believe subjects will rely on the conceptually larger sized noun to help them determine who is the "doer".

It is my expectation that vocabulary level will also significantly influence which sentence interpretation techniques a child uses. Children with more advanced vocabularies will have typically had a longer period of exposure, or have gained more knowledge through their exposure to the English language, than their peers with lower vocabularies. It would make sense then that those with higher vocabularies would have better understanding of the rules governing the English language.

Methods

Participants

Subjects included 36 children, 18 girls and 18 boys, between 38 and 62 months of age [Mean age = 50.72mo; SD =7.3mo]. Children were recruited for the study from within Boulder, CO and neighboring cities. All 36 children were age matched to the subjects in Professor Pui Fong Kan's Cantonese and English Bilingual Study for use as a future comparison group. Selection criteria included filtering out any children who were bilingual, or non-native English speakers, as well as any atypically developing children.

The recruitment of subjects and running of experiments began in the spring of 2012 and continued into the fall of 2012. The experiments all took place in the Language Laboratory of Professor Kan's associate, Professor Eliana Colunga, from the Psychology department of CU Boulder. I had worked for a year previously in Professor Colunga's lab, which is how I became aware of this project. I quickly gained interest in the study's focus and began to formulate my own assertions and theories relating to how sentence interpretation is driven. I was a major contributor to the process of subject running in the spring and became the sole project manager late in the spring, through the summer, and fall.

The guardian of each child was contacted either by phone or email, through the CU "Kids Database" found at "<http://kelp.colorado.edu/kids/index.br1>". The study was then described and an invitation to participate in the study was extended for the child following a brief series of screening questions. We would schedule the child at the most convenient time for the guardians. The guardians were then given directions to our lab. Each subject came in for a one Hour visit and completed one consent form, one survey, and two experimental tasks. Parents were given two consent forms, one to sign for their child, and the other to keep for their records. Next, the guardians were asked to fill out a language learning history form which was used to help us

screen out any children who had been exposed to another language other than their native language of English as well as any atypically developing children. I would play with the child in the waiting room while the parents filled out these initial forms. When these parental tasks were completed, I would bring the Child and the' parent into the experimental room and administer a vocabulary comprehension measure and the sentence interpretation task.

The Vocabulary Measure:

Peabody Picture Vocabulary Test version 4 or PPVT-4 (Dunn & Dunn 2007) was used to examine children's vocabulary skills. The PPVT-4 is a standardized vocabulary measurement system for children as young as 2 years 6 months. There are two equivalent forms, form A and form B, for PPVT-4. Only form A was used for this study. The PPVT-4 is a simple picture flipbook that correlates with vocabulary words. Each page of the flipbook has four pictures, one of which corresponds to the word the experimenter says. The child is asked to point to the picture they think matches the word the experimenter says, and their answer is recorded. The words are grouped into sets of twelve. Each set corresponds to an age group's typical vocabulary comprehension level. As the age group increases so too does the difficulty of the vocabulary words. The first set of 12 words corresponds to the youngest age group, 2 years 6 months. The task ends when a child gets 8 vocabulary words wrong in one 12-word section, or reaches the end of the PPVT-4 book, which goes up to a vocabulary comprehension level of 18 years. Scoring the PPVT depends on the child's age in year/month format. The total number of errors the child makes is subtracted from the total number of vocabulary words the child attempted before getting 8 wrong in one section. The score obtained in this fashion is referred to as the raw score. The standard score is obtained through the use of the PPVT-4 scoring chart. The raw score must be located in the scoring chart corresponding to the child's age. Next to this raw score will

be the standardized score, which essentially indicates a child's developmental progress based upon the progress of their peers. This vocabulary measurement was used as a baseline measure of vocabulary development to compare sentence interpretation strategies across different vocabulary levels in addition to a comparison across chronological ages.

The Sentence Interpretation Task

The sentence interpretation task, developed by Professor Kan for use in the Cantonese-English study, was administered via an iPad. The stimuli included 72 sentences constructed from English words. Each sentence has two nouns and one verb. The sentences also vary in animacy. That is, the two nouns are either both animate or both inanimate. The sentences are varied in structure between noun-verb-noun, noun-noun-verb, and verb-noun-noun. The final variable manipulated was size order of nouns. Each sentence contained one large noun and one small noun, and the sentences varied in which noun was first and which was second. There were twelve different sentence types, each occurring six times with different nouns and verbs throughout the sentence interpretation task. The twelve sentences were structured as follows (See Appendix A for examples of each sentence type):

- | | |
|----------------------------|-------------------------------|
| 1. NVN Animate Large-Small | 7. NVN Inanimate Large-Small |
| 2. NNV Animate Large-Small | 8. NNV Inanimate Large-Small |
| 3. VNN Animate Large-Small | 9. VNN Inanimate Large-Small |
| 4. NVN Animate Small-Large | 10. NVN Inanimate Small-Large |
| 5. NNV Animate Small-Large | 11. NNV Inanimate Small-Large |
| 6. VNN Animate Small-Large | 12. VNN Inanimate Small-Large |

The picture slides were customized to the nouns in each sentence. The slide was presented simultaneously as each corresponding sentence was read (See Appendix B for examples of pictures slides).

Procedure

First, children were presented with 3 trial items. These trial items contained noun combinations that were not present in the test items. The “practice items” included the following three sentences:

1. NVN Animate Large-Small: “The man pushes the baby”
2. NVN Animate/ Inanimate Large-Small: “The horse kicks the ball”
3. NVN Animate/ Inanimate SS: “The ball kicks the baby”

The training session was meant to familiarize the child to the activity and show them how to respond. During the training session, examiners would read the practice sentence and present a corresponding picture slide. Then examiners would ask the child to tell them who was the “doer” or “who is kicking”. The child would pick their choice by pointing to the picture slide.

After a participant hears a sentence the experimenter asks them “who is doing the action”. Because the children we work with are relatively young, we ask them this in an easy to understand way during the three training sentences I mentioned previously, as well as after each sentence is read during the *testing* portion. For example after the sentence, “the dog the cat chases” is read, the participant is asked, “who is chasing?” The participant then points to either the picture of the dog or the cat on the current slide to indicate their choice. By repeating the phrase “who is ___ing?” with the correct verb inserted after each sentence, it is easier for the child to remain focused on their task. Again because of how young these children are, they tire easily. It was necessary, depending on the child’s temperament, to insert a break halfway through

the sentence interpretation task. The children were allowed to use a coloring application on the iPad, or were encouraged to get up and walk around. Fun puffy stickers were also used to entice children to finish the task. With these techniques all of the children included in the results completed each task successfully.

There are no right or wrong answers in the sentence interpretation task. Scoring the sentence interpretation data sheets was simply a matter of recording whether the subject chose the first or second noun in each sentence. I input the data into the program “file maker pro”. The sentences were divided up by the variables they tested; twenty-four different combinations of variable manipulations were used. The raw data at this point was run through an ANOVA, and the variables in each sentence were tested for significance based upon first noun choice.

Results

First Noun Choice Across Conditions

Table 1 summarizes the average number of participants who selected the first noun as the “actor” or doer across different conditions. As discussed previously in the methods section, the sentence interpretation task contains twelve different sentence structures as a result of the possible cue combinations. This is reflected in table 1.

Table 1. First Noun Choice by Condition

	Animate		Inanimate	
	Large-Small	Small-Large	Large-Small	Small-Large
NVN	4.83 (1.42)	3.89 (1.79)	4.5 (1.23)	4.5 (1.65)
NNV	3.08 (1.76)	1.86 (1.61)	2.69 (1.70)	2.83 (1.16)
VNN	2.11 (1.58)	1.0 (1.07)	2.19 (1.64)	2.0 (1.53)

Note. Table 1 contains the mean of first noun choice for each cue combination followed by the standard deviation in parentheses for that mean.

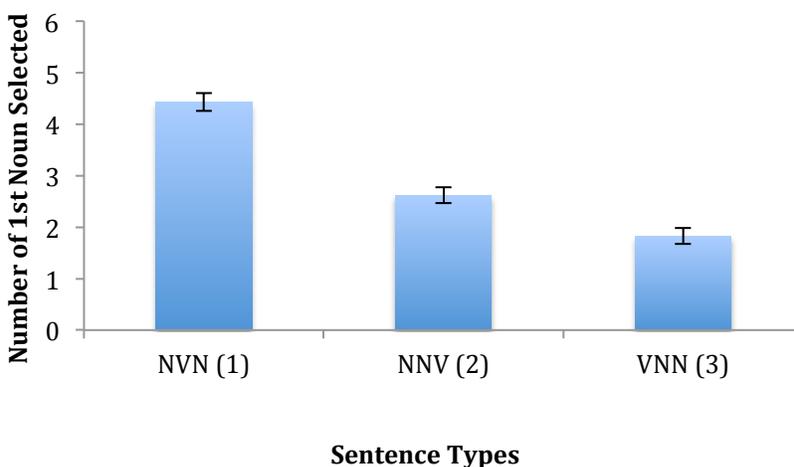
The number of first noun responses served as the dependent variable. The independent variables were animacy (i.e., animate and inanimate), size order (large-small and small-large), and sentence type (NVN, NNV, and VNN). The responses were submitted to a 3 x 2 x 2 (3 sentence type, 2 animacy, and 2 size order) analysis of variance (ANOVA). There was a significant main effect for sentence type $F(2, 34) = 36.78, p < .001, \eta^2 = .68$, a significant main effect of animacy $F(1, 35) = 8.38, p < 0.01, \eta^2 = .19$, and a significant main effect of size order $F(1, 35) = 6.24, p < 0.05, \eta^2 = .15$. There was also a significant interaction between animacy and size order, $F(1, 35) = 10.99, p < 0.01, \eta^2 = .02$.

For sentence type, (see Table 2 and Figure 1), participants tended to choose the first noun as the doer in NVN sentences (NVN: Mean = 4.43; SD = .18, $p < .001$) but did not choose the first noun in the other two sentence types (NNV: Mean = 2.62, SD = 1.51, $p < .001$; VNN: Mean = 1.83, SD = .15, $p < 0.001$).

Table 2. First Noun Choice Variations by Sentence Type

Sentence Type	Mean	Standard Deviation
NVN	4.43	1.06
NNV	2.63	.91
VNN	1.83	.9

Figure 1. First Noun Choice by Sentence Type

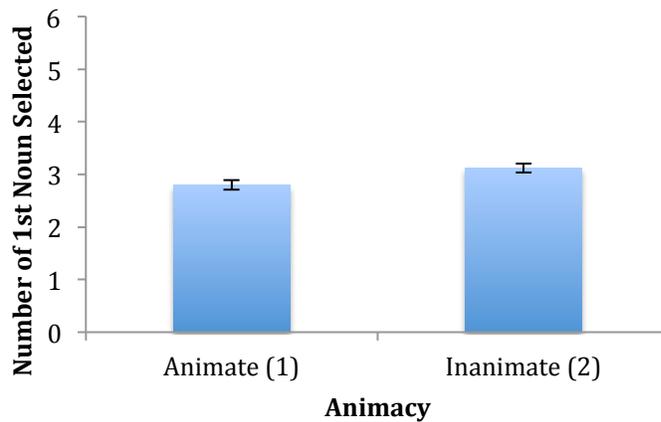


The animacy effect indicated that children tended to select the first noun as the doer when the nouns are *inanimate* ($p < .01$), suggesting that semantic cues (e.g., animate or inanimate) are also important for determining the doer in the sentences (see Table 3 and Figure 2).

Table 3. First Noun Choice Variations by Animacy

Animacy	Mean	Standard Deviation
Animate	2.8	.53
Inanimate	3.12	.51

Figure 2. First Noun Choice by Animacy

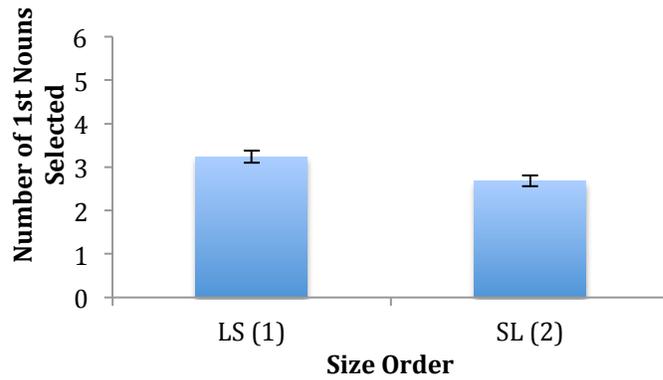


The size order main effect, (Large-Small vs. Small-Large), indicated that first noun choice varied significantly as a result of the conceptual size of the noun ($p < .05$). Children tended to choose the first noun as the “doer” when the first noun was larger in size than the second noun (see table 4 and Figure 3).

Table 4. First Noun Choice Variations by Size Order

Size Order	Mean	Standard Deviation
Large-Small (LS)	3.236	.82
Small-Large (SL)	2.681	.73

Figure 3. First Noun Choice by Size Order



The significant interaction between animacy and size order ($p < .01$) indicated that the effect of size order depends on whether the nouns were animate or not (see Table 5 and Figure 4). There was a size order effect for the sentences that contain two animate nouns, but no such effect was found for the sentences with two inanimate nouns.

Table 5. First Noun Choice Variations by Animacy and Size Order

Animacy and Size Order	Mean	Standard Deviation
Animate Large-Small	3.34	1.12
Animate Small-Large	2.25	.97
Inanimate Large-Small	3.13	.96
Inanimate Small-Large	3.11	.85

Figure 4. First Noun Choice by Animacy and Size Order



Correlation Analysis

Table 6 displays the correlations between age, PPVT raw scores, and the first noun choice across the 12 conditions. As shown in Table 6, the correlations for age and vocabulary level were not significantly related to the first noun choice *across conditions* ($p > .05$). The insignificant correlations contradicted my assertion that vocabulary level would be related to children's strategies to figure out the meanings of the sentences. Age was positively related to the first noun choice in NVN sentences with a large inanimate object as the first noun and a small inanimate as the second noun ($r = .34, p < .05$). The result shows that older children tend to choose the first noun as the doer in NVN sentences with a large inanimate object as the first noun and a small inanimate as the second noun. There was a negative correlation found for age ($r = -.35, p < .05$) and PPVT scores ($r = -.41, p < .05$) in VNN sentences with a small inanimate noun first and a large inanimate noun second. This essentially means that the younger children and those with less developed vocabularies were more likely to choose the first noun as the "doer" in VNN sentences with a small inanimate noun first and a large inanimate noun second.

While these three correlations are significant there is not a larger pattern of correlations across each variable. For example, if each sentence with nouns ordered large small were positively correlated with age or PPVT score, it would be clear that the two are related. It remains unclear why these correlations occurred.

Table 6. Correlations between conditions, age, and PPVT raw scores

	Age	PPVT raw score
Age	1	.6**
PPVT raw score	.6**	1
NVN Animate Large-Small	.29	.3
NVN Animate Small-Large	.12	.05
NVN Inanimate Large-Small	.34*	.17
NVN Inanimate Small-Large	.03	.16
NNV Animate Large-Small	.22	.11
NNV Animate Small-Large	-.33	-.22
NNV Inanimate Large-Small	.26	.29
NNV Inanimate Small-Large	-.13	-.12
VNN Animate Large-Small	-.14	.02
VNN Animate Small-Large	-.29	-.19
VNN Inanimate Large-Small	-.1	-.16
VNN Inanimate Small-Large	-.35*	-.41*

Note.

** $p < .01$

* $p < .05$

Discussion

This study examines whether the first noun choice of monolingual English speaking children depends on the syntactic cues (i.e., word order type) or the semantic cues (i.e., animacy, and size order) that are present in sentences. It is clear, from previous research studies involving similar cue manipulation, that noun choice is indicative of sentence interpretation strategy. This study was performed in order to distinguish which cues most strongly effect preschool aged English sentence interpretation as well as to explore whether or not vocabulary level and age correspond with the cues subjects relied upon most often.

The results of the study showed a significant main effect for sentence type, animacy, and size order, and a significant interaction between animacy and size order. The findings suggest that each variable influenced noun choice significantly. The significant interaction indicates that the variables of animacy and size order together influence how the subjects choose the noun. It is understood at this point that the noun chosen as the “actor” or “doer” varies based upon whether the sentence contains syntactic or semantic cues. Specific sentence structures and cue presences result in reliance upon certain cues under certain conditions. In the discussion to follow, I will address each research question separately and the implications of our results in relation to each question.

1. Are there any relationships between age/vocabulary and interpretation strategies?

The results showed that there was no clear pattern of correlations between age/vocabulary and interpretation strategies. As mentioned in the results section, there are two significant correlations for age out of all the possible correlations we analyzed; one positive and one negative, across the twelve sentence types. My assertion that vocabulary level and age of the subject would be indicators of their strategy use was incorrect. The findings in this study indicate

that even the youngest subjects and the subjects that had the lowest vocabulary levels still had had enough experience with English that they could understand and use syntactic word order cues. The lack of correlation between vocabulary level or age and noun choice is not consistent with the findings of previous studies. For example, in Borovsky et al. (2012), children with more advanced vocabulary levels would visually fixate on the agent faster than children with lower vocabulary levels. Similarly, the results of Berger et al. (2012) showed that younger children, seven and eight, did not possess the technique used by older children in choosing the second noun as the subject. Berger et al.'s (2012) study did not measure vocabulary level and only relies on age as a dividing factor. It is very clear that all age and vocabulary levels in the current study were able to identify the second noun as the subject in sentences of VNN and NNV structure. Different methodology, i.e. how the task was administered, is a possible explanation for the different results obtained in the current study. Another explanation is that this study included children who are old enough to have developed strategies using syntactic cues to interpret the meanings of the sentences. Younger subjects who have lower vocabulary level and lower syntactic skills might interpret the sentences differently based on different cue dependence. I believe that future research should focus on younger children in order to find the level at which they begin to use syntactic cues.

2. Do children rely on syntactic cues to figure out the meaning of the sentences?

The sentence type main effect suggests that children rely on, to a certain extent, syntactic cues (i.e., word order) to interpret the meaning of the sentences. At this point in development, all of our subjects were older than 32 months of age. Based on the results of the age and vocabulary correlations, the participants had all been exposed to English for a long enough period of time that the syntactic cues of English were sufficiently understood and overwhelmingly used in

comparison to world knowledge. The syntactic results of the current study suggest that even at the young age of 38 months (our youngest subjects) first and second noun choice was consistent across age groups. Children choose the first noun as the "doer" in NVN sentence type, including sentences with animate nouns (i.e., semantically meaningful) and inanimate nouns (i.e., not semantically meaningful). The findings indicate that they are already significantly dependent upon syntactic cues. In contrast, VNN and NNV structures show significantly less first noun choice. When presented with NVN sentences, children do not rely upon world knowledge because they have already been exposed to their language structure (i.e., NVN) for long enough that the syntactic rules have been prioritized. The results of this experiment clearly suggest that young children already rely upon syntactic structure to interpret sentence meaning, and specifically identify the "doer". Children are already advanced enough to have internalized important sentence structure information. Indeed, sentence structure is the strongest significant cue used by subjects in this study. This first noun choice in NVN structures is a clear indicator of syntactic sentence interpretation. NNV and VNN sentences showed less consistency in interpretation in comparison to NVN, yet the second noun was still chosen more frequently in these structures. That is, children who are exposed to English from birth are more likely to label the second noun in each of these sentence structures, NNV and VNN, as the "doer."

These findings that sentence structure is the most significant cue overall for English interpretation has also been shown in previous sentence interpretation research. Bates et al. (1984), MacWhinney et al. (1984), Liu et al. (1993), Bates et al. (1999), Evans et al. (2002), and Borovsky et al. (2012) all found similar results regarding the strength of word order cues for English adult speakers. Only Bates et al. (1984), Berger et al. (1996), Evans (2002) and, Borovsky (2012) found these results through the testing of children. The word order results of

this study are somewhat at odds with Berger et al. (1996) in particular. Berger et al. (1996) found that the group of seven and eight year olds did not choose the second noun as the subject with the consistency and skill that the older children did.

3. Do children use semantic cues to figure out the meaning of the sentences?

The main effects of animacy and the size-order and the interactions between the two variables suggest that 3-to-5 year old children rely on semantic cues to interpret the sentences. In sentences with inanimate nouns, subjects chose the first noun reflecting their reliance upon semantic cues. In contrast, in sentences with animate nouns, subjects did not necessarily choose the first noun as the doers. These results suggest that semantically cued sentences result in children relying upon semantic knowledge to choose the “doer” of the sentence. Interestingly, although the inanimate nouns are less commonly found in such sentence structures in comparison to animate sentences, children tend to choose the first noun, or the larger noun, as a doer in inanimate conditions. I believe this unfamiliarity leads to children being more dependent on other cues.

Size ordering significantly influenced noun choice, again indicating subject’s reliance upon semantic cues for interpretation. Size order varied by small-large and large-small. When the first noun was large, and the second small, subjects more often chose the first noun as the “doer”. This is a clear example of reliance upon semantic cues. The larger noun (i.e. a bear or a plane) is more likely to eat/push the smaller noun (i.e. a mouse or a cup).

Finally the statistical results of the interaction between animacy and size order demonstrate that participants are dependent upon both semantic types of cues for interpretation of sentences. While sentences that vary by size order and are animate are interpreted via semantic cues of size order, inanimate sentences varying by size order are not. Size order

variations in animate sentences cause children to rely more on semantic knowledge.

In addition, from my observations it became apparent that when presented with sentences containing animate nouns, children tended to use their semantic knowledge to identify the doer, especially when they were not familiar with the sentence structures (i.e., NNV, VNN). For example, when presented a sentence, “the mouse the tiger pushes,” children tend to choose tiger as the “doer”. It is possible that children use their world knowledge about large and small animals (i.e., semantic cues) to judge who the doer is. However, no such semantic cues are available in sentences with inanimate nouns (e.g., *the plane the pen pushes*) for interpreting the doer because the inanimate nouns are not semantically meaningful; a plane or a pen would never realistically push something because they are inanimate. The findings suggest that children rely on semantic cues (e.g., large vs. small; animate vs. inanimate) for figuring out the doer in the sentences. Taken together, the findings suggest that children use a combination of syntactic and semantic cues to interpret the meanings of the sentences.

A trend across prior research was the manipulation of the semantic feature of animacy; noun animacy was alternated within the sentence. This type of animacy manipulation within sentences, i.e. one animate noun and one inanimate noun, can be seen in MacWhinney et al. (1984), Bates et al. (1984), and Berger et al (1996). The current study added a semantic cue, size order, and kept the semantic cue of animacy consistent across the entire sentence. Both nouns were either animate or inanimate in a sentence. However, size order was varied *within* the sentences as well as across the sentences. The first noun was large and the second small for half the sentences, and vice versa for the other half of sentences. Because of this added semantic cue, and how animacy was manipulated in this study, the results we found are less comparable to the studies mentioned above. Evans et al. (2002), Liu et al. (1992), and Li et al. (1993) also all used

sentences with animacy alternating within sentences. The semantic interaction results found in the current study when a sentence contained inanimate nouns indicated that subjects would revert to reliance on size order to help them determine which noun was the doer. This effect could not have been found in previous research because of a lack of competing semantic cues.

Conclusion

The results of this study are relevant to overall language development and sentence interpretation research in that they have furthered the understanding of monolingual English preschoolers use of syntactic and semantic cues. Specifically, this study has helped in gaining a better understanding of how children who are still learning the rules of English interpret sentences with competing cues. Previous research has touched on the strategies but has not fully examined the cues and how their interactions with each other affects overall sentence interpretation. It is evident through previous research and this current study that syntactic cues are used and relied upon most by English speakers. The introduction of animacy and size order to the sentence interpretation task teaches us that under certain conditions, when syntactic cues are weaker, semantic cues are used in combination with syntactic cues. The competition between the semantic cues also teaches us that even young children still in the process of developing language are attempting to use the most logical cues available, choosing larger nouns as the “doer” in less syntactically clear sentences. It is my hope that these results can help to instruct children in the process of acquiring sentence interpretation skills at a quicker rate and with ease. These results could also help children who are struggling with the rules of language.

An especially important use for these results is as a comparison piece to the interpretation of data from bilingual children. Such a comparison would allow us to gain a better understanding of the differences between bilinguals learning English and children learning only English. This

comparison could shed light on ways to help bilingual children acquire the rules of English more effectively in a way that still preserves their native language. Future steps that we can take in research to further our understanding of children and sentence interpretation would be to conduct this experiment with a younger age group. I had initially hoped that this experiment would pinpoint the exact age or developmental level that children switch from sentence interpretation based on semantic knowledge to syntactic based interpretation. All of the children involved in the study had passed this pivotal point.

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APPENDIX A: Example Sentences

1. NVN Animate Large-Small: “The tiger chases the rabbit.”
2. NNV Animate Large-Small: “The bear the bird pushes.”
3. VNN Animate Large-Small: “Bites the tiger the chicken.”
4. NVN Animate Small-Large: “The chicken chases the elephant.”
5. NNV Animate Small-Large: “The cat the bear pushes.”
6. VNN Animate Small-Large: “Kicks the rabbit the tiger.”
7. NVN Inanimate Large-Small: “The desk hits the ball.”
8. NNV Inanimate Large-Small: “The couch the bowl knocks.”
9. VNN Inanimate Large-Small: “Hits the refrigerator the shoe.”
10. NVN Inanimate Small-Large: “The bowl hits the desk.”
11. NNV Inanimate Small-Large: “The bowl the desk knocks.”
12. VNN Inanimate Small-Large: “Chases the leaf the desk.”

APPENDIX B: Example Picture Slides

1. NVN Animate Large-Small: “The tiger chases the rabbit.”



2. VNN Inanimate Large-Small: “Grabs the plane the pen.”



3. VNN Animate Small-Large: “Chases the mouse the elephant.”

