THE RELATION BETWEEN BASIC MEMORY PROCESSES AND AWARENESS OF LEXICAL IGNORANCE IN YOUNG CHILDREN

A thesis submitted to Kent State University in partial fulfillment of the requirements for the degree of Master of Arts

by

STACY L. LIPOWSKI

August, 2008
Thesis written by
Stacy L. Lipowski
B.A., Mount Union College, 2005
M.A., Kent State University, 2008

Approved by

_________________________________, Advisor
William Merriman
_________________________________, Chair, Department of Psychology
MaryAnn Stephens
_________________________________, Dean, College of Arts and Sciences
John R. Stalvey
# TABLE OF CONTENTS

LIST OF FIGURES ........................................................................................................ iv
LIST OF TABLES .......................................................................................................... v

<table>
<thead>
<tr>
<th>CHAPTER</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>INTRODUCTION ................................................................. 1</td>
</tr>
<tr>
<td>2</td>
<td>STUDY 1 ................................................................. 12</td>
</tr>
<tr>
<td>3</td>
<td>STUDY 2 ................................................................. 40</td>
</tr>
<tr>
<td>4</td>
<td>GENERAL DISCUSSION .................................................. 62</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>................................................................. 68</td>
</tr>
</tbody>
</table>

APPENDIX

| A | THE BIG BAR OF CHOCOLATE .............................................. 72 |
| B | PICTURE NAMING .......................................................... 73 |
# LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Examples of stimuli used in object recognition task</td>
<td>18</td>
</tr>
<tr>
<td>2</td>
<td>Example of stimuli used in picture naming task</td>
<td>48</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table Page

1 Mean Proportions of Correct Responses on Tasks in Study 1 ............................ 22
2 Age-Partialled Correlations Among Measures in Study 1 ................................. 24
3 Age-Partialled Correlations Between Object Recognition Accuracy and Other Measures in Study 1 .......................................................... 29
4 Zero-Order Correlations Between Object Recognition Latency and Other Measures in Study 1 ................................................................. 37
5 Mean Proportion Correct on the Measures in Study 2 ............................................ 52
6 Age-Partialled Correlations Among Measures in Study 2 ..................................... 55
CHAPTER 1

INTRODUCTION

Children learn to make basic judgments about their lexical knowledge during the preschool years. For example, when asked, “Do you know what a pilson (or a shoe) is?”, most 4-year-olds answer correctly, whereas many 2- and 3-year-olds claim that they know both non-words and familiar words (Chaney, 1992; Merriman & Lipko, 2008; Smith & Tager-Flusberg, 1982). A similar trend is evident in children’s judgments of whether various objects have known names, with younger children often claiming to know names for both unfamiliar and familiar types of objects (Marazita & Merriman, 2004). The ability to report whether various words are known (word familiarity judgment) has been found to be positively associated with the ability to report whether various objects have known names (object nameability judgment), even after the contribution of age or individual differences in vocabulary have been statistically controlled (Marazita & Merriman, 2004; Merriman, Lipko, & Evey, 2006). Thus, explicit awareness of one’s own lexical ignorance emerges as a distinct type of metacognitive ability during early childhood.

The development of such awareness may ultimately facilitate children’s word learning (Marazita & Merriman, 2004). A child who realizes that a word or a type of
object is unknown should be less likely to spend time trying to retrieve or construct other lexical-semantic information about it, such as the word’s meaning or the object’s name. Such awareness may also make the child more likely to attend to this missing information if it happens to be presented in input.

The current investigation had two goals. The first was to determine whether children’s awareness of lexical ignorance is related to another type of sensitivity to mental states that undergoes substantial development during the preschool years, namely, understanding of false belief. The second goal was to determine whether children’s awareness of lexical ignorance is related to the quality of their basic memory processes, in particular, those involved in object recognition.

Possible Relations between Awareness of Lexical Ignorance and Understanding of False Belief

Children’s understanding of false belief has been assessed in several ways. The classic false belief task (Wimmer & Perner, 1983), also referred to as the change-of-location task, is usually given to children in the form of a story. For example, they might be told about a child who puts a candy bar in a cupboard and then goes outside to play. While the child is outside, someone moves the candy bar to a new location, such as a different cupboard or a drawer. The story ends when the child returns to the house to get the candy bar. The participants are then asked where the child in the story will look for the candy bar first.

Another commonly used task, which assesses children’s understanding of both their own and other people’s false belief, involves unexpected contents. Children are
shown a candy box, for example, and after verifying that they expect to find candy inside of it, they are shown that the box is actually filled with pencils. The children are then asked what they believed was inside the box before they looked inside of it and what another person who has never seen the contents of the box will say is inside.

A meta-analysis by Wellman, Cross, and Watson (2001) showed that most children do not pass these tasks until about the age of four or five. The mistake that younger children tend to make in the change-of-location task is to claim that the individual in the story will look for the object where it is currently located. In the surprising contents task, younger children typically say that they knew what the box contained (e.g., pencils) before they looked inside of it and that other children will also say that it has these contents. In the present investigation, I expect to find the typical developmental pattern of false belief understanding.

One reason why awareness of lexical ignorance and understanding of false belief may be related is that both imply some form of appreciation for the potential inadequacy of mental representations. Awareness of lexical ignorance involves the realization that one’s representation of a word is missing an associated representation of its meaning or that one’s representation of an object is missing an associated representation of its name. Understanding false belief involves realizing that people, including oneself, can have inaccurate mental representations of reality. For example, the change-of-location task requires children to understand that others can have beliefs that are different from their own. Similarly, the surprising contents task requires children to understand that the identity of objects can be misrepresented by themselves or by other people. In addition,
successful performance on the false belief tasks requires that one think intelligently about ignorance. In the change-of-location task, success depends on reasoning that because the story character did not know about an object’s change of location, he or she will believe that it is in its original location. Likewise, in the surprising contents task, reconstructing what one originally expected the contents to be may be helped by thinking about the fact that one did not know, and could not have known, the contents of the box before it was opened.

Despite the conceptual similarity between awareness of lexical ignorance and understanding of false belief, these cognitive achievements do have unique properties that may cause them to develop rather independently of one another. Determining that a word’s meaning or an object’s label is unknown requires the realization that certain information is missing from a mental representation. On the other hand, only false belief understanding requires the realization that a piece of information in one’s own or someone else’s mental representation does not match what is known about reality. Only false belief understanding requires an ability to coordinate two mental representations of the same situation - a representation of what is believed about the situation and a representation of the true nature of the situation. For this reason, children’s awareness of lexical ignorance may not be strongly related to their understanding of false belief.

One purpose of the current studies was to examine the relationship between awareness of lexical ignorance and understanding of false belief. In Studies 1 and 2, the measures of awareness of lexical ignorance were word familiarity judgment and object nameability judgment. In Study 1, understanding of false belief was assessed by
children’s performance on the change-of-location task. In Study 2, it was assessed by performance on both the change-of-location task and the surprising contents task.

Possible Relations between Awareness of Lexical Ignorance and Basic Memory Processes

Previous research has provided some support for the claim that children who are more aware of the gaps in their lexical knowledge also possess superior basic memory processes. In the current investigation, I focused primarily on relations between awareness of lexical ignorance and object recognition memory, but also addressed relations between such awareness and phonological working memory (WM).

Object Recognition Memory

Merriman and Lipko (2008) found that 3- and 4-year-olds’ performance on an object recognition test was correlated with measures of the children’s awareness of their own lexical ignorance. This relation was especially strong for judgments of object nameability. The particular recognition test used by Merriman and Lipko involved presenting pictures of familiar objects that each had a distinct basic level name, then later asking participants to select these pictures from displays that also contained pictures of other familiar objects. The distracters also had distinct basic level names (e.g., only one object among the entire set presented at test was a truck, only one was a car, and so on). Due to the “name distinct” structure of this task, it may have been possible for those children who performed well to have done so by relying on either name retrieval or visual recognition processes. For example, a child who did not encode or retain the visual features of the depicted objects very well might still have performed well on the task if he
or she consistently retrieved the name for an object at presentation, retrieved it again when the object was encountered at test, and upon this second retrieval recognized the name as having been retrieved for the object during presentation. Likewise, a child whose name retrieval processes were not strong might still have performed well by relying on superior visual encoding and retention processes to simply recognize the visual features of the object at test.

Merriman and Lipko (2008) proposed that either memory process – name retrieval or visual object recognition – could account for the relation between object nameability judgment and performance on the name-distinct object recognition test. A child who is especially efficient in retrieving names for objects may have an advantage over other children in learning that the nameability of an object can be judged by whether a name can be retrieved for the object. On the other hand, a child who has superior visual object recognition processes may have an advantage over other children in learning a different criterion, which is that the nameability of an object can be judged by whether the object itself evokes a strong recognition response.

One goal of the current study was to assess the relation between object nameability judgment and performance on an object recognition test in which the role of name retrieval processes was minimized. The new test involved presenting pictures of unfamiliar kinds of objects that children could not readily label. The children’s task was to determine whether each such picture was the same or slightly different from a picture of the same kind of object that had just been presented. The targets and distractors in this task were such that even if children used a basic level name to describe them (e.g, “It
looks like a toaster”), the same name described both the target and its corresponding distractor (e.g., both looked like toasters). As a result, word retrieval processes would be of little help to children when making their recognition decision. Thus, if the quality of processes for encoding and storing visual information about objects affects how quickly a child learns to judge object nameability, then performance on the object recognition test used in the current investigation should correlate positively with the accuracy of object nameability judgment.

Merriman and Lipko (2008) did not offer an explanation for the moderate correlation found between word familiarity judgment and performance on the name-distinct object recognition test. This relation may just reflect the association of each measure with vocabulary knowledge, or with factors that affect the accumulation of vocabulary knowledge. Preschool-age children who have larger receptive vocabularies tend to judge word familiarity more accurately (Chaney, 1992; Merriman et al., 2006; Smith & Tager-Flusberg, 1982) and also tend to outperform other children on object recognition tests (Cardell & Bell, 2006; Fagan, 1984). In Study 1 of the current investigation, the correlation between object recognition and each of the two lexical knowledge judgments -- word familiarity and object nameability -- was examined after children’s scores on a receptive vocabulary test were partialled out.

Another feature that distinguished the current investigation from that of Merriman and Lipko (2008) was that, in addition to accuracy, the speed of recognition responses was examined. This additional measure may shed additional light on the nature of the relations between visual recognition processes and awareness of lexical ignorance. For
example, children who show greater levels of such awareness might respond more accurately on the recognition test only because they take more time to examine the test stimulus before responding. Alternatively, they might make recognition responses faster than other children without necessarily making them more accurately.

The relative speed of “same” and “different” responses in the recognition memory task was also of interest. In many studies requiring same/different judgments about successively presented stimuli, adults tend to take longer to say that two mismatching stimuli are different than to say that two matching stimuli are the same (Krueger, 1978). Both Krueger (1978) and Ratcliff (1985) have proposed that this “fast same effect” reflects adults’ metacognitive awareness that their impression that a stimulus at test mismatches the stimulus that was just presented is less trustworthy in these situations than their impression that the two match. In support of this claim, adults often make more false “different” than false “same” responses in these tasks, despite their taking longer before they say “different” than before they say “same” (Krueger, 1978).

Kreuger (1978) proposed that adults are aware that their processes of encoding the test stimulus and comparing it to their memory representation of the study stimulus are more prone to producing false impressions of difference than false impressions of sameness under certain circumstances. He refers to the source of this difference as the \textit{internal noise principle}. If an adult has ample time to exhaustively encode a visual stimulus at study, and the retention interval is short, then “internal noise” in the processes of encoding the test stimulus and comparing it to the study stimulus can make identical pairs seem different, but can only rarely make different pairs seem identical. Thus, an
impression that the test stimulus is identical to the study stimulus is more trustworthy than an impression that it is different. According to Krueger, because adults are less willing to accept the latter impression, they are slower to say “different” than “same.” They more often re-examine the test stimulus if their first impression is that it is different than if their first impression is that it is the same as the previously presented stimulus.

I hypothesized that those children who show greater awareness of lexical ignorance would be more likely to show the fast same effect on the easiest trials of the recognition memory test, which were the ones in which no time elapsed between the offset of a study picture and the presentation of the test picture (i.e., retention interval = 0 sec). One rationale for this hypothesis was that a general sensitivity to representational inadequacy may underlie both awareness of lexical ignorance and the tendency to suspect that an object only seems slightly different from another. An alternative rationale is based on the possibility that an unfamiliar word, an unfamiliar type of object, and a test picture that seems slightly different from a just-seen study picture may have something in common. They may all evoke an impression of novelty, or of not fitting in one’s system for representing it. A meaning cannot be assigned to the unfamiliar word, a name cannot be assigned to the unfamiliar type of object, and the identity of the study picture cannot be assigned to the test picture. Individual differences in the general tendency to reflect on impressions of novelty, or impressions of lack of representational fit, may tie skill in the two types of lexical ignorance judgments together with skill in judging whether a test picture that seems slightly different from its study picture is actually different from it.
No predictions were made about a fast same effect on recognition test trials that involved a 5 second retention interval. This delay was expected to result in forgetting, or at least difficulty retrieving some of the features of the study stimulus. In such cases, a child might not trust an impression that the test stimulus was the same as the study stimulus because the child may realize that he or she does not remember some of the features of the study stimulus and suspect that these features may not match those of the test stimulus. For these reasons, a fast same effect might not even be observed on delayed test trials.

Because my goal was to examine children’s awareness of instances in which mental representations are inadequate, participants in Study 1 were also told before the recognition test began that after a test picture was presented, they could recheck the study picture before responding. If they chose to recheck a study picture, the experimenter flipped the picture of the test object over so the child could see the picture of the study object on the other side. The children were periodically reminded of this option throughout the test.

I expected that children would have some awareness of how well they remembered the features of the study picture, and so hypothesized that they would recheck a study picture more often on delayed test trials (involving a 5 sec retention interval) than on immediate test trials. I also hypothesized that children who showed a greater awareness of their own lexical ignorance would be more likely than other children to increase such rechecking from the immediate to the delayed test trials.
Phonological Working Memory

One of the most widely used tests of the efficiency of young children’s phonological WM assesses their ability to repeat back nonsense words that are structured very similarly to real words (e.g., *rubid* and *stoppogratic*) (Baddeley, Gathercole, & Papagno, 1998; Gathercole, 1995). Preschool-age children’s ability to repeat back such “high-wordlike pseudowords” was found by Merriman et al. (2006) to be moderately correlated with the accuracy of word familiarity judgment, but not the accuracy of object nameability judgment. Merriman and Lipko (2008), however, found comparable correlations between pseudoword repetition performance and each type of lexical judgment. The latter findings were independent of the relations found between performance on the name-distinct object recognition test and the two lexical judgments.

Merriman et al. (2006) proposed that children who possess superior phonological WM tend to acquire the ability to judge word familiarity faster than other children do, and that they make these judgments based on recognition of a word’s sound form. That is, they judge a word such as *car* to be one they know because the word itself evokes a strong recognition response. Because a relation between pseudoword repetition performance and object nameability judgment has not been found consistently, Merriman and colleagues have not proposed a mechanism by which this judgment might be affected by a children’s phonological WM. The first study in the current investigation included both the pseudoword repetition test and a test of object nameability judgment, which allowed us to assess this relation further.
CHAPTER 2

STUDY 1

Our first goal was to examine the relations between awareness of lexical ignorance and understanding of false belief in 3- and 4-year-olds. Awareness of lexical ignorance was measured by word familiarity judgment and object nameability judgment. Understanding of false belief was measured by the classic change-of-location task (Wimmer & Perner, 1983).

A second goal was to examine the relations between awareness of lexical ignorance and basic memory processes. Visual object recognition was measured by having children determine as quickly as possible whether a line drawing of an unfamiliar object was identical to or different from a line drawing that had just been presented. The test picture was presented either immediately after or five seconds after the offset of the study picture. Participants were given the opportunity to physically recheck the study picture after the test picture was presented.

Based on Merriman and Lipko’s (2008) findings, and their dual criterion account of linguistic judgment, the accuracy of children’s recognition responses was expected to correlate positively with their awareness of lexical ignorance, especially with the accuracy of their object nameability judgments. Based on Krueger’s (1978) internal noise
principle, children who showed greater awareness of their lexical ignorance were predicted to show a stronger fast same effect than other children on the immediate recognition test trials. Because of their greater awareness that a mental representation can be misleading or incomplete, these children were also expected to be more likely than other children to increase their rechecking of stimulus pictures from the immediate to the delayed test.

The relation between awareness of lexical ignorance and phonological WM, which was measured by having children repeat high word-like pseudowords (Gathercole, 1995), was also assessed. Based on previous findings (Merriman et al., 2006; Merriman & Lipko, 2008) as well as the dual criterion account of linguistic judgment (Merriman & Lipko, 2008), the repetition measure was expected to show a moderate correlation with the accuracy of word familiarity judgment, but not necessarily with the accuracy of object nameability judgment.

Our final goal was to examine the distinctiveness of any correlations found between either lexical judgment and any of the basic memory processes. These correlations were compared with those between either vocabulary size or false belief understanding and the basic memory processes. The correlations that were predicted based on the dual criterion account of early linguistic judgment (Merriman & Lipko, 2008) were expected to be distinctive.
Method

Participants

Thirty-seven children (M = 4 – 1; range = 3 – 0 to 5 – 0) were recruited from area preschools. There were 20 boys and 17 girls. The children were split into two groups. One group completed object nameability judgment, word familiarity judgment, false belief, object recognition, pseudoword repetition, and then the vocabulary test. The other completed word familiarity judgment, object nameability judgment, object recognition, false belief, pseudoword repetition, and then the vocabulary test. The pseudoword repetition task was inadvertently omitted for one child.

Materials and Procedures

After the parents signed the consent forms, the children were tested individually at their preschools. The tasks were administered once the children felt comfortable with the experimenter and were willing to participate. The children completed the tasks based on the order of their assigned group.

Word Familiarity Judgment

Merriman and Lipko’s (2008) method for measuring word familiarity was used, but the stimuli were different. The children were told that they would hear a list of words. They were also told, “I don’t know what some of the words means. I want you to tell me if you know what these words mean.” The children were asked if they knew five familiar words (cat, school, bed, boat, flower) and five unfamiliar words (blicket, hust, pilson, zav, jegger). The children were given two practice trials at the beginning of the
task, which included one familiar (book) and one unfamiliar word (zimbidy). The children were simply asked if they knew what each of the words was (e.g., “Do you know what a cat is? Do you know what a zav is?”). The experimenter responded to every answer with a neutral or positive response.

After the list was read once, the experimenter repeated the questions about the novel words that the children said they knew. When the children gave a positive response, the experimenter asked, “What is it?” When the children gave a negative response, the experimenter asked, “Can you tell me anything about it?” Novel words that were defined by a child as a phonologically-similar familiar word (e.g., pilson as if it was person) were excluded from the calculation of the child’s correct responses ($M$ number excluded per child = .05, range = 0-1).

Object Nameability Judgment

The procedure used by Merriman and Lipko (2008) was used, but some of the stimuli were different. The children were shown six familiar and six unfamiliar objects in random order. The familiar objects were a sock, cup, flower, key, and spoon. The unfamiliar objects were a staple remover, telephone cord organizer, wine pourer, waterbed hose adapter, and a piece of a bike lock. After each object was presented, the children were asked, “Do you know the name for this?” They were told that they did not have to say the name of the object, but to just shake their head yes if they knew the name of the object or to shake their head no if they did not. As a practice trial, the children were shown one familiar (Matchbox car) and one unfamiliar object (CD opener) to confirm that they understood the instructions. After the last test trial, if the children said
that they knew the name for any of the novel objects, the experimenter showed those objects to the child for a second time. They were told, “I am going to show you some of those things again, but this time you can talk.” If the child said that they knew the name of the object for a second time, the experimenter asked, “What is it?” If the child responded, “No,” the experimenter asked, “Can you tell me anything about it?” When calculating rates of correct judgment, unfamiliar objects for which participants overextended a familiar word were excluded ($M$ number excluded per child = .13, range 0-1).

*False Belief Understanding*

Children’s understanding of false belief was assessed with a change-of-location task. The task was modeled after the version developed by Siegel & Beattie (1991). In this version, the child is asked where the character in a story who did not observe the change in location of an object will look for that object “first.” Wellman et al. (2001) found that emphasizing the time frame during questioning can help younger children succeed on this task.

The experimenter read the children a short story about a child who put a candy bar in one location, then went outside to play (see Appendix A). His mother came in and moved the candy bar to a different location. Before the child returned to the house, the participants were asked two questions including, “Where is the bar of chocolate now?” and “Where did the child put it before he/she went outside to play?” After the child in the story returned to the house, the participants were asked, “Where will the child look for the bar of chocolate first?”
Object Recognition

The children viewed 2 practice cards and 16 test cards, each of which had a line drawing of an object on both sides. The objects on the practice cards were familiar and the objects on the test cards were unfamiliar. Half of the cards had the same objects on both sides and the remaining cards had the same objects with one feature difference between them (see Figure 1). The children completed one immediate practice trial, then eight immediate test trials. On each immediate trial, children were shown one side of a card (the study picture), then the card was flipped over to reveal the other side of the card (the test picture). Next the children completed one delayed practice trial and eight delayed test trials. The only difference between delayed and immediate trials was that a 5 sec retention interval occurred after the study picture had been removed and before the test picture was presented.

Before the first practice trial, the experimenter said, “I am going to show you a picture and I want you to take a good look at it because after a few seconds I am going to show you another picture. Then you will have to tell me whether those two pictures are the same or different. If you do not remember, you can turn the card over and look at the first picture again to check. Do you think you know how to play?” For the immediate practice trial, the child was shown a familiar picture for five seconds, then the picture was turned over to reveal the test picture on the other side. The experimenter said, “Are those two pictures the same or different, or do want to turn the card over to check?” For the immediate practice trial, the pictures were the same. If the child’s response was correct, the experimenter told the child that he or she gave the right answer. If the child’s
Figure 1. Examples of stimuli used in object recognition task.
response was incorrect, the experimenter told the child the correct response and presented the study picture for a second time. The child received no further feedback.

On all the test trials that followed, the experimenter held the study picture in front of the child for five seconds and said, “Take a good look at it.” On immediate test trials, once a study picture had been presented, the experimenter turned it over to reveal the test picture, and asked the child whether it was the same as the picture they had just seen or different from it. For the delayed practice trial, the child was shown a familiar picture for five seconds. Next, the experimenter hid the picture for five seconds and then turned it over to show the test picture to the child. For the delayed practice trial, the two pictures were different. The experimenter’s responses and feedback were the same as for the immediate practice trial. On the test trials for the delayed test, after each study picture had been presented for five seconds, the experimenter covered it for five seconds, then turned it over to reveal the test picture, and asked the test question. On all trials, the children were reminded that they could turn the card over to check if they were not sure. To control presentation times, the experimenter listened to a metronome, which beeped every second. The entire recognition test was videotaped. The latency of children’s verbal responses and card turning behaviors was coded from these videotapes.

Pseudoword Repetition

The efficiency of children’s phonological WM was assessed by their ability to repeat back high-wordlike pseudowords (Gathercole, 1995). The stimuli and procedures were the same as those used by Merriman and Lipko (2008). Children were told they were going to play an “echo game.” They were told, “You are going to be an echo. I am
going to read you some words and I want you to repeat them back to me.” The children were warned that they would have to listen carefully because the experimenter was going to cover her mouth. The experimenter covered her mouth so that the children could not use lip movements to aid them in repeating the words. The children were also told that they would have to repeat some words that they know and others that were made up. The list of words consisted of ten familiar words and eleven pseudowords (roobid, grundle, diller, penned, brastering, dopelate, kannifer, parrozon, commeecitate, stoppogratic, confrantual). The first five words were familiar to allow for practice. For the remainder of the list, the familiar words and pseudowords were intermixed with words increasing in syllable length throughout the list. Responses were video taped.

*Vocabulary Test*

The last task administered to each child was the Peabody Picture Vocabulary Test-Form IIIA (Dunn & Dunn, 1997).

*Results and Discussion*

The two lexical ignorance judgments and the test of false belief understanding were analyzed for their relative difficulty, then the relations of each measure to age and vocabulary size were assessed. Correlations between the three measures were then analyzed to determine whether children’s awareness of lexical ignorance was related to their understanding of false belief. Finally, children’s performance on the two memory tasks – pseudoword repetition and object recognition – was analyzed for relations to awareness of lexical ignorance.
Awareness of Lexical Ignorance and Understanding of False Belief

Three- and four-year-olds’ performance is summarized in Table 1. Regarding the two lexical ignorance judgments, accuracy was greater for object nameability than for word familiarity, \( t(36) = 3.69, p < .01 \) (see Table 1). The accuracy of word familiarity judgment was greater than chance, however, \( t(36) = 6.60, p < .001 \). Some children may find the object nameability judgment to be easier because it concerns a stimulus that remains in view (i.e., an object) rather than one that must be maintained in working memory (i.e., a word).

Merriman and Lipko (2008) also found preschool-age children’s object nameability judgments to be more accurate than their word familiarity judgments, but Marazita and Merriman (2004) and Merriman et al. (2006) found no difference between them. The use of actual objects versus line drawings of objects may explain this discrepancy. Actual objects were used in the current study and by Merriman and Lipko (2008), but line drawings were used in the other studies. Children may tend to make more accurate judgments for actual objects than for drawings of them because the latter contain less visual information, which increases the chance of an unfamiliar object being mistaken for a familiar one.

Thirty-eight percent of the children passed the false belief task. To pass the task, children had to answer all three questions correctly -- “Where is the bar of chocolate now?”, “Where did the child put it before he/she went outside to play?” and “Where will the child look for the bar of chocolate first?” For the sake of comparison, passing the object nameability or word familiarity judgment task was defined as responding correctly
Table 1. Mean Proportions of Correct Response on Tasks in Study 1.

<table>
<thead>
<tr>
<th>Measure</th>
<th>3-yr-olds (N = 14)</th>
<th>4-yr-olds (N = 23)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metacognitive:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Object Nameability</td>
<td>.74 (.23)</td>
<td>.90 (.14)</td>
</tr>
<tr>
<td>Word Familiarity</td>
<td>.59 (.15)</td>
<td>.80 (.20)</td>
</tr>
<tr>
<td>False Belief</td>
<td>.07(^a) (--)</td>
<td>.57(^a) (--)</td>
</tr>
<tr>
<td>Memory:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pseudoword Repetition</td>
<td>.54 (.21)</td>
<td>.74 (.14)</td>
</tr>
<tr>
<td>Object Recognition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immediate</td>
<td>.55 (.18)</td>
<td>.77 (.19)</td>
</tr>
<tr>
<td>Delayed</td>
<td>.51 (.10)</td>
<td>.78 (.19)</td>
</tr>
</tbody>
</table>

Note - Standard deviations are in parentheses.

\(^a\) Children were scored as either passing or failing this test.
on .80 or more trials. (The likelihood of satisfying this criterion by chance was fairly low, \( p = .089 \).) By this criterion, a greater percentage of children passed the object nameability judgment task (76%) than the false belief task. Every child who passed the false belief task also passed the object nameability judgment task, whereas only 14 of the 28 children who passed the object nameability judgment task also passed the false belief task, \( \chi^2 (1, N = 14) = 14, p < .001 \). In contrast, the percentage of children who passed the word familiarity judgment task (41%) and false belief task did not differ. Performance on the three tasks improved with age (see Table 1). Coefficients for the correlations between task performance and age, \( r (35) \), ranged from .50 to .64, \( p < .005 \). The percentages of 3-year-olds passing the object nameability judgment, word familiarity judgment, and false belief tasks were only 50, 14, and 7, respectively. For the 4-year-olds, these percentages were 91, 57, and 57, respectively.

Replicating previous studies (Marazita & Merriman, 2004, Study 2; Merriman et al., 2006, Study 1; Merriman & Lipko, 2008), the two lexical judgments were significantly related to each other even after age was partialled out, \( r (34) = .37, p < .05 \). (Age-partialled correlations are summarized in Table 2). This finding supports the conclusion that the relation between these judgments is not simply a reflection of the general increase that occurs with age in nearly every ability, but rather a reflection of specific cognitive processes and/or knowledge structures that the two judgments share.

Performance on each of the three tasks was also positively correlated with vocabulary size, \( r (35) \)s ranged from .55 to .67, each \( p < .001 \). When age was paritalled out, the coefficients were reduced from .18 to .37 (see Table 2.) The age-partialled
Table 2. Age-Partialed Correlations Among Measures in Study 1

<table>
<thead>
<tr>
<th>Measure</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Obj Nameability J</td>
<td>.37*</td>
<td>.20</td>
<td>.30</td>
<td>.22</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(34)</td>
<td>(34)</td>
<td>(34)</td>
<td>(33)</td>
<td></td>
</tr>
<tr>
<td>2. Word Familiarity J</td>
<td>.30</td>
<td>.37*</td>
<td>.30</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(34)</td>
<td>(34)</td>
<td>(33)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. False Belief</td>
<td>.18</td>
<td>.24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(34)</td>
<td>(33)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Vocabulary Size</td>
<td></td>
<td></td>
<td>.37*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(33)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Pseudoword Repetition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note - df are listed in parentheses.

* p < .05
coefficients for the two lexical judgments were similar to those that have been previously reported (Chaney, 1992; Merriman et al., 2006; Smith & Tager-Flusberg, 1982). Children with larger vocabularies, and presumably greater verbal ability, show a moderate advantage over other children with respect to how accurately they judge their own lexical ignorance.

The two lexical judgments were still significantly intercorrelated when vocabulary size was partialled out, \( r (34) = .33, p < .05 \). This relation may have been attenuated by the floor level performance of the 3-year-olds in word familiarity judgment. Only 2 of the 14 children in this age group passed the test of these judgments, and no child under 42 months old did so. When just the data from those 42 months and older were analyzed, the vocabulary-partialled correlation was stronger, \( r (26) = .45, p < .02 \). The strength of the correlation remained at this level when both age and vocabulary were partialled out, \( r (25) = .49, p < .01 \). Merriman et al. (2006) reported a similar finding for children who ranged in age from 3.5 to 4.5 years. Taken together, these results support Marazita and Merriman’s (2004) contention that the two lexical judgments are measures of a specific metalinguistic construct in preschool-age children, namely, awareness of lexical ignorance.

The weakness of the age-partialled correlation between vocabulary size and understanding of false belief is surprising in view of the moderate relation reported in previous studies (Astington & Jenkins, 1999; Carlson, Moses, & Claxton, 2004; Cutting & Dunn, 1999; Farrar & Maag, 2002; Hughes, Jaffee, Happe, Taylor, Caspi, & Moffitt, 2005; Watson, Painter, & Bornstein, 2001). One possibility is that the floor effect in 3-
year-olds’ performance on the false belief task attenuated this relation. Only one 3-year-old passed this task, and no child under 42 months did so. When just the data from children who were more than 42 months old were analyzed, the age-partialled correlation between vocabulary and false belief was essentially unchanged, \( r(26) = .22 \), one-tailed \( p > .10 \). There was no evidence of a relationship between vocabulary size and false belief when their common association with age was statistically controlled.

Object nameability and word familiarity judgments were more strongly related to each other than either was to performance on the false belief task. The results for the full data set are summarized in Table 2; for just the children who were 42 months or older, age-partialled \( r(26) = .43, p < .05 \). Neither object nameability nor word familiarity judgment was significantly correlated with false belief performance when age was partialled out (see Table 2); for the children 42 months or older, the correlation coefficients fell just below the cutoff for significance, respective \( r(26)’s = .36 \) and \(.30, both p > .05 \). When vocabulary size was partialled out, false belief performance was not correlated with object nameability judgment, \( r(34) = .20, p > .10 \), but was correlated with word familiarity judgment, \( r(34) = .33, p < .05 \). In the analysis of the children who were 42 months or older, neither of these correlations were significant, respective \( r(26)’s = .32 \) and \(.26, both p > .05 \). Thus, the hypothesis that awareness of lexical ignorance and understanding of false belief reflect a more general ability to judge the inadequacy of mental representations did not receive strong support.
Relations Between Basic Memory Processes and Awareness of Lexical Ignorance

Three- and four-year-olds’ mean levels of correct response on the memory tests are summarized in Table 1. The nature of the relations between these tests and awareness of lexical ignorance was addressed first for pseudoword repetition, and then object recognition performance. Three aspects of recognition performance were analyzed, namely, study picture rechecking, response accuracy, and response latency. Both overall response latency and the relative speed of responses on match and mismatch trials (i.e., the fast same effect) were analyzed.

Pseudoword Repetition. Consistent with previous research (Gathercole, 1995; Merriman, et al., 2006; Merriman & Lipko, 2008), the proportion of high-wordlike pseudowords that children repeated back correctly was positively correlated with age, \( r(34) = .45, p < .01 \), and vocabulary size, \( r(34) = .56, p < .001 \). This measure of the efficiency of children’s phonological working memory (WM) was also related to the accuracy of the two lexical judgments as well as performance on the false belief task. For object nameability judgment, \( r(34) = .40, p < .02 \); for word familiarity judgment, \( r(34) = .49, p < .01 \); and for false belief, \( r(34) = .44, p < .01 \). Age-partialled correlations for the same relations were not significant, however (see Table 2). The coefficient for the partial correlation with word familiarity judgment, \( r = .33 \), did meet the criterion for a one-tailed test, \( p < .05 \). The somewhat higher partial coefficient for word familiarity judgment than for object nameability judgment, \( r = .20 \), is in line with previous results. The average age-partialled correlations in past studies (Merriman et al., 2006, Study 1; Merriman &
Lipko, 2008) were .36 and .27 for word familiarity judgment and object nameability judgment, respectively.

Object Recognition: Accuracy and Response Bias. The accuracy of children’s responses on the object recognition test also improved with age, \( r(35) = .63, p < .001 \). Three-year-olds’ mean accuracy did not exceed chance in either the immediate or delayed tests (see Table 3). Seven of the 14 children in this age group showed a response bias, making the same response on at least 15 of the 16 test trials. For all but one of these seven, the dominant response was “different.” In contrast, 4-year-olds performed well above chance on both the immediate and delayed tests, and responded correctly on match trials about as often as on mismatch trials (\( M \) proportion correct = .80 and .76, respectively). Only three 4-year-olds showed a response bias.

Some of the children who showed a response bias may have misunderstood instructions. They may not have interpreted the expressions “same as” or “different from” in the way that the experimenter had demonstrated. Those who nearly always said, “different,” may have thought that this response meant that they judged the test stimulus to be a different individual instance of the same type as the study stimulus, akin to saying “another one” (see Glucksberg, Hay, & Danks, 1976, for evidence that preschoolers interpret different this way in certain contexts). Other children may have understood the experimenters’ instructions, but found the recognition judgment so difficult that they fell back on giving the same response on every trial. Because the cause of any one child’s response bias was unknown, the data from those who showed a response bias were excluded from subsequent analyses of recognition performance.
Table 3. Age-Partialled Correlations Between Object Recognition Accuracy and Other Measures in Study 1.

<table>
<thead>
<tr>
<th>Object Recognition Accuracy</th>
<th>WFJ</th>
<th>ONJ</th>
<th>FB</th>
<th>Vocab</th>
<th>Pseud</th>
<th>Recheck</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate</td>
<td>.45*</td>
<td>.60**</td>
<td>.26</td>
<td>.52**</td>
<td>.39†</td>
<td>.23</td>
</tr>
<tr>
<td>Delayed</td>
<td>.17</td>
<td>-.04</td>
<td>.01</td>
<td>.14</td>
<td>.11</td>
<td>.51*</td>
</tr>
<tr>
<td>Overall</td>
<td>.44*</td>
<td>.43*</td>
<td>.20</td>
<td>.47*</td>
<td>.36†</td>
<td>.48*</td>
</tr>
</tbody>
</table>

Notes—†p < .10  * p < .05  ** p < .01

Data from children who showed a response bias on the recognition test were excluded.

df = 24, except for correlations with pseudoword repetition, where df = 23.

WFJ = word familiarity judgment, ONJ = object nameability judgment, FB = understanding of false belief, Vocab = receptive vocabulary size, Pseudo = pseudoword repetition, Rechecker = whether or not child rechecked more pictures in delayed than immediate test.
Object Recognition: Study Picture Rechecking. A unique feature of the recognition test was that the participants were told that they could turn over any card at test to recheck the study picture on the other side. Eleven children (41%) rechecked at least one study picture during the test. Nine of them rechecked more pictures on delayed test trials ($M = 4.89$ for this group) than on immediate test trials ($M = 1.89$). The two who showed the opposite pattern were both 3-year-olds. The greater incidence of rechecking on delayed than on immediate trials by the older children is consistent with the possibility that their decision to recheck a particular picture was influenced by how certain they were about their recognition decision.

As a group, the eleven recheckers did not differ from the other children in age or on any cognitive measure. However, the nine who rechecked more often on delayed than on immediate test trials did have larger vocabularies than the other children (i.e., the other two recheckers plus the children who did not recheck at all), $r_{pb}(25) = .47, p < .05$, and also tended to be older, $r_{pb}(25) = .37, p < .05$. Importantly, these recheckers did not outperform other children on any metacognitive measure. Even if their decisions to recheck study pictures did reflect a greater tendency to monitor uncertainty on their part, or a greater awareness that a memory representation may be inadequate, the results provide no support for the view that such metacognitions in this context are related to awareness of lexical ignorance or understanding of false belief.

Table 3 summarizes age-partialled correlation coefficients for relations between accuracy of object recognition performance and a variety of other measures. As the rightmost column of the table indicates, the nine children who rechecked more pictures in
the delayed than in the immediate test also tended to make more accurate recognition
decisions than the other children, especially in the delayed test. These findings lend
further support to the view that these children rechecked pictures because they were
monitoring their own uncertainty and were aware that their memory representation for a
study picture could be inaccurate or incomplete.

Object Recognition: Relations between Accuracy and Awareness of Lexical
Ignorance. Merriman and Lipko (2008) proposed that children’s ability to encode and
store visual information about objects affects how quickly they learn to judge object
nameability based on object recognition. Consistent with this proposal, the overall
accuracy of children’s responses in the recognition test was related to the accuracy of
their object nameability judgments, even after age was partialled out (see Table 3). When
recognition responses on immediate and delayed test trials were considered separately,
the age-partialled correlation was significant only for immediate trials, however.

Merriman and Lipko (2008) also found that the overall accuracy of responses on
their name-distinct object recognition test correlated with the accuracy of word
familiarity judgments, even after age was partialled out. This result was replicated with
the recognition test in the current study (see Table 3). When immediate and delayed
recognition were considered separately, the age-partialled correlation was significant only
for the immediate test, however.

Regarding the distinctiveness of these results, the age-partialled correlations for
vocabulary size and pseudoword repetition in Table 3 were similar to those for the two
lexical knowledge judgments. That is, coefficients for the correlations between these
measures and recognition accuracy were substantial for the immediate recognition, but not delayed recognition. In contrast, understanding of false belief was not related to either immediate or delayed recognition.

An alternative explanation for the relations between awareness of lexical ignorance and object recognition accuracy is that these merely reflect shared associations with vocabulary knowledge, or with factors that affect the accumulation of vocabulary knowledge, such as verbal intelligence. When vocabulary size was partialled out, object nameability judgment remained significantly related to immediate recognition, \( r(24) = .50, p < .02 \), though not to overall recognition, \( r = .23, p > .10 \). Word familiarity showed the opposite pattern, \( r = .36, p = .07 \), for immediate recognition, and \( r = .45, p < .05 \), for overall recognition. When z-scores for the two lexical judgments were combined to create a general measure of awareness of lexical ignorance, this measure was found to be related to both immediate and overall recognition, even after vocabulary size was partialled out, \( r = .53 \) and \( .43 \), respectively, both \( p < .05 \). Thus, the alternative explanation was not supported.

Two findings do present a challenge for Merriman and Lipko’s (2008) claim, however. First, object nameability judgment was not related to the accuracy of responses in the delayed recognition test. Secondly, word familiarity judgment was just as strongly related to overall recognition performance as object nameability judgment was. One possible explanation is that the increase in frequency of study-picture rechecking from the immediate to the delayed test, which was associated with more accurate responding on the delayed test (see Table 3), obscured the relation between object nameability
judgment and recognition accuracy on the delayed test. This possibility is unlikely, however, because when children’s rechecker status was partialled out, response accuracy on the delayed test was not correlated with object nameability, \( r(24) = -0.08, p > .10 \), but was correlated with word familiarity judgment, \( r(24) = 0.45, p < .05 \).

A more plausible explanation is that the better judges of object nameability experienced a negative carryover effect from the immediate to the delayed test. Let us suppose, as hypothesized, that these children have superior visual encoding skills. Their confidence in these skills and their success on immediate test trials may have left them less well prepared than the other children for the increase in difficulty that resulted when the five second retention interval was added to the recognition test. The retention interval presumably increased the difficulty of retrieving some of the visual features of the study pictures, and so increased the likelihood that a child would not be able to determine whether some features of a test stimulus matched or mismatched the corresponding features in the study stimulus. Children who performed well on the immediate test may not have experienced this sort of difficulty until the delayed test, and so may not have had the opportunity to adjust their encoding or decision processes in response to it until after making errors on the delayed test.

One finding that is compatible with this possibility is that an increase in false “same” responses from immediate to the delayed test was positively associated with the accuracy of object nameability judgment, \( r(25) = 0.50, p < .01 \), but not with the accuracy of word familiarity judgment, \( r = 0.06, p > .10 \) (Change in the frequency of false “different” responses from the immediate to the delayed test was not associated with
either of these measures, $r = .06$ and .09, respectively, $p > .10$.) When children who were
the better judges of object nameability experienced instances in the delayed test in which
they could not retrieve the feature of the study stimulus that corresponded to some feature
of the test stimulus, they may have assumed that if the two stimuli had been different, a
feature mismatch would have been readily apparent at test. Such had been their
experience in the immediate test. In contrast, the other children may have responded to
such situations by continuing their attempt to retrieve the missing feature of the study
stimulus. This continued attempt may have occasionally succeeded in retrieving a
mismatching feature, and thus, kept their rate of making false “same” responses from
increasing.

Object Recognition: Relations between Response Latency and Awareness of
Lexical Ignorance. The mean recognition response latencies of the children who did not
show a response bias were submitted to a 2 (test: immediate vs. delayed) x 2 (trial type:
match vs. mismatch) repeated measures analysis of variance. No effects were significant.
On average, children took 3.44 sec ($SD = 1.30$) to respond. Neither overall response
latency nor the effects of test or trial type on response latency varied with age (in
months), all $p > .10$.

The zero-order correlations between response latencies and other measures are
summarized in Table 4. (Age was not partialled out because it was not a significant
correlate of response latencies.) Only study-picture rechecking and pseudoword
repetition ability were related to the mean response latencies. The children who increased
their rechecking from the immediate to the delayed test tended to take longer to make a
recognition decision, $M$ latency = 3.99 ($SD = 0.77$), than the other children, $M = 2.95$ ($SD = 1.21$). Both their tendency to recheck study pictures and to make recognition decisions more slowly than other children may reflect their greater cautiousness or concern about making an incorrect judgment.

Children who were better able to repeat back high-wordlike pseudowords tended to respond more quickly on the recognition test, especially on the immediate trials. According to Baddeley (2003), pseudoword repetition ability reflects the efficiency of the two major components of phonological WM – the phonological short-term store and the articulatory output buffer. When speech is perceived, phonological representations become established in the short-term store, where they decay rapidly unless rehearsal occurs. The output buffer assembles speech-motor programs for pronouncing the information in the store before it decays. The latter component may be responsible for the relation observed in the current study between pseudoword repetition and the speed of recognition responses. Children who are generally faster than their peers at assembling speech-motor programs should be faster at the specific task of assembling the programs for saying “same” or “different” in the current recognition task.

The results of these analyses provide guidance for interpreting the significant relations found between the accuracy of lexical ignorance judgments and the accuracy of recognition responses. It is not the case that the children who showed greater awareness of their own lexical ignorance made more accurate decisions in the immediate recognition test only because they took more time to examine test pictures before
responding. The age-partialled correlations between the accuracy of the lexical judgments and response latencies on the immediate test were close to zero (see Table 4).

Object Recognition: Relations between the Fast Same Effect and Awareness of Lexical Ignorance. Children who showed greater awareness of lexical ignorance were expected to be more likely than other children to show the “fast same effect” in immediate recognition. This effect is the tendency for responses on match trials to be made more rapidly than ones on mismatch trials. The fast same effect in adults is considered by some (Krueger, 1978; Ratcliff, 1985) to reflect adults’ awareness that a certain kind of cognitive impression is rather untrustworthy, namely, the impression that one stimulus differs from another stimulus that was just seen. Internal noise in the encoding and comparison of stimuli can cause identical stimuli to seem different, but is much less likely to cause different stimuli to appear identical. Because adults do not trust impressions of difference in this context, they react to them by examining a test stimulus further before deciding whether it is actually different from the stimulus that they just saw.

Table 4 summarizes the coefficients for correlations between a measure of the fast same effect (response latency on mismatch trials minus response latency on match trials) and other measures. The prediction that children who showed a greater awareness of lexical ignorance would be more likely to show a fast same effect on immediate test trials received mixed support. The magnitude of the fast same effect was significantly correlated with the accuracy of word familiarity judgment, but not with the accuracy of object nameability judgment. Those who scored above the median on the word
Table 4. Zero-Order Correlations Between Object Recognition Latency and Other Measures in Study 1.

<table>
<thead>
<tr>
<th>Object Recognition Latency</th>
<th>WFJ</th>
<th>ONJ</th>
<th>FB</th>
<th>Vocab</th>
<th>Pseud</th>
<th>Recheck</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General –</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immediate</td>
<td>.06</td>
<td>.05</td>
<td>-.17</td>
<td>.00</td>
<td>-.56**</td>
<td>.37†</td>
</tr>
<tr>
<td>Delayed</td>
<td>.34†</td>
<td>.23</td>
<td>.12</td>
<td>.22</td>
<td>-.29</td>
<td>.47*</td>
</tr>
<tr>
<td><strong>Mismatch-minus-Match –</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immediate</td>
<td>.44*</td>
<td>.21</td>
<td>.17</td>
<td>.22</td>
<td>.20</td>
<td>.34†</td>
</tr>
<tr>
<td>Delayed</td>
<td>-.10</td>
<td>-.17</td>
<td>-.22</td>
<td>-.32</td>
<td>-.65**</td>
<td>-.07</td>
</tr>
</tbody>
</table>

*Notes – †p < .10  *p < .05  **p < .01

df = 24, except for correlations with pseudoword repetition, where df = 23.
familiarity judgment task showed a fast same effect on the immediate test; their mean response latency on match trials (2.83 sec) was significantly less than on mismatch trials (4.30 sec), $t(11) = 2.60, p < .05$. For the remaining children, mean response latency on match trials (3.04 sec) was comparable to that on mismatch trials (3.12 sec), $t(13) < 1$.

One possible explanation for why the correlation between the fast same effect and object nameability judgment was not significant is sampling error. The coefficient for this correlation (.21) was not significantly less than that for the correlation between word familiarity judgment and the fast same effect (.44). An alternative possibility is that if, as hypothesized, children who are the better judges of object nameability have superior visual encoding and storage processes, they may have less cause to distrust impressions of difference than other children do. They may actually experience less of the internal noise in encoding and comparison processes that has been hypothesized to be the source of the occasional false impression that identical objects differ.

Awareness of lexical ignorance was not expected to be related to a fast same effect in the delayed recognition test. The introduction of the five second retention interval in this test was considered likely to result in forgetting, or at least difficulty retrieving some of the features of the study picture. In such cases, a child might not trust an impression that a test picture was the same as the study picture because the child may realize that he or she does not remember some of the features of the study picture and suspect that these features may not match those of the test picture. Consequently, “same” responses would not be made faster than “different” responses. No relation was found
between the measure of the fast same effect in the delayed test and either lexical
judgment (see Table 4).

Unexpectedly, pseduoword repetition ability was associated with the relative
latency of responses on match versus mismatch trials in the delayed recognition test (see
Table 4). The mean response latency of those who scored above the median on the
pseudoword repetition test was 3.90 sec for match trials versus 3.40 sec for mismatch
trials, \( t (9) = 1.45, p > .10 \), whereas the corresponding means of the remaining children
were 3.00 sec versus 3.88 sec, respectively, \( t (14) = 1.65, p > .10 \). The reason for this
finding is not apparent. One possibility is that those children who could assemble the
speech program for saying “same” more rapidly than others did not produce this response
any faster in the delayed test because impressions of sameness became much less
trustworthy from the immediate to the delayed test.
CHAPTER 3

STUDY 2

The main goals of Study 2 were similar to those of Study 1. The first goal was to examine the relation between awareness of lexical ignorance and understanding of false belief. The second was to examine the relations between awareness of lexical ignorance and basic memory processes, especially those involved in object recognition.

Relation between Awareness of Lexical Ignorance and Understanding of False Belief

Although age-partialled correlations between understanding of false belief and the two measures of awareness of lexical ignorance were not significant in Study 1, the coefficients were of moderate size (.33 on average) for children who were more than 3.5 years old. If correlations of a similar magnitude were obtained in Study 2, and the combined results of the studies were statistically significant, this result would support the conclusion that older preschool-age children’s awareness of lexical ignorance and understanding of false belief are both at least partly influenced by a general sensitivity to representational inadequacy. Due to their overall poor performance in Study 1 on the false belief task and word familiarity judgment, children younger than 3.5 years were not included in Study 2.
Two changes were made in the change-of-location task that was used to assess children’s understanding of false belief. Each change was intended to promote correct responding by those children who truly understood false belief, but to not affect the responses of those who lacked this concept. First, the story was revised to include a sentence stating that the protagonist did not see his/her mother move the candy bar to other cupboard. Also, before posing the false belief question to the child, the experimenter asked, “Did the child in the story know that his/her mother moved the candy bar to the other cupboard?” Both changes were intended to cause the protagonist’s belief to be represented more saliently by the child. Increasing the salience of this representation has been found to increase the proportion of children who pass the false belief test (Wellman et al., 2001).

One weakness of Study 1 is that only the change-of-location task was used to assess children’s understanding of false belief. To address this weakness, children in Study 2 completed a surprising contents task in addition to the change-of-location task. In the surprising contents task, the child is shown a container that appears to contain a certain type of object (e.g., crayons). The experimenter opens the box to show the child that there is a different type of object in the box (e.g., frogs). The child is asked to report both what he or she had expected to find in the container before the actual contents were revealed and what another child would expect to find in the container.

The surprising contents task was also useful for addressing the role that the self-other distinction plays in relations among measures of false belief understanding as well as relations between these measures and awareness of lexical ignorance. Both of the
judgments of lexical ignorance require the child to assess his or her own mental representations. In contrast, the change-of-location task requires the child to assess the mental representation of someone else, the character in a story. Thus, the finding in Study 1 that the two measures of awareness of lexical ignorance were more strongly related to each other than either was to performance on the change-of-location task may have more to do with the distinction between appraising one’s own versus someone else’s representations than with the distinction between detecting gaps in representations and understanding how false representations influence behavior or thought.

This confound is disrupted in the surprising contents task because the child is asked about both his or her own representations and the representations of another child. I hypothesized that the self-other distinction would not account for the pattern of relations among the four metacognitive measures (i.e., word familiarity judgment, object nameability judgment, the false belief question in the change-of-location task, and the false belief question in the surprising contents task), but that the distinction between awareness of lexical ignorance and understanding of false belief would.

Relations between Awareness of Lexical Ignorance and Basic Memory Processes

As in Study 1, relations between awareness of lexical ignorance and aspects of object recognition memory performance were assessed. The positive correlation found between the accuracy of object nameability judgment and the accuracy of immediate object recognition responses was expected to replicate. This prediction was based on Merriman and Lipko’s (2008) proposal that those children who possess superior visual
encoding and storage processes learn more readily than other children to judge the nameability of an object by whether the object evokes a strong recognition response.

Four changes were made to the object recognition task. First, presentation of the pictures was automated to allow for better control of the duration of retention intervals and study picture exposures. Secondly, rather than manipulating the duration of the retention interval, only a 1 sec retention interval was used. This interval was considered to be similar enough to the one used on immediate test trials of Study 1 to yield similar results. A third change involved not allowing children to recheck study pictures. In Study 1, very few children rechecked study pictures during the immediate test trials, and the main individual difference that was observed in study-picture rechecking was unrelated to awareness of lexical ignorance. The fourth change addressed the possibility that some children in Study 1 misunderstood the instructions to the object recognition task, and for this reason, tended to say that nearly every test picture was “different” from its corresponding test picture. To increase comprehension of the instructions in Study 2, additional practice trials were administered and the experimenter provided feedback on these trials to help the children understand the meanings that “same” and “different” were intended to express.

The speed with which children could name pictures of familiar objects was also evaluated in Study 2. According to the dual criterion account of Merriman and Lipko (2008), children use either an object recognition or a name retrieval procedure to judge object nameability. Merriman and Lipko also proposed that those who possess highly efficient name retrieval processes learn more readily than others to use the name retrieval
procedure, that is, to decide that they know the name for an object only if they succeed in
retrieving a name for it. The speed with which a child can name pictures of familiar
objects was assumed to reflect the efficiency of name retrieval processes. Thus, children’s picture naming speed was expected to be positively correlated with the accuracy of their object nameability judgments.

No hypotheses were advanced regarding relations between picture naming speed and performance on the object recognition test. Name retrieval processes were assumed to play no direct role in the latter because the study pictures were of unfamiliar objects and mismatches between study and test pictures involved visual details. However, children who possess superior visual encoding and storage processes may very well also retrieve names for familiar objects more efficiently. Upon seeing an instance of a familiar object, the child who encodes its features more rapidly than others may activate a representation of its familiar category more rapidly, and consequently, retrieve the name for the category more rapidly. Secondly, children who encode and store the visual features of objects more efficiently may learn more rapidly than others which particular visual features are the most reliable cues for membership in particular familiar object categories (e.g., that length of neck distinguishes a swan from a goose). Consequently, they would retrieve names for familiar pictures faster and more accurately.

Regarding the theoretical motivation for designing the picture naming task so that priming could be measured, priming is central to a possible alternative interpretation of the fast same effect in immediate object recognition. I have interpreted the latter effect in the same way that Krueger (1978) and Ratcliff (1985) have interpreted it in adults,
namely, as indicating that participants consider impressions of difference to be less trustworthy than impressions of sameness in the immediate recognition test. For this reason, children are more likely to continue to examine a test picture if it initially seems different from the study picture than if it initially seems identical to it. However, Proctor (1981) has proposed that the fast same effect in adults derives from a priming benefit that is greater when pictures match than when they mismatch. When pictures match, virtually all of the visual encoding processes that occurred when the picture was initially encountered get repeated when it is re-encountered. However, when pictures mismatch, only the encoding processes for the visual features that the pictures share get repeated. Because the priming benefit is greater on match trials than on mismatch trials, children respond faster on match trials than on mismatch trials (i.e., show a fast same effect).

In Study 2, this alternative explanation for the fast same effect in children’s object recognition memory was evaluated. If the explanation is valid, then the magnitude of the priming effect that children show in picture naming should be positively correlated with the magnitude of the fast same effect they show in the recognition test. This test of the explanation assumes that children who experience a greater priming benefit in general would also show a greater difference between the full priming benefit that occurs when pictures match and the partial priming benefit that occurs when they mismatch.
Method

Participants

Forty children ($M = 4 - 4$; range = 3 – 4 to 5 – 2) were recruited from area preschools. There were 16 girls and 24 boys. The children were split into two groups. One group completed tasks in the following order: word familiarity judgment, change-of-location, surprising contents, object nameability judgment, object recognition, and picture naming. For the other group, the order was object nameability judgment, surprising contents, change-of-location, word familiarity judgment, object recognition, and picture naming.

Materials and Procedures

After the parents signed the consent forms, the children were tested individually at their preschools. The tasks were administered once the child felt comfortable with the experimenter and was willing to participate. The materials and procedures used for the two lexical judgment tasks were identical to those of Study 1.

Two changes were made to the change-of-location task. At the point in the story right after the candy bar was moved, the child was explicitly told that the protagonist did not see his mother move it (see Appendix A). Also, an additional control question was asked right before the false belief question was posed, namely, “Did the child in the story know that his/her mother moved the candy bar to the other cupboard?”

The surprising contents task was based on a version developed by Esbensen, Taylor, and Stoess (1997). The experimenter showed the child a crayon box and said, “I
brought something to show you. Let’s open it.” The experimenter opened the box and showed the child that the box contained plastic frogs. She said, “Oh, there are frogs in the box.” The child was asked, “When you first saw the box, before you looked inside it, what did you think was in the box?” After the child responded, the experimenter said, “The other children haven’t seen what is in this box. When they see the box, before they look inside it, what will they think is in the box?”

Both the object recognition and picture naming tests were presented on a Dell laptop computer. The pictures used for the object recognition test were drawn from the same set as was used in this test in Study 1. A subset of Rossion and Pourtois’s (2004) familiar pictures were used for the picture naming task. The pictures were colored line drawings (see Figure 2). Direct RT software was used to control picture presentations during both the object recognition and picture naming tests.

To introduce the object recognition test, the experimenter told the child, “You are going to see some pictures come up on the screen. They are not going to be things that you know. They are just silly things, so you do not have to tell me what they are. When the first picture comes up, I want you to take a good look at it. Then you are going to see a second picture come up. I want you to tell me if the pictures are exactly the same or a little bit different. Do you think you know how to play?” Six practice trials were presented. On each of these, a study picture of an unfamiliar object was presented for five seconds, followed by a black screen with an addition sign in the center for 1 second, which was followed by a test picture that was either identical to the study picture (three trials) or slightly different from it (three trials). When the test picture appeared, the
Figure 2. Example of stimuli used in picture naming task.
experimenter asked the child, “Are those two pictures exactly the same or a little bit different?” If the child responded correctly, the experimenter said either, “You’re right. Those are the same. The first picture looked just like that” or, for example, “You’re right. Those two pictures are different because the first one had a line on it, but the second one was plain.” If the child responded incorrectly, the experimenter said either, for example, “Those pictures were different because the first one has a small top, but this one has a big top” or “Those pictures were the same. The first one looked just like that one.”

The recognition test itself consisted of four match trials and four mismatch trials. As in Study 1, the pictures used for these were of unfamiliar objects. The instructions and the temporal structure of the test trials were the same as for the practice trials except that the experimenter accepted the child’s responses without commenting on them. Unlike the procedure used in Study 1, children were not given the option to recheck the study picture. The task was audio taped in order to record reaction times. The presentation of the test picture was accompanied by a beep, which allowed the experimenter to determine how long it took the child to respond.

To introduce the picture naming task, the experimenter said, “You are going to see some pictures come up on the screen. They are all going to be things that you know. As soon as the picture comes up I want you to name it as fast as you can. Some pictures may come up twice, but I just want you to keep naming them.” There were four practice trials. Two pictures were presented once and a third picture was presented twice. All children named every picture on these trials correctly. As soon as the child responded,
the experimenter pressed the space bar to advance to the next trial. Before each trial, a black screen appeared with an addition sign in the center for 3 seconds. After the child indicated that he or she was ready to play the game, 22 test trials were presented. The first two pictures were considered warm-up. For the remaining trials, all pictures were presented twice. For ten pictures, the second exposure occurred immediately after the first exposure. For five pictures, the second exposure occurred after a lag of three intervening pictures. For the remaining five, the lag was six pictures. See Appendix for the presentation order. This task was audio taped in order to record response latencies. To determine when a picture was presented on the audiotape, a beep accompanied the presentation of each picture. For two children, one immediate and one delayed trial were dropped because they did not know the name of a picture. Also, for two children, one trial was dropped because response latencies were longer than 10 seconds due to distraction.

Results and Discussion

Performances on the lexical ignorance judgments and tests of false belief understanding were analyzed for their relative difficulty and for their relations to age. Correlations were then analyzed to determine whether children’s awareness of lexical ignorance was related to their understanding of false belief. Finally, children’s performance on the two memory tasks – object recognition and picture naming – was analyzed for relations to awareness of lexical ignorance.
Awareness of Lexical Ignorance and Understanding of False Belief

Performance on the tasks is summarized in Table 5. Accuracy of object nameability judgment and word familiarity judgment did not differ, \( t(39) = 1.24, \ p > .05 \) (see Table 5). Although this result is not significant, the pattern matches the findings in Study 1. Specifically, children’s performance was better on object nameability judgments than on word familiarity judgments. This result may not have been significant in the current study because the sample included fewer three year olds. The means for the 4-year-olds in the current study (ONJ: .91 and WFJ: .85) were fairly comparable to those for the 4-year-olds in Study 1 (ONJ: .90 and WFJ: .80).

Children performed comparably on the two assessments of their understanding of false belief (see Table 5). Note that in order to pass the change-of-location task, a participant had to answer all four questions correctly, including the three questions from Study 1 and the new question (i.e., “Does the child know that his mother moved the candy bar to the other cupboard?”). Seventy-eight percent of the children answered this new question correctly. The addition of this question did not improve performance on the change-of-location task. In Study 1, 57% of four-year-olds passed the task, while only 53% of four-year-olds in Study 2 passed the task. Fifty percent of children from the entire sample in Study 2 passed the change-of-location task. Regarding the surprising contents task, 41% of the children answered both the self and other questions correctly. Forty-three percent of the children answered the self question correctly and 40% answered the other question correctly. There was no evidence that children performed better on the other question than on the self question. I expected that children may have
Table 5. *Mean Proportion Correct on the Measures in Study 2.*

<table>
<thead>
<tr>
<th>Measure</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Metacognitive:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Object Nameability</td>
<td>.88</td>
<td>(.18)</td>
</tr>
<tr>
<td>Word Familiarity</td>
<td>.84</td>
<td>(.17)</td>
</tr>
<tr>
<td>False Belief- location</td>
<td>.50</td>
<td>(--)</td>
</tr>
<tr>
<td>False Belief- content</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self</td>
<td>.43</td>
<td>(--)</td>
</tr>
<tr>
<td>Other</td>
<td>.40</td>
<td>(--)</td>
</tr>
<tr>
<td><strong>Memory:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Object Recognition</td>
<td>.60</td>
<td>(.20)</td>
</tr>
</tbody>
</table>

*Note - Standard deviations are in parentheses.*

N = 40

* Children were scored as either passing or failing this test.
performed better on the other question because their answer might be less biased. When answering the self question, children may have said what was actually in the box because they wanted to get the correct answer or because they wanted to impress the experimenter.

The two lexical judgments and the two false belief tasks were analyzed for their relative difficulty. As in Study 1, passing the object nameability or word familiarity judgment task was defined as getting .80 or more trials correct. To pass the surprising contents task, children had to answer both the self question and other question correctly. Significantly more children passed the word familiarity judgment task than either the change-of-location task, \( \chi^2 (1, N = 40) = 4, p < .05 \), or the surprising contents task, \( \chi^2 (1, N = 40) = 12.25, p < .01 \). Also, significantly more children passed the object nameability judgment task than change-of-location task, \( \chi^2 (1, N = 40) = 7.14, p < .01 \), or the surprising contents task, \( \chi^2 (1, N = 40) = 12.8, p < .01 \). These results suggest that the two lexical judgments are less difficult than the false belief tasks. Although the difference was not statistically significant, more children passed the change-of-location task than the surprising contents task, \( \chi^2 (1, N = 40) = 3.6, p > .05 \).

Children’s scores on the self and other questions for the surprising contents task did not differ and were averaged for all subsequent analyses. Regarding correlations with age, only performance on object nameability judgments increased significantly with age, \( r (38) = .41, p < .05 \), but nonsignificant age trends were evident in the other tasks: the coefficients were .13 for wfj, .30 for change-of-location, and .13 for surprising contents.
Table 6 summarizes the coefficients for age-partialled correlations between tasks. Two findings of Study 1 were replicated. The accuracy of word familiarity judgment was significantly intercorrelated with the accuracy of object nameability judgment even after age was partialled out, \( r(37) = .43, p < .01 \). Also, neither lexical judgment was significantly related to performance on the change-of-location task. Support was also found for the new predictions of Study 2. The two tests of understanding of false belief, change-of-location and surprising contents, were significantly intercorrelated, \( r = .45, p < .01 \), and performance on the surprising contents task was not as strongly related to the two lexical judgments (average \( r = .29 \)) as the lexical judgments were to each other.

These results provide convergent and discriminant validity evidence (Campbell & Fiske, 1959) for considering awareness of lexical ignorance and understanding of false belief to be distinct individual difference constructs in early childhood. On the other hand, these two types of understanding do not appear to be completely unrelated. In both Studies 1 and 2, the average coefficients for the age-partialled correlations between tasks representing these two constructs were .33 and .30, respectively. When these results are combined in a meta-analysis (by the Stouffer method, see Rosenthal, 1991), the average coefficient, .31, was significant, \( z = 2.52, p < .02 \). This shared variance may reflect the contribution of individual differences in a general sensitivity to representational inadequacy to performance on all of these tasks.
Table 6. Age-Partialed Correlations Among Measures in Study 2.

<table>
<thead>
<tr>
<th>Measure</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Obj Nameability J</td>
<td>.43**</td>
<td>.30</td>
<td>.19</td>
<td>.44*</td>
<td>-.27</td>
<td>.40*</td>
<td>-.36*</td>
<td>-.08</td>
</tr>
<tr>
<td></td>
<td>(37)</td>
<td>(37)</td>
<td>(37)</td>
<td>(23)</td>
<td>(22)</td>
<td>(22)</td>
<td>(34)</td>
<td>(34)</td>
</tr>
<tr>
<td>2. Word Familiarity J</td>
<td>.30</td>
<td>.38*</td>
<td>-.02</td>
<td>.26</td>
<td>-.00</td>
<td>-.08</td>
<td>.24</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(37)</td>
<td>(37)</td>
<td>(23)</td>
<td>(22)</td>
<td>(22)</td>
<td>(34)</td>
<td>(34)</td>
<td></td>
</tr>
<tr>
<td>3. False Belief- Location</td>
<td>.45**</td>
<td>.11</td>
<td>-.09</td>
<td>.41*</td>
<td>.00</td>
<td>.28</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(37)</td>
<td>(23)</td>
<td>(22)</td>
<td>(22)</td>
<td>(34)</td>
<td>(34)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. False Belief- Content</td>
<td>.19</td>
<td>-.17</td>
<td>.24</td>
<td>-.05</td>
<td>.16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(23)</td>
<td>(22)</td>
<td>(22)</td>
<td>(34)</td>
<td>(34)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Recognition- Accuracy</td>
<td>-.44*</td>
<td>.47*</td>
<td>-.52**</td>
<td>-.19</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(22)</td>
<td>(22)</td>
<td>(22)</td>
<td>(22)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Recognition- Overall Latency</td>
<td>-.15</td>
<td>.32</td>
<td>.19</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(22)</td>
<td>(220)</td>
<td>(22)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Recognition- Fast Same Effect</td>
<td>-.44*</td>
<td></td>
<td>-.52**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(22)</td>
<td></td>
<td>(22)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Pic Naming- Overall Latency</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.64**</td>
<td>(34)</td>
</tr>
<tr>
<td>9. Pic Naming- Priming Effect</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* df are listed in parentheses.

* p < .05
** p < .01
Relations between Basic Memory Processes and Awareness of Lexical Ignorance

Mean levels of correct response on the memory tests are summarized in Table 5. The nature of the relations between these tests and awareness of lexical ignorance was addressed first for object recognition, and then picture naming. Regarding object recognition, relations to response accuracy and response latency were analyzed. As in Study 1, both overall response latency and the relative speed of responses on match and mismatch trials (i.e., the fast same effect) were analyzed. Finally, the relations between awareness of lexical ignorance and picture naming response latency were analyzed.

Object Recognition: Accuracy and Response Bias. Mean performance on the object recognition task was .60. In contrast to Study 1, performance on the object recognition test did not improve with age, \( r(39) = .20, p > .05 \). One explanation for this finding may be that there were fewer three-year-olds in the current study. Also, younger three-year-olds were excluded from Study 2. There was only one child who was less than 43 months old. A second explanation may be that children in the current study were given more detailed instructions, as well as more practice trials and feedback. These changes may have helped the younger children perform as well as the older children. Fourteen children did show a response bias, however. Seven said “same” on every trial and seven said “different” on every trial. These response biases suggest that the task was still difficult for children, despite the more extensive instruction. As in Study 1, data from children showing a response bias were excluded from subsequent analyses involving object recognition performance because the cause of their response bias was unknown.
Object Recognition: Relations between Accuracy and Awareness of Lexical Ignorance. The age-partialled correlations between recognition accuracy and other measures are summarized in Table 6. As in Study 1, accuracy of response on the object recognition test was related to the accuracy of object nameability judgments, even after age was partialled out, $r(23) = .44, p < .05$. This result provides additional support for Merriman and Lipko’s (2008) proposal that children’s ability to encode and store visual information about objects affects how quickly they learn to judge object nameability based on an object recognition criterion. In contrast to the results of Study 1, accuracy of response on the object recognition test was not related to the accuracy of word familiarity judgments when age was partialled out, $r = -.02, p > .10$.

The distinctiveness of the relation found between recognition accuracy and object nameability judgment in the current study makes more sense than the rather nondistinctive relation found in Study 1. It is easy to understand why a child’s ability to encode and store visual information about objects would influence his or her ability to make a linguistic judgment about objects. It is not as apparent why this same ability should be related to the child’s ability to make a linguistic judgment about words that are spoken without reference to objects or anything else. The significant relation found between word familiarity judgment and object recognition accuracy in the immediate test in Study 1 may just reflect the contribution of verbal intelligence to performance in that context. Children received only one trial of practice before the immediate test of Study 1 began, and perhaps the less intelligent children had more difficulty understanding what they were supposed to do based on such limited instruction. In support of this conjecture,
receptive vocabulary size, which is a fairly reliable index of verbal intelligence (Dunn & Dunn, 1997), was as strongly related to immediate recognition accuracy in Study 1 as word familiarity judgment was.

Object Recognition: Relations between Response Latency and Awareness of Lexical Ignorance. On average, the children who did not show a response bias took 2.82 sec ($SD = 1.13$) to respond on the object recognition test. Response latency was significantly correlated with age, $r(24) = -.44, p < .05$. Older children responded more quickly than younger ones.

The age-partialled correlations between response latencies and other measures are summarized in Table 6. Neither the lexical judgments nor the false belief tasks were related to mean response latencies. Only accuracy on the object recognition task was significantly related to mean response latencies, $r(22) = -.44, p < .05$. Children who were less accurate on the object recognition task also took longer to make recognition decisions. The results of these analyses provide additional support for the claim that the relationship between object nameability judgment and accuracy of object recognition is not simply the result of the more accurate judges of object nameability taking more time to examine test pictures before responding in the object recognition test.

Object Recognition: Relations between the Fast Same Effect and Awareness of Lexical Ignorance. The coefficients for correlations between a measure of the fast same effect (response latency on mismatch trials minus response latency on match trials) and other measures are summarized in Table 6. As in Study 1, the prediction that children
who showed a greater awareness of lexical ignorance would be more likely to show a fast same effect on immediate test trials received mixed support. The magnitude of the fast same effect was significantly correlated with the accuracy of object nameability judgment, but not with the accuracy of word familiarity judgment. This last difference is the opposite of the one observed in Study 1. Children were split into two groups based on whether or not they scored at the median on the object nameability judgment task (median = 100% correct response) to analyze whether mean latency on match trials was significantly less than on mismatch trials. No significant difference was found for either group. For children who scored at the median on the object nameability judgment task, mean response latency was 2.60 sec on match trials and 2.86 sec on mismatch trials, $t(15) < 1$. For children who scored below the median on the object nameability judgment task, mean response latency was 3.25 sec on match trials and 2.71 sec on mismatch trials, $t(8) < 1$. The results of Study 1 and the current study suggest that there is a relationship between the fast same effect and awareness of lexical ignorance; however, it is not clear which lexical judgment is more strongly related to the fast same effect.

**Picture Naming.** On average, children took 1.42 sec (SD = .50) to name a picture the first time it was presented and 1.41 sec (SD = .51) to name a picture the second time it was presented. The time it took children to name a picture did not significantly decrease from the first to the second presentation, that is, no priming was evident, $t(36) < 1$. Therefore, response latencies for the first and second presentation were collapsed for the remaining analyses.
Response latencies on the picture naming task significantly decreased with age, $r(35) = -0.50, p < .01$. On average, children who were at or above the median for age (median = 52 months) responded in 1.23 sec and children below the median responded in 1.62 seconds. The age-partialled correlations between response latencies for picture naming and the other measures are summarized in Table 6. Picture naming response latency was not related to word familiarity judgment or to either of the false belief tasks. Response latency for picture naming was significantly correlated with performance on the object nameability judgment, however, $r(34) = -0.36, p < .05$. Children who were better at judging whether or not an object had a known name were also quicker to name familiar pictures.

Regarding its relations with object recognition, response latency for picture naming was significantly correlated with the accuracy of responses on the object recognition task, $r(22) = -0.52, p < .01$, but not with the latency of these responses. Response latency for picture naming was also significantly correlated with a fast same effect on the object recognition task, $r(22) = -0.44, p < .05$. On average, children who had response latencies at or above the median on the picture naming task (median = 1.33 sec) took 3.34 sec to respond on match trials and 3.02 sec to respond on mismatch trials, $t(12) < 1$. Children who had response latencies below the median on the picture naming task took, on average, 2.29 sec to respond on match trials and 2.57 sec to respond on mismatch trials, $t(11) < 1$.

Correlations between a measure of priming (first presentation minus second presentation) on the picture naming task and other measures are summarized in Table 6.
Priming was significantly correlated with response latency on the picture naming task, $r(34) = .64$, $p < .01$. Priming was not related to any of the lexical judgment or false belief tasks. Also, there was no relationship between priming and accuracy or response latency on the object recognition task. Based on Proctor’s theory, the magnitude of the priming effect that children showed in picture naming was expected to be positively correlated with the magnitude of the fast same effect they showed in the recognition test. This hypothesis was not supported by the results of the current study. Although priming was significantly correlated with the fast same effect on the object recognition task, the relationship was not in the expected direction, $r(22) = -.52$, $p < .01$. Specifically, priming was significantly correlated with response latency on match trials in the object recognition task, $r(22) = .43$, $p < .05$. 
CHAPTER 4

GENERAL DISCUSSION

Relations between Awareness of Lexical Ignorance and Understanding of False Belief

The results of the current studies did not provide strong support for the hypothesis that awareness of lexical ignorance and understanding of false belief reflect a more general ability to judge the inadequacy of mental representations. In both Studies 1 and 2, object nameability and word familiarity judgments were significantly intercorrelated and they were more strongly related to each other than either was to performance on the false belief tasks. In Study 2, the two tests of understanding of false belief, change-of-location and surprising contents, were also significantly correlated. These results suggest that awareness of lexical ignorance and understanding of false belief are distinct constructs during the preschool years. However, when the results of the two studies were combined, there was a moderate correlation between awareness of lexical ignorance and false belief understanding. This correlation may reflect the contribution of individual differences in a general sensitivity to representational inadequacy to performance on these tasks. Another possibility is that the correlation is simply a reflection of the role that verbal intelligence plays in each of the tasks.
One limitation of the current investigation is that Study 2 did not include a measure of verbal intelligence. This limitation makes it difficult to make any strong conclusions about whether verbal intelligence or a general sensitivity to the inadequacy of representations plays a stronger role in the moderate correlation between awareness of lexical ignorance and understanding of false belief. Future studies should include at least one measure of verbal intelligence. In order to gain a better understanding of the role that verbal intelligence plays in the lexical judgments and understanding of false belief, it may be helpful to include both receptive and productive measures of vocabulary. Another limitation is the small sample sizes of both Studies 1 and 2. The correlation between awareness of lexical ignorance and understanding of false belief may have been consistently statistically significant in studies with more power.

Relations between Basic Memory Processes and Awareness of Lexical Ignorance

The results of the current studies provide support for Merriman and Lipko’s (2008) hypothesis that at least some children use an object recognition criterion when judging whether or not an object has a known name. Object nameability judgment was positively correlated with accuracy of immediate object recognition in both studies. Consistent with Merriman and Lipko’s (2008) hypothesis, this result suggests that children’s ability to encode and store visual information about objects affects how quickly they learn to judge object nameability based on object recognition. In particular, children learn to say that they do not know the name for an object if they decide that they have not seen that kind of object before.
A limitation of the object recognition task used in the current investigation is that several children showed a response bias. The task may have been too difficult for some children and/or some may not have understood the instructions. In future studies, changes will have to be made to the object recognition task in order to improve performance. One possible way to improve performance is to design a training procedure that will help the children understand what they are required to do to complete the task. In future studies it will also be important to insure that children understand what is meant by “same” and “different” responses.

Response latency in the object recognition task was not related to awareness of lexical ignorance in either study. This finding provides additional information about the significant correlation between accuracy on the object recognition task and object nameability judgment. These results suggest that children who showed greater awareness of lexical ignorance did not make more accurate decisions in the immediate recognition test only because they took more time to examine test pictures before responding.

In Study 1, children were given the opportunity to recheck the study picture when viewing the test picture. Although this procedure provided a measure of children’s monitoring of their certainty about their recognition decision, it made it difficult to interpret response latencies because not all children rechecked. In future studies, not allowing children to recheck would allow for a clearer interpretation of response latencies.

The hypothesis that children who showed a greater awareness of lexical ignorance would be more likely to show a fast same effect on immediate trials of the object
recognition task received mixed support. The fast same effect was not consistently related to either object nameability or word familiarity judgments. The fast same effect does not seem to reflect how some children take more time before saying different than before saying same, because the children who took longer to say different did not show lower rates of false “same” responses. This does not provide support for Krueger’s (1978) theory of the fast same effect because children should show lower rates of false “same” responses if they decide to reexamine the test stimulus when their initial impression is that two stimuli are different. Also, the individual differences in the relative speed of “same” and “different” responses do not provide support for the priming explanation proposed by Proctor (1981). In Study 2, the size of the priming effect of picture naming increased as the speed of children’s “same” responses decreased relative to their different responses.

As expected, response latency on the picture naming task was related to accuracy of object nameability judgments. According to the dual criterion account of Merriman and Lipko (2008), children can use either an object recognition or a name retrieval process to judge object nameability. Specifically, they proposed that children who possess highly efficient name retrieval processes learn more readily than others to use name retrieval when judging whether an object has a known name. The results of Study 2 supported this hypothesis.

Although the current studies supported Merriman and Lipko’s (2008) dual criterion model, it is not clear whether children are using one of the criteria, object recognition or name retrieval, when making object nameability judgments, or both. Since
accuracy on object recognition and response latency on picture naming were correlated, it is difficult to determine whether name retrieval or object recognition plays a stronger role when making object nameability judgments. Future studies should examine the effect of manipulations that are hypothesized to affect the accuracy or ease of using one or the other criteria. For example, the name retrieval process should be suppressed by having children who are making object nameability judgments also listen for certain words presented at the same time over headphones. This manipulation should have a greater negative effect on children who use the name retrieval criterion to judge object nameability than on those who use object recognition. If so, then the extent to which the interfering words undermine a children’s judgment accuracy should be more strongly correlated with how quickly he or she names familiar objects (a measure of name retrieval efficiency) than with how accurately he or she responds in the immediate object recognition tests used in the current investigation.

There were also several other interesting findings in the current studies. For example, in Study 1 children who rechecked more pictures in the delayed than in the immediate test also tended to make more accurate recognition decisions than the other children. This suggests that children were aware that their memory representation for a study picture could be inaccurate and rechecked study pictures because they were monitoring their uncertainty. No relation was found between the tendency to show this pattern of study picture rechecking and the measures of awareness of lexical ignorance, however.
Also, the Study 1 results showed that the ability to repeat pseudowords was related to both the ability to make word familiarity judgments and to the speed of responses in the object recognition test. Further studies will need to be conducted to determine whether these relations replicate and if they do, to examine various explanations for them. One possible explanation for the relationship between pseudoword repetition and word familiarity judgments is that children who possess superior phonological WM acquire the ability to judge word familiarity faster than other children because they can make these judgments based on recognition of a word’s sound form (Merriman et al., 2006). Pseudoword repetition and the speed of object recognition responses may be related because both abilities require use of the output buffer. Both of these explanations need to be examined further in future studies.
REFERENCES


This is Tommy.

Tommy had a big bar of chocolate.

Tommy wanted to save the big bar of chocolate so he could eat it later.

Tommy put the big bar of chocolate in the blue cupboard so he could eat it after playing outside.

Tommy then went outside to play.

Tommy’s mom found the big bar of chocolate and decided to bake a cake with some of it.

When she was done with the cake, she put the rest of the big bar of chocolate in the red cupboard.

Tommy was outside when this happened. So he didn’t see his mother put the candy bar back in the other cupboard. (only in Study 2)

Where is the bar of chocolate now?

Where did Tommy put it before he went out to swing?

When Tommy finished swinging, he went back to the kitchen to get the bar of chocolate.

Does Tommy know that his mother put the candy bar back in the other cupboard? (only in Study 2)

Where will Tommy look for the candy bar first?
### APPENDIX B

#### PICTURE NAMING

<table>
<thead>
<tr>
<th>Version A</th>
<th>Version B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Practice Trials</strong></td>
<td><strong>Practice Trials</strong></td>
</tr>
<tr>
<td>cat</td>
<td>cat</td>
</tr>
<tr>
<td>leaf</td>
<td>leaf</td>
</tr>
<tr>
<td>pig</td>
<td>pig</td>
</tr>
<tr>
<td>leaf</td>
<td>leaf</td>
</tr>
<tr>
<td><strong>Test Trials</strong></td>
<td><strong>Test Trials</strong></td>
</tr>
<tr>
<td>fork</td>
<td>fork</td>
</tr>
<tr>
<td>eye</td>
<td>eye</td>
</tr>
<tr>
<td>sun</td>
<td>shoe</td>
</tr>
<tr>
<td>boat</td>
<td>tree</td>
</tr>
<tr>
<td>shoe</td>
<td>sun</td>
</tr>
<tr>
<td>shoe</td>
<td>shoe</td>
</tr>
<tr>
<td>sun</td>
<td>sun</td>
</tr>
<tr>
<td>bed</td>
<td>bird</td>
</tr>
<tr>
<td>tree</td>
<td>boat</td>
</tr>
<tr>
<td>tree</td>
<td>boat</td>
</tr>
<tr>
<td>boat</td>
<td>tree</td>
</tr>
<tr>
<td>truck</td>
<td>dog</td>
</tr>
<tr>
<td>bird</td>
<td>bed</td>
</tr>
<tr>
<td>bird</td>
<td>bed</td>
</tr>
<tr>
<td>bed</td>
<td>bird</td>
</tr>
<tr>
<td>kite</td>
<td>bat</td>
</tr>
<tr>
<td>dog</td>
<td>truck</td>
</tr>
<tr>
<td>truck</td>
<td>dog</td>
</tr>
<tr>
<td>kite</td>
<td>bat</td>
</tr>
<tr>
<td>fish</td>
<td>kite</td>
</tr>
<tr>
<td>fish</td>
<td>kite</td>
</tr>
</tbody>
</table>