THE PENNSYLVANIA STATE UNIVERSTIY

SCHREYER HONORS COLLEGE

DEPARTMENT OF COMMUNICATION SCIENCES AND DISORDERS

FAST MAPPING AND THE EXTENSION OF NEWLY LEARNED WORDS IN YOUNG CHIDREN

JENNIFER POLLOCK
Spring 2011

A thesis
submitted in partial fulfillment
of the requirements
for a baccalaureate degree
in Communication Sciences and Disorders
with honors in Communication Sciences and Disorders

Reviewed and approved* by the following:

Krista M. Wilkinson
Professor
Thesis Supervisor

Carol A. Miller
Associate Professor
Honors Advisor

*Signatures are on file in the Schreyer Honors College.

ABSTRACT

Research has established that typically developing children rapidly acquire new words at very young ages. Fast mapping is one potential explanation for this rapid word learning. Fast mapping refers to the idea that children are able to understand, whether completely or partially, the meaning of a new word through only brief exposure to that word. This study sought to determine how complete children's understandings are following initial word learning instances. We examined whether children of different ages comprehended that a new word learned through fast mapping is not simply a single exemplar, but is a part of a larger category of items. The participants were all preschool children, ranging in age from 2 to 5-years-old. The children were taught two novel target words. Following this, children participated in 4 probe sessions in order to test the extent of their knowledge. The children demonstrated their learning during fast mapping, and extended the knowledge to new variants of the initial exemplars. Older children performed better on all sessions and extended the novel words' meanings with much greater accuracy than the younger children did.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGEMENTS

I would like to thank Dr. Krista Wilkinson for her exceptional support and guidance throughout this entire process. I have learned so much from Dr. Wilkinson, and I am extremely thankful to have had the chance to work with her. This has been a wonderful learning experience and I am grateful for the opportunity.

I would also like to thank Dr. Carol Miller for her continual guidance throughout my education, as well as her assistance and support throughout this thesis process.

Chapter 1: Introduction

The Role of Fast Mapping in Word Learning

It is remarkable how quickly children seem to progress from producing pure vocalizations to generating meaningful and complete utterances. Children appear capable of learning numerous new words at an exceptionally fast rate quite suddenly in their development. In fact, in their book, "How babies talk: the magic and mystery of language in the first three years of life", Golinkoff and Hirsh-Pasek (1999) state that children usually undergo a "vocabulary spurt" around the second half of their second year of life. The authors estimate that children gain nine new words per day, averaging around 63 new words per week (Golinkoff & Hirsh-Pasek, 1999). During their discussion of the vocabulary spurt, Golinkoff and Hirsh-Pasek (1999) mention that the time of onset is a bit controversial, with some experts claiming it to be once children have acquired 30 words and others claiming acquisition of 50 words and beyond is necessary. According to Gershkoff-Stowe and Hahn (2007), "the average toddler typically accrues a lexicon of more than 500 words before the age of three years" (p.682). It is evident that young children experience large growth in their vocabularies, and do so rather rapidly, but clearly, the developmental path is still under debate.

Word learning is essential for effective communication, both expressive and receptive. As children go through the word-learning process they are in an increasingly better position to continue acquiring new words, and are more inclined to make inferences about word meanings. Without an increasing lexicon, language growth cannot progress at a developmentally typical rate.

Children are not always explicitly taught new words at the point in their development when they reach the vocabulary spurt, but they do appear to pick up on the meanings of new words quite easily. How are they able to do this? One well researched hypothesis regarding children's rapid word acquisition concerns "fast-mapping." Fast-mapping refers to an individual's ability to understand the meaning of a word, or at least a partial meaning, from context clues such as how a word is used in a sentence, or comparing a spoken word to its visual representation. This theory of word-learning proposes that children are able to gather and remember the meaning of a novel word from very limited exposure.

While the ways in which children can fast map varies, comparing a novel word to its visual representation is one common teaching method. In this situation, a child is exposed to a new word, typically through simply hearing the new word spoken aloud, and is then prompted to make a connection between the spoken word and its corresponding picture.

For example, to introduce a child to a novel term, he or she may be presented with a group of pictures while simultaneously hearing the novel term spoken aloud. The pictures might represent a few items that the child is familiar with, such as a book or a bed, and one completely unknown item. Researchers contend that fast mapping allows children to accurately match the unknown word to the unknown picture, and gain understanding regarding its meaning. Learning occurs through the child's appreciation of the contrast of familiar and unfamiliar terms.

If fast mapping is a valid explanation of word learning processes, it can explain how children are able to gain such large vocabularies so rapidly. The current study examined this phenomenon and tested children's abilities to extend their knowledge. There are a number of past studies that have also observed fast mapping and its influence on vocabulary development. Six articles will be reviewed in detail in order to shed light on past research and provide support for the current study. The literature describes experiments focused on fast mapping as well as the type of information a child learns during the fast mapping process. Table 1 and 2 provide information regarding these six studies, including a detailed description of the subjects tested, research questions presented, and results found from each specific study.

Fast Mapping Literature

Heibeck and Markman (1987) described the word-learning studies they conducted in their research article, “Word Learning in Children: An Examination of Fast Mapping”. Heibeck and Markman (1987) sought to test if children can truly gain information about a word’s meaning through the process of fast mapping, and how general this process can be considered. In Study 1, 83 children between the ages of 2.2 and 4.8 years were split into three groups according to age, and tested individually (see Table 1). Children were selected at random to learn a new term from one of three categories: color, shape, or texture. The target terms chosen for each condition were taken from a list of unfamiliar words.

Study 1 consisted of an introduction event, production task, hyponym task, comprehension task, and a short vocabulary test. In order to properly introduce the new terminology for all three conditions, the subjects participated in an interaction with the experimenter. The experimenter prompted the children to retrieve one of two items placed on a chair in the classroom. For instance, in order to introduce the novel color term “chartreuse,” the experimenter would say to the children, “Could you bring me the chartreuse book, not the red one, the chartreuse one" (Heibeck & Markman, 1987, p.1023). While books of various colors were used for the color condition, trays of different shapes were used for the shape condition, and boxes coated with diverse materials were used for the texture condition.

The production task reviewed if the children could produce the novel names they had just learned. There were a number of objects set out for the children to see, including three unfamiliar objects, three familiar objects, and the target object. The experimenter proceeded to ask the subjects what each of the objects was.

The hyponym task tested whether the children understood that the novel terms they were just exposed to come from specific domains (colors, shapes, textures). For example, to check comprehension within the texture domain, the experimenter showed children boxes covered in what was assumed to be a familiar texture, such as soft. The experimenter would then say something like, "See this box? It's not fibrous because it is…" (Heibeck & Markman, 1987, p. 1024). If the subjects were able to accurately respond with a texture term, it was concluded that they understood the word's correct domain.

The comprehension task asked children to point out the target item when it was placed beside numerous distracters. For instance, to measure the color condition, children may have heard, "can you show me the chartreuse one" (Heibeck & Markman, 1987, p. 1024).

Finally, after all of these tasks were completed, children took part in a vocabulary test, which was used to measure the children's current lexicon. The assessment was developed by the researchers, and consisted of index cards displaying familiar pictures related to color, shape, and texture. The children were asked to produce the names of the pictures when presented with the cards.

The results showed strong support for fast mapping. The production task appeared to have been the most challenging task for the subjects. The comprehension and hyponym tasks resulted in much higher accuracies of response. As represented by all three tasks, shape terms appeared to be the easiest to learn. On the other hand, texture terms seemed to be the least known and hardest to acquire. The results from the vocabulary assessment supported this, as the authors point out that the children "knew most of the color and shape words included in the vocabulary assessments but knew many fewer texture words" (Heibeck & Markman, 1987, p. 1028). Heibeck and Markman (1987) suggested the possibility that once particular domains have been established, as in the case of the shape and color domains within this study, children may have an easier time making proper connections between new words and their meanings in regards to these already established domains. Older children performed better than younger children on the vocabulary test. However, the findings showed that in general, age did not affect the outcomes, since the younger children gained equal information about new words as the older children.

Study 2 looked at the possibility that the explicit language contrast used in the introduction event allowed children to determine the novel terms' meanings. Study 2 was executed using the same tasks as Study 1; however, during the introduction event, half of the children heard the same prompts used in Study 1, and half heard less explicit requests like "bring me the chartreuse one, not the other one" (Heibeck & Markman, 1987, p. 1029).

Study 2 also addressed the question of why shape terms dominated over color and texture terms. The researchers suggested this preference may be the result of children's expectations that the new terms must be referring to category labels of the objects (Heibeck & Markman, 1987). In order to test if children were automatically assuming new words were connected with nouns, Heibeck and Markman (1987) also changed the introduction of shape words. As in Study 1, some children heard the shape terms in their noun forms, such as "trapezoid". The remainder of children heard the shape terms in their adjective forms, for example, "trapezoidal".

The results of Study 2 added further support to the findings from Study 1, since the modifications made in Study 2 had little to no impact on the outcomes. These studies together offered support for fast mapping and its ability to generalize over multiple categories.

In the research article, "Fast Mapping Skills in the Developing Lexicon", Gershkoff-Stowe and Hahn (2007) explained another word-learning study, which focused on examining children's growing capacity to "access information in lexical memory" (p. 685). The researchers were not only interested in children's abilities to fast map novel terms with unfamiliar items, but also wanted to see if more practice with a specific set of novel terms would assist in learning less practiced novel words. Gershkoff-Stowe and Hahn (2007) discussed the importance of the lexicon size and suggested that as children's productive vocabularies improve, their language processing skills similarly improve. Acknowledging the work of other language researchers, they stated that it has been found that "the pace at which normally developing toddlers acquired a productive vocabulary was closely related to developments in their overall ability to store and retrieve words" (Gershkoff-Stowe & Hahn, 2007, p.684). Therefore, it would be a significant finding if repeated exposure did help children learn not only the novel words regularly presented in the test, but also other unfamiliar words. This research relates to the present study as it offered more confirmation that fast mapping is an extremely effective learning process, and can affect children beyond initial introduction tasks.

The research was aimed towards typically developing children ages 16-18 months. This age group was of particular interest because during this period of development, children are producing fewer than 100 words. Children were split into an experimental and a control group.

The study took place over the course of 12 weekly sessions. Children were introduced to novel terms through the use of 24 photographs of both familiar and unfamiliar real-life objects. The target terms were related to specific unfamiliar objects. There were two high-practice picture sets, seen the most often, one medium-practice set, and one low-practice set, represented only at the final session. Children in the experimental group saw two sets per session, while children in the control group saw two sets only at sessions 1 and 12. During sessions 2 through 11, the control group looked at a picture book and named 12 familiar objects. Gershkoff-Stowe and Hahn (2007) hypothesized that children in the experimental group would have better results for learning new words due to the repeated exposure.

Both groups received ostensive training, where the meaning of a new word is communicated by showing explicit examples. Therefore, before each session, both parents and experimenters provided the children with labels for pictures of the novel items. The control group was trained on familiar terms during the intermediate sessions. Children were then immediately tested. The participants were shown pictures and asked to point to the appropriate picture as the experimenter said an object name aloud.

The experimental group showed a much more substantial increase in correctly identified high-practice words over the 12 weeks than the control group. Considering that the percentages of correctly identified words from both groups were extremely similar at session 1, the importance of repeated exposure was evident. The results illustrated the strength of fast mapping and extended practice on lexical growth.

The response outcomes associated with the low-practice words were assessed to address the idea that repeated exposure to a particular list of novel terms might be able to aid children in learning less practiced novel words, since the low-practice set was equally exposed. Participants in the experimental group responded to the low-practice words with 71% accuracy, while the control group responded with only 38% accuracy. The results clearly supported the idea that frequent exposure to unfamiliar words does strengthen children's fast-mapping skills and therefore, supports lexical development.

The final research article, "Young Children and Adults Use Lexical Principles to Learn New Nouns", described three experiments directed by Golinkoff and her colleagues (1992) which examined individuals' capacities for retaining the understanding of novel words' meanings. This study examined fast mapping in addition to several other word learning principles, and was crucial to the current work as it looked at whether children were capable of extending newly learned novel words.

The first experiment observed how adults learned the meaning of unknown words. Experiment 1 was conducted with eight university students, participating as a group. The group took part in three separate blocks, each with four trials. The participants were given booklets that contained pictures, both familiar and unfamiliar, on each page that were related to the words said aloud by the experimenter. Unfamiliar items were randomly chosen to represent the target terms, and were given novel labels.

The first trial tested the subjects' likelihood to choose an unfamiliar picture after hearing a novel term. Participants saw three familiar items and one unfamiliar item. Trial 2 checked if the adults would extend the meaning of the novel term to a slightly altered representation of the term. The adults were prompted with the same novel term from Trial 1, while seeing two familiar objects and two novel objects, one of which depicted the just-learned novel term in a different color. Trial 3 assessed comprehension by presenting a second novel term. The page showed two familiar objects and two unfamiliar objects, one being the novel term learned in Trial 1. Trial 4 tested the extension of the second newly learned term. Subjects saw two familiar and two unfamiliar items, again one of which pictured the just-learned novel term from Trial 3 in a different color.

The adults responded with 100% accuracy across all 4 trials. The results provided overwhelming evidence that fast mapping occurred and that adults were capable of extending newly learned words when they were further presented in different contexts.

Experiment 2 was performed individually with 12 children ranging in age from 28 months- 32 months. Like the first experiment, children participated in three blocks of four trials. The testing method was altered so that the objects were displayed in a transparent plastic box.

The children's results for all four trials were not as high as those of the adults. Still, they scored well above chance levels on all trials, showing that through very brief exposure to a new word, children were aware that it referred to a specific novel object, and could even extend that knowledge.

Experiment 3 was a control study, to check if the results from Experiment 2 occurred because children actually made word-referent connections, or because they simply favored handing over the novel objects. The design of this experiment was exactly the same as Experiment 2, except that instead of saying the novel names aloud, the experimenter just said "May I have something else in the box" (Golinkoff et al., 1992, p.105).

Children earned scores significantly below chance levels on all four trials of Experiment 3. The results indicated that the observations from Experiment 2 were valid, and therefore, that the children could not have been handing over novel objects simply because it was enjoyable.

Overall, the experiments proved that individuals not only gained information about the meaning of a word from a single exposure, but also understood that a novel term did not simply refer to a single exemplar, but to a potential class of items. Secondly, individuals in the study were able to distinguish that another new word could not refer to a novel object they had just named. The results were especially strong because children were asked to learn six new words in one session, increasing lexical demands.

Table 1: Fast Mapping Literature

Author(s)/Titles	**Subjects**	**Questions Addressed**	**Findings**
Tracy H. Heibeck and Ellen M. Markman (1987) "Word Learning in Children: An Examination of Fast Mapping"	**Study 1**: 83 children ages 2.2-4.8 -Group 1: 27 2-year-olds (2.2-2.11; M= 2.7) -Group 2: 30 3-year-olds (3.0-3.8; M= 3.4) -Group 3: 26 3 and 4-year-olds (3.9-4.8; M= 4.1) **Study 2**: 64 children ages 2.8-4.5 (M= 3.8)	Can children comprehend new words when they are contrasted against known words in three domains (shape, color, texture); Can they identify the specific domains the words belong to	**Comprehension task average percentage of correct answers:** *Study 1*: 63% *Study 2*: 66% **Hyponym task (domain comprehension) percentages of correct responses:** *Study 1*: 100% shape, 90% color, 56% texture *Study 2*: 90% shape, 56% color, 75%texture **Production task percentages of correct responses:** *Study 1*: 43% shape, 4% color, 8% texture *Study 2*: 38% shape, 6% color, 0% texture
Lisa Gershkoff-Stowe and Erin R. Hahn (2007) "Fast Mapping Skills in the Developing Lexicon"	**Experimental group**: 8 children ages 16-18 months (M= 17.1 months; SD= 0.93) **Control group**: 8 children ages 16-18 months (M= 16.5 months; SD= 0.51))	Can extensive practice with a specific set of novel terms assist children in learning low-practiced novel words	**Correctly identified high-practice words:** Experimental group *Session 1*: 23% *Session 12*: 81% Control group: *Session 1:* 21% *Session 12:* 35% **Correctly identified low-practice words:** Experimental group: 71% Control group: 38%
Roberta Golinkoff, Kathy Hirsh-Pasek, Leslie M. Bailey, and Neill R. Wenger (1992) "Young Children and Adults Use Lexical Principles to Learn New Nouns"	**Experiment 1**: 8 university students (4 men, 4 women) **Experiment 2**: 12 children (6 boys, 6 girls) ages 28 months, 26 days-32 months, 10 days (M=30 months, 31 days) **Experiment 3**: 8 children (3 boys, 5 girls) ages 28 months, 17 days- 30 months, 25 days (M= 29 months, 13 days)	When presented with both familiar and unfamiliar pictures, will adults and children be able to appropriately map an unknown term to an unknown object; Can they extend the newly learned novel terms to different exemplars	**Percentage of choosing correct novel objects:** Trial 1 *Experiment 1:* 100% *Experiment 2:* 78% *Experiment 3:* 25% Trial 3 *Experiment 1:* 100% *Experiment 2:* 80% *Experiment 3:* 46% **Percentage of correct novel extensions:** Trial 2 *Experiment 1:* 100% *Experiment 2:* 69% *Experiment 3:* 0% Trial 4 *Experiment 1:* 100% *Experiment 2:* 60% *Experiment 3:* 0%

Category Learning Literature

It is essential to analyze whether children comprehend that new words learned through fast mapping do not simply refer to single exemplars, but rather to entire classes of items, or categories. Understanding categorization is crucial to word learning, since it allows children to make more inferences about words and their meanings, which supports their language development. Also, grasping the concept of categorization in word learning is important as it is indicative of natural language situations. While the research articles just discussed offered support for the influence of fast mapping as a learning tool, they did not reflect on the idea of category learning, and whether or not children require extensive exposure to understand this concept. The present study examined what kinds of information children gathered through the fast mapping process. As the current study combined both testing on fast mapping and category learning, it is also necessary to reflect on past literature related to categorization studies.

Ward and his colleagues (1989) performed a study which examined what specific attributes needed to be present for an object to be considered part of a category of items. In order to do this, they first directed a labeling study. The participants included 32 preschoolers, 28 second graders and 64 undergraduate students, taking an introductory psychology course (see Table 2). The participants learned novel terms for certain objects and were subsequently presented with variations of these objects. Participants were then asked if these varied objects were still given the same name as the target objects. Ward and his colleagues (1989) decided to include three manipulations of the objects: the number and type of parts present, the shape of the whole object, and the overall size. There were two levels for each of the four attributes, making

16 different possible variants for each set. During this task, each participant saw the four separate sets. Animate objects were presented as pets within a story, while inanimate objects were presented as toys within a story. After hearing the story, the participants were urged to choose all instances, or only one instance, of the pet or toy that was mentioned. The target item remained in view.

The experimenters also wanted to analyze whether children employed a holistic or an analytic mode of processing. Holistic processing means children include objects in a category if it is similar in overall appearance to the initial object. Analytic processing, on the other hand, contends that children identify a specific attribute(s) in a new object that is also present in the initial object for it to be considered part of that category.

Ward and his colleagues (1989) looked at how differences in labeling may have affected the children's understanding. The experiment incorporated a single label condition and a dual label condition. Half of the participants in each age group were presented with the information in the single mode, where they saw one picture and were given one name for it. The other half participated in the dual mode, where the participants saw each of the members of the pairs and were given two different labels for each member.

When analyzing the results, the researchers attempted to separate the participants according to their mode of processing. They may have used a single, dual, triple, quadruple, or holistic approach to categorizing. In order to be considered using a single rule approach, 15 of the individual's answers must have consistently shown the use of a specific attribute. For those using a dual attribute rule, the participant must have responded that items belonged to a category if they had the same two attributes for all 16 responses. The same idea explains the triple and quadruple attribute rules. Holistic rule users had to include items with at least three similar attributes to the original item. In this case, participants could have identified any three attributes each time, as opposed to a consistent three.

According to Ward and his colleagues (1989), 51% of preschoolers, 46% of second graders, and 57% of college students used one of these rules, and were further considered. The results showed that preschoolers primarily used the single attribute rule, and equally favored each of the four attributes when applying it. The second graders and college students differed from the preschoolers, predominantly using the dual and triple attributes rules. There were three consistent attributes applied for the triple attribute rule for all the college students and 19 of 22 instances for the second graders: the number of parts, type of parts, and body shape. This implied that the older children and students did not consider same size to be relevant for category membership. Only one preschooler, two second graders, and one college student exhibited a holistic pattern.

A second group made up of 10 undergraduate psychology students participated in a similarity judgment task. The similarity judgment task was developed in order to guarantee salience among the different attributes. “An attribute would be considered to be relatively salient if a difference on that attribute alone resulted in an item having less perceived similarity to the prototype than a difference on any other single attribute” (Ward et al., 1989, p. 221). The variants were presented in the same way as in the single mode. The participants were simply asked to give a rating of the overall similarity of each variant to the exemplar, rather than make category decisions like in the main task. The rating went from one, “very similar”, to nine, “not at all similar” (Ward et al., 1989, p. 217). According to Ward et al. (1989), the varying attributes held equal salience, ensuring that salience could not have explained any of the results from the labeling task.

The data from this study indicated that young children seemed to focus on single attributes when deciding upon category membership, whereas older children and adults focused on dual or triple attributes. The authors proposed the possibility that children may have focused on single attributes as a result of their underdeveloped sense of categories and what is typical for membership, while older individuals had a better sense of categorization due to their past experiences (Ward et al., 1989). Still, the data clearly showed that children were capable of making extensions beyond initial word learning, and further specified what is especially important to them when making category decisions.

In addition to the attributes of an item, it is important to explore the effect of viewpoint variance on children’s perceptions. Michael Tarr and his colleagues have done extensive research on the idea of object recognition related to altering viewpoints. They conducted a study testing the well-known recognition-by-components (RBC) theory, and sought to prove that viewpoint variations are significant to object recognition (Tarr et al., 1998). According to the authors, RBC theory holds that “a complex object can be recognized from its constituent geons, which can themselves be recognized from any viewpoint” (Tarr et al., 1998, p. 275). Geons are “simple 3D volumes” that can be portrayed two-dimensionally (Tarr et al., 1998, p. 275). In this way, the RBC theory implies that when the viewpoint with which a simple geon is seen changes, it is equally as easy to know what is being presented, and is therefore viewpoint-invariant.

Tarr et al. (1998) conducted a set of nine experiments challenging the RBC theory. The first five experiments consisted of a sequential matching task. Two images were shown, with one immediately following the other. Experiment 1 presented line drawings while Experiments 2 through 5 presented shaded images. The geons were portrayed at viewpoints differing by 0°, 45°, or 90°. Participants were asked if the two images portrayed the same geons or different ones. According to the authors, the RBC theory did not support any of these experiments, as it took increasing amounts of time to recognize that the images depicted the same geons (Tarr et al., 1998).

The next four experiments utilized a match-to-sample task, in which participants first saw a target geon at 0° and were then urged to decide if the 0°, 45°, and 90° views of the geon represented the same initial target geon. The difference in these experiments was that these trials were performed in blocks, where the different views of the geon were interspersed with nine other geons. These experiments also did not provide support for the RBC theory, although the mean response time was reduced. The authors suggest this was at least partially due to the effect of practice, since the first trials in each block took significantly longer than the third trials (Tarr et al., 1998).

The last experiment was a naming task, where participants learned labels for geons presented at 0°. Following this learning, participants were asked to name the geon at all three viewpoints (0°, 45°, and 90°) in two blocks. Again, the results were in opposition with the RBC theory. However, mean response time did considerably drop during the second block, as the participants were gaining information about the viewpoints.

The results strongly negated the idea that geons could be recognized from any viewpoint with equal speed and accuracy. This data clearly suggested that object recognition is not viewpoint-invariant, but rather viewpoint-dependent. The authors also insisted that viewpoint-invariance could not possibly hold true for any type of object recognition, if it is so strongly refuted in these experiments, which were focused on extremely simple geons (Tarr et al., 1998).

Another study, directed by Behrend and his colleagues (2001), centered on children's capabilities to extend just-learned novel words to other examples of those words. Behrend and his colleagues (2001) pointed out the necessity of extendibility for fast mapping to truly be considered a word-learning system. The authors mentioned work from other researchers in the field, who argued that fast mapping could be related to memory and general learning processes (Behrend et al., 2001). This argument stemmed from their findings that children were able to extend novel facts equally as well as they could extend novel words. Behrend and his colleagues (2001) performed two experiments to test this idea, and prove that children are able to perform categorization tasks with great accuracy. Since the extension of novel facts is not particularly pertinent to the present research, the focus of this review will lie on the extension of novel words.

Experiment 1 consisted of 40 children between 15 and 59 months of age, primarily of European descent. All children spoke English as their dominant language.

The experiment began with a training phase. During this phase, children were presented with an array of 11 novel objects, consisting of unfamiliar household items, and given two minutes to explore it. Two of the objects were the targets, one representing a novel name (in this case, “koba”), and one representing a novel fact (in this case, “the thing that fell in the sink”). The experimenter then picked up one of the target objects and labeled it. Then, the experimenter suggested measuring the object and finally, putting the object away, by saying for example “let’s put away the koba” (Behrend et al., 2001, p. 700).

After training, the children participated in a memory test to check their understanding. The experimenter simply asked the children to pick out either the “koba” or “the thing that fell in the sink” from an array of eight objects. These arrays contained the initial target objects, three new exemplars of the training object which varied in size and color from the initial objects, and four new distracter objects.

Lastly, the children completed an extension test. Here, children were provided with the same arrays as in the memory test and asked to show each target object. Once the objects were chosen, the experimenter further prompted the children to see if there were any other instances of the two objects.

According to the authors, 65% of the participants passed both memory tests with no differences across age groups (Behrend et al., 2001). These were the only participants considered when looking at the rest of the results. During the extension tests, children properly extended the novel word to all of its exemplars on 71% of the trials.

The results of the extension tests demonstrated that children of all ages extended the novel word with a high degree of accuracy. Looking at individual responses further indicated this pattern. “All but 2 of the participants extended the novel word to all appropriate exemplars during the word trials, and none restricted the word to a single exemplar” (Behrend et al., 2001, p. 701).

Experiment 2 consisted of 77 children, ranging in age two-years-old to four-years-old. The novel word and novel fact were presented together in a single sentence with the word “this” instead of “the” to be sure children were not assuming that only one thing was being talked about. For example, the children might have heard something like, “This is a ball that is green” (Behrend, 2001p. 702). Also, the target object remained in view during the tests.

The children first completed a familiarization trial to introduce them to the procedure. The participants saw an array of familiar items, such as balls, of different colors and substances. Then the experimenter labeled one of the balls by saying, “this is a ball that is green” (Behrend et al., 2001, p. 702). The children were prompted to select any balls, or any green things, seen.

Succeeding the familiarization trial there were four test trials. The arrays shown during the trials consisted of a target novel object, four instances of that object, and four distracter objects. Three times the experimenter labeled a target object, again in a sentence indicating an unknown name and fact. Then the target object was placed to the side and the children were asked to point out any exemplars of that object present.

Again, the results showed high percentages of correct extensions of novel names. This data was especially applicable to the current research study for its support of category extension.

Children as young as two and a half years-of-age chose the correct exemplars for the target novel words presented in these experiments. Children at this age are typically undergoing early word learning processes, which made this data even more meaningful. Demonstrating that young children may be able to correctly make decisions regarding category extension shed greater light on the word learning processes children undergo.

Table 2: Category Learning Literature

Author(s)/Titles	Subjects	Questions Addressed	Findings
Thomas B. Ward, Edward Vela, Mary L. Peery, Sherri N. Lewis, Niels K. Bauer, Kimberley A. Klint (1989) "What Makes a Vibble a Vibble? A Developmental Study of Category Generalization"	**Main category generalization task:** 32 preschoolers ranging in age from 3-10 to 5-3 (M= 4-7); 28 second graders ranging from 7-0 to 7-10 (M= 7-6); 64 undergraduate students **Similarity judgment task:** 10 undergraduate students	What attributes do individuals regard as necessary for category membership? Do adults and children employ an analytic or holistic mode of processing?	**Percentages of preschoolers using single attribute rule that chose one of the attributes**: 24% - number of parts, 24% -type of parts, 27% - body shape, 25% - body size Majority employed analytic mode 1 preschooler, 2 second graders, 1 college student exhibited holistic mode
Michael J. Tarr, Pepper Williams, William G. Hayward, and Isabel Gauthier (1998) "Three-dimensional object recognition is viewpoint dependent"	Unavailable	Is object recognition viewpoint invariant, as is explained in the recognition by components (RBC) theory, or do recognition response times differ according to altering viewpoints?	86% of participants (average 9.3/10 geons) faster for 0° viewpoint changes than for 90° 76% of participants (average 8.2/10 geons) faster for 0° viewpoint changes than for 45° 70% of participants (average 7.3/10 geons) faster for 45° viewpoint changes than for 90°
Douglas A. Behrend, Jason Scofield, and Erica E. Kleinknecht (2001) "Beyond Fast Mapping: Young Children's Extensions of Novel Words and Novel Facts"	**Experiment 1:** 40 children (25 girls, 17 boys) - 10 2-year-olds (28- 34 months) - 15 3-year-olds (37- 48 months) - 15 4-year-olds (51-59 months) -18% Asian descent, 1 Hispanic, 1 African American (remainder European descent) **Experiment 2:** 77 children (35 girls, 42 boys) - 28 2-year olds (M= 38 months) - 25 3-year-olds (M= 41 months) - 24 4-year-olds (M= 54 months) 90% European descent	How well can children extend novel words to different exemplars after only a short introduction? Does presenting a novel word in the same sentence as a novel fact affect the results?	Children who chose correct exemplars on name trials: M=3.92; SD= .28 Children who correctly extended novel names: M= 3.32; SD= 0.96 Children extended the novel word to all exemplars on 71% of the trials Children restricted the novel word to just the initial exemplar on 7% of the trials

Summary and Research Goals

Much research supports the likely role of fast mapping on word-learning. However, considering the definition of fast mapping includes only partial understanding of word meaning, it is important to examine what this partial understanding might really mean. Are children able to reason that the novel word is a part of a category, rather than simply referring to one exemplar? If so, are they able to do this with limited introduction, or do they require increased exposure to grasp the concept? The present study sought to explore both fast mapping and category extension, and in turn, provide answers to these questions.

Chapter 2: Methods

Participants

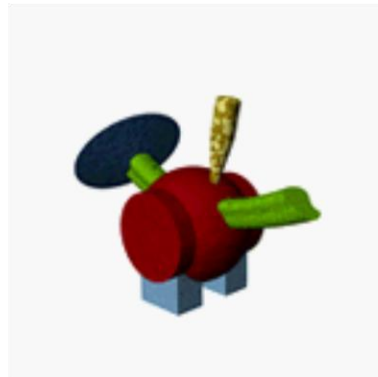
The participants included 33 children ranging from 34 to 65 months of age. There was one two-year old (2.8 months of age), 11 three-year-olds, ranging from 36 to 47 months of age (M= 42.7 months of age), 18 four-year-olds, ranging from 48 to 59 months of age (M= 53.5 months of age), and three five-year-olds, ranging from 60 to 65 months of age (M= 62 months of age). Children participated in the Peabody Picture Vocabulary Test (PPVT), a norm-referenced test that measures receptive vocabulary. The test scores were used to estimate the receptive vocabulary age of all participants.

The majority of children spoke English (23 out of 33 participants); however, the participants also included five children who were bilingual as well as, four Chinese, and one Russian language user. Children were identified as English dominant, bilingual, or an English Language Learner (ELL) through a questionnaire completed by parents. For those who used a language other than English, the questionnaire inquired into how often the non-English language was used in the home. Children were classified as bilingual if they were reported as using a non-English language in the home 75% of the time, but scored within age expectations on the PPVT. Children who used a non-English language 75% of the time, but who received PPVT scores below age expectations were considered ELL, and were identified according to their specific dominant language. If children were reported as using a language other than English at home 25% to 75% of the time, and had PPVT scores within age expectations, they were also classified as bilingual. Lastly, children who heard a non-English language less than 25% of the time were labeled English monolingual. All children were typically developing as reported through school personnel and behavioral observations by the research assistant.

Materials

All testing took place on a computer, and each child was tested individually. The participants were taught labels for two novel stimuli. Both stimuli were abstract figures shown on the computer in two-dimensional representations, pictured in Figure 1-1. The first novel stimulus was called “nove”, and the second, “jik”. There were other unfamiliar stimuli, which served as distracters, as well as pictures of familiar objects shown throughout the procedure. The pictures, both unfamiliar and familiar, as well as the location on the computer screen that contained the correct answer choice were balanced. It was important to do this to rule out the possibility that children were selecting a certain picture that appeared more than others, or simply favoring a specific location of the computer screen. Children were shown three pictures per trial during all testing sessions, with only one representing the correct response. Children were prompted during each trial to select a specific picture by a recorded spoken word produced through the computer speakers.

Figure 1-1: Novel Targets "Nove" and "Jik"



"nove" **"jik"**

Procedure

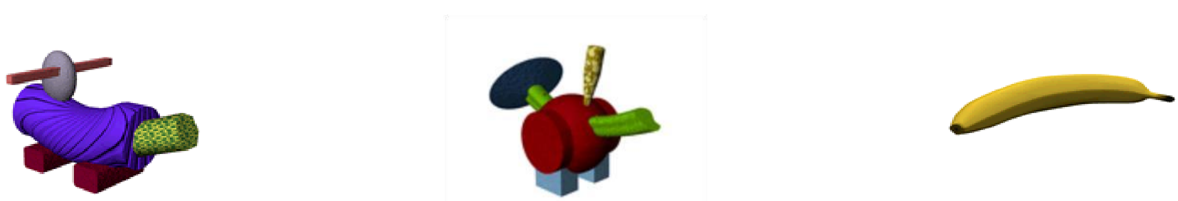
Exposure and Basic Outcome Testing

The study began with an exposure session, which introduced the novel target words and their corresponding novel stimuli. In order to introduce the targets, both "nove" and "jik" were contrasted against pictures of items that were already familiar to the participants. An example of a trial from this session can be seen in Figure 2-1. There were 12 trials in total. Six of these trials tested the targets, with three exposures of "nove" and three exposures of "jik". These trials occurred in a randomized order. The remaining 6 trials requested selections of familiar objects.

Figure 2-1: Trial Example from Exposure Session

Next, children participated in the basic outcome testing session. The purpose of this session was to check whether the children remembered the target labels and their appropriate representations. There were 14 basic testing trials. During these trials, one familiar picture was displayed against both of the just-learned novel targets. Children were asked to select the appropriate stimulus after hearing the word spoken aloud. Figure 2-2 offers an example of a basic outcome trial. There were four testing trials for each novel target. The other six trials presented either three familiar items, or two familiar items and one novel target.

Figure 2-2: Trial Example from Basic Outcome Session



After the participants completed the exposure and outcome testing sessions, four probe sessions tested if the children could further extend their knowledge of the just-learned stimuli, and make appropriate connections concerning their relevant categories.

Probe Sessions 1-4

Each Probe Session began with a number of fast mapping exposure and basic outcome trials, which were incorporated as reminders so that any errors in response could not be attributed to lack of memory. Interspersed throughout each probe session were trials containing pictures of only known objects, in order to ensure success and maintain motivation. The only reinforcement given throughout the procedure were pre-planned auditory reinforcements spoken through the computer. In this way, reinforcement was sporadically offered during certain trials, while the remainder of trials contained no reinforcement. Figures 3-1 through 3-4 display the probe sessions as they might have been seen by the participants.

The first Probe session consisted of 28 trials. It began with nine exposure trials, and seven outcome testing trials. In both the exposure and testing trials, each target was tested two times.

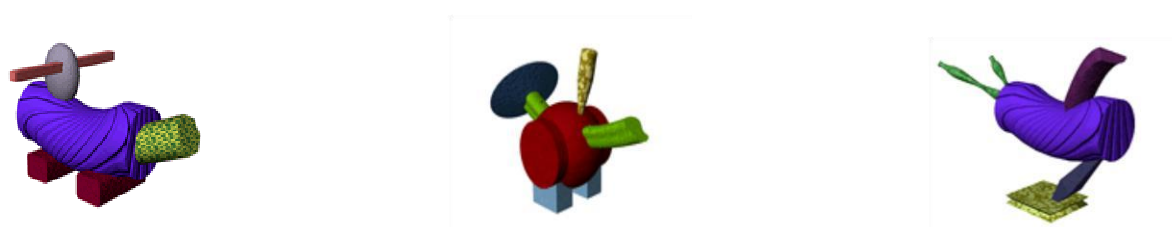
Probe Session 1 continued with 12 more trials. For eight of these, “nove” and “jik” were displayed alongside a never-before-seen novel distracter, another abstract figure (Figure 3-1). Children therefore had to choose between three unfamiliar items. The participants were prompted to choose “nove” and “jik” four times each, again in a randomized order. For the remaining four trials, the correct selections were all familiar objects. Probe Session 1 was performed to determine if the children still remembered the novel terms they had just learned, and if they could confidently choose the correct target even in the presence of a highly distractible novel stimulus.

Figure 3-1: Trial Example from Probe Session 1

The second Probe Session consisted of 24 trials, and began with four exposure and six basic outcome testing trials. This time, the number of reminders was reduced to one for each target, while the outcome testing still presented two prompts for each target.

There were 14 more trials. In Probe Session 2, the targets were displayed against a novel distracter that looked similar to one of the novel targets in either body shape, or body color (Figure 3-2). The participants again had to pick which picture represented “nove” or “jik”. Each target was tested four times. The additional six trials tested selection of familiar items. The purpose of Probe Session 2 was to further examine how much learning took place during the exposure and teaching events. Portraying the two novel targets beside a similar looking novel distracter increased the difficulty of choosing correctly and was a stronger test of comprehension.

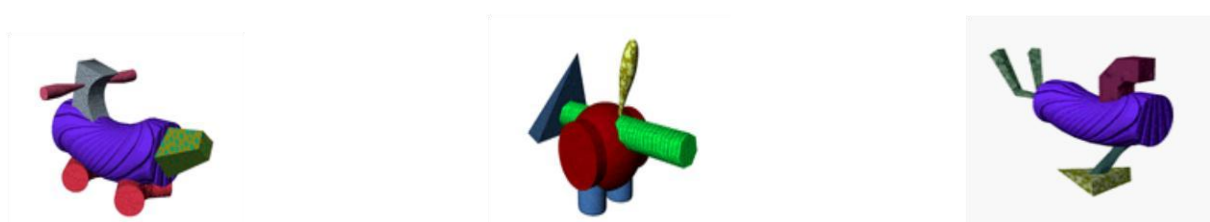
Figure 3-2: Trial Example from Probe Session 2



Probe Session 3 also included 24 trials. The first four trials were exposure trials, with one instance of each target. The next six were outcome trials, where targets were tested two times each.

Probe Session 3 was considered a generalization trial, where participants saw variations of the original novel targets (Figure 3-3). This included a variation of “nove”, a variation of “jik”, and variations of the similar stimuli of both “nove” and “jik” used in Probe Session 2. The variants looked similar to the original novel targets, but differed from these representations on certain features. They were composed of differently shaped or colored parts; however, they “generally” looked the same. For four trials each, participants were asked to choose the correct variant of “nove” and “jik”. Here, there were three variants shown on the computer screen, with no pictures of the original novel stimuli. The other six trials again prompted for familiar items only. If children were able to extend the just-learned novel terms to their equivalent generalization variants, it was assumed that they understood that the novel targets were part of a category of objects

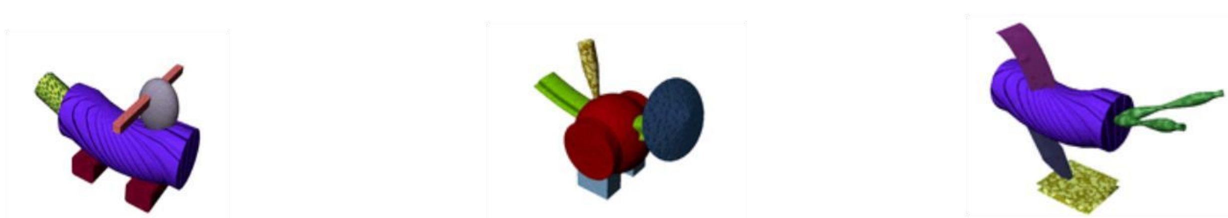
Figure 3-3: Trial Example from Probe Session 3



Probe Session 4 involved 22 trials and began with four exposure and six basic outcome trials. There was one exclusion reminder for each target and two prompts of each target during the outcome trials.

Probe Session 4 was a viewpoint test. To test viewpoint dependence or invariance on selection of novel targets, the stimuli were seen at an altered viewpoint. The novel figures were essentially flipped around, so that the back sides were now seen from the front (Figure 3-4). The stimuli, both the original targets as well as the similar novel distracters, were again displayed in their original forms. Therefore, although participants saw the same pictures they had been introduced to from the start of the procedure, the way in which they were presented was changed. There were four trials that tested for “nove” and four that tested for “jik”, all of which appeared in a randomized order. Four more trials prompted the children to choose familiar objects. If children realized that the altered viewpoint still represented the same item, then they had made even more extensive category decisions.

Figure 3-4: Trial Example from Probe Session 4



Chapter 3: Results

Exposure and Basic Outcome Testing

Table 3 as well as Figure 4-1 display an overview of the results from all of the sessions, including the response accuracy differences between younger children (2 and 3-year-olds) and older children (4 and 5-year-olds), as well as standard deviation (SD).

The main questions this study sought to address were whether children can learn new words through fast mapping, and how complete their understandings may be from the initial word learning instances.

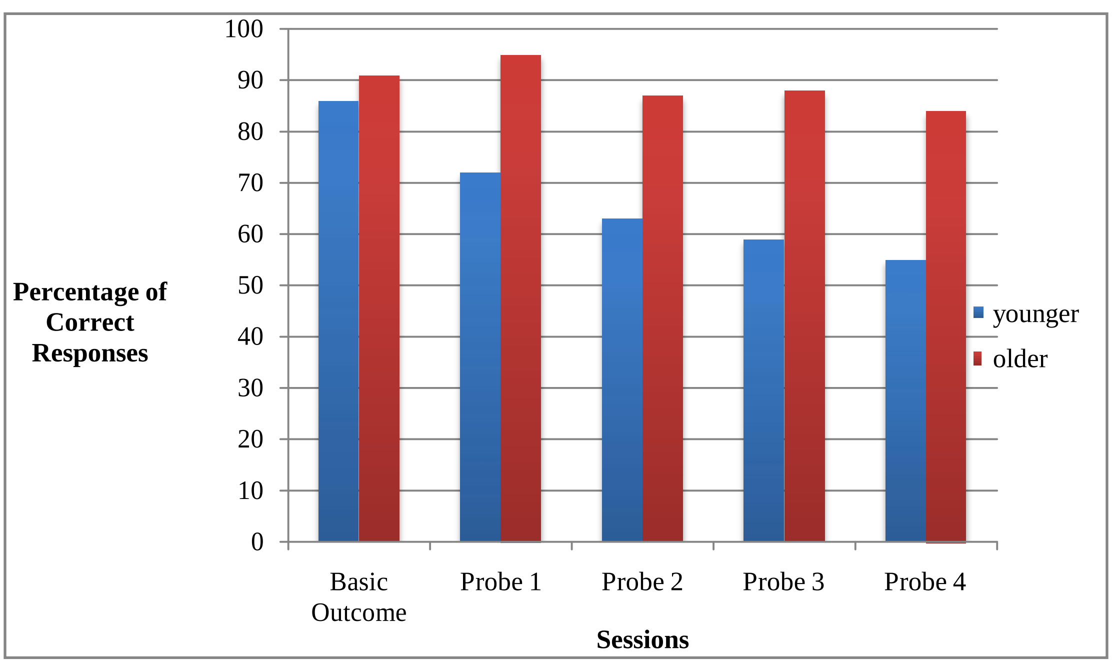
The study began with an exclusion session, which introduced the participants to two novel targets by displaying the targets against pictures of well-known objects. Following this, children participated in a basic testing session in order to determine if they had learned the targets just introduced. This was done through presentation of both novel targets against one another and a well-known distracter.

Children learned the novel targets and were able to differentiate between the two. Table 3 clearly indicates that all participants learned the new words, regardless of age. Because there were three items to choose from on the computer screen at all times, approximately 33.33% of responses could be expected to be correct due to chance. Clearly, the participants responded well above chance levels. Because all of the participants seemed to be making the proper word-referent connections, as well as understanding the testing procedures, it was appropriate to continue the testing beyond the basic outcome session.

Table 3: Overall Results with Age Comparisons

Session	***Response Accuracies All Participants***	***Response Accuracies Younger Group (2 and 3-year-olds)***	***Response Accuracies Older Group (4 and 5-year-olds)***	***Standard Deviation***
Basic Outcome Session	89%	86%	91%	All: 11% Younger: 15% Older: 9%
Probe Session 1 (novel distracter)	87%	72%	95%	All: 18% Younger: 22% Older: 7%
Probe Session 2 (similar distracter)	78%	63%	87%	All: 29% Younger: 35% Older: 22%
Probe Session 3 (generalization)	77%	59%	88%	All: 26% Younger: 33% Older: 14%
Probe Session 4 (Viewpoint)	73%	55%	84%	All: 32% Younger: 36% Older: 25%

Figure 4-1: Age-Related Results



Probe Sessions 1-4

Children then participated in Probe Session 1, where on eight trials the novel targets were displayed alongside a never-before-seen novel distracter. The results showed that older children responded correctly with a higher degree of accuracy than younger children. The range of variability, as indexed by the standard deviations, suggested that the performance of the older children was reliably better than that of younger children, as not only the mean performance, but the standard deviations too were almost non-overlapping. Nonetheless, the younger group still answered above chance levels, and appeared capable of identifying the novel targets even in the presence of a new novel distracter.

Probe Session 2 contained eight trials in which the novel targets were seen against a novel distracter that was quite similar in body shape and color to one of the newly-learned targets. Accuracy for this session was still high, although not as high as the previous sessions. Similarly to Probe Session 1, the range of standard deviation as well as the response accuracy of the younger group's performance was lower than that of the older group.

Probe Session 3 was a generalization test. There were eight probe trials presenting generalization variants of the original targets. Here, the younger children performed with less accuracy than the older children, which can be seen in the mean percentages. As in the previous sessions, the range of variability was also lower in the younger group compared to the older group, which further provided support for the older group's more proficient performance.

In Probe Session 4, the original novel targets were shown in altered viewpoints during eight probe trials, that is, as if the participants were looking at the object from behind. Again, the difference between the responses of the younger and older group was considerable. The older group had significantly higher mean percentages of correct responses as well as range of standard deviation.

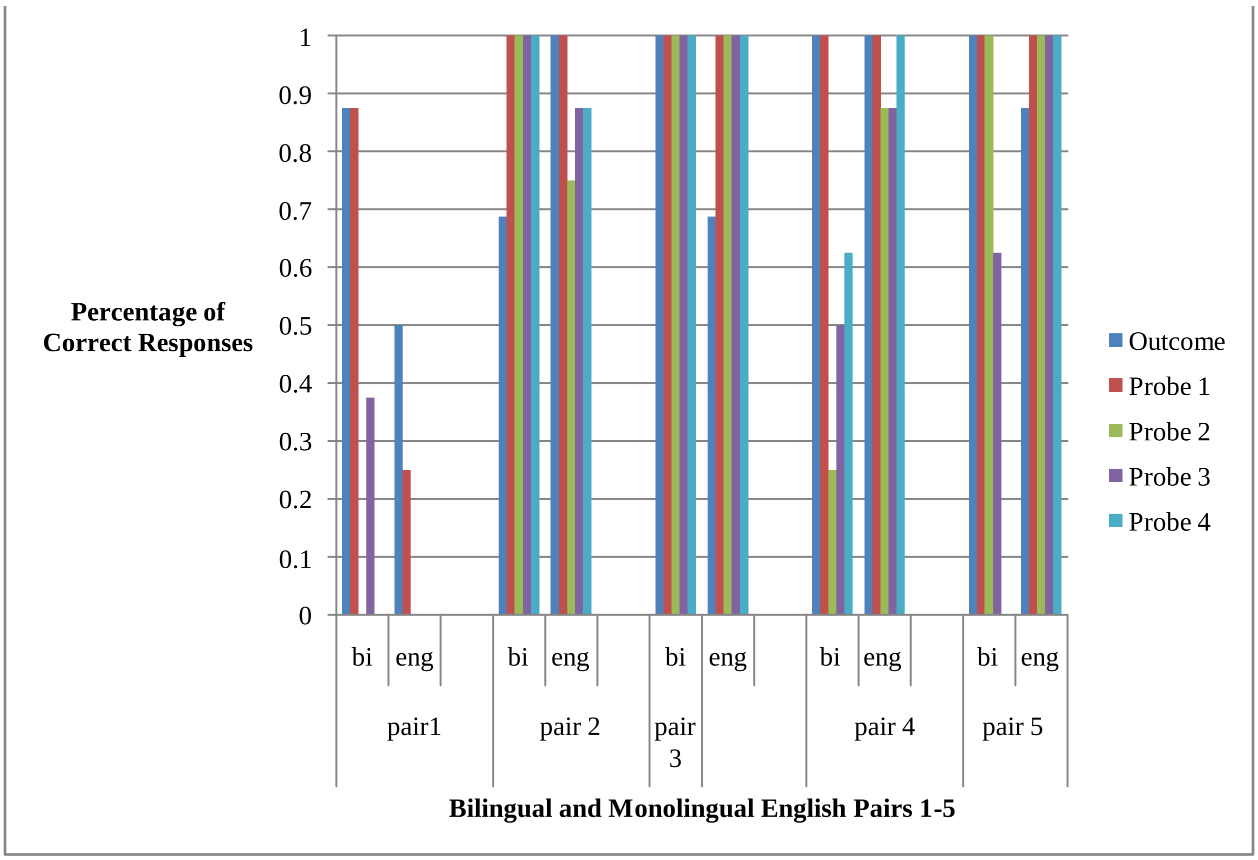
Language Outcomes

Because we had participants of diverse linguistic and cultural backgrounds, it seemed critical to look into whether or not language status had an impact on results. To do this, we compared the data from the English language users to the data from the non-English language users. However, there were a significantly larger number of monolingual English speakers participating in the study, making up 23 of the 33 participants. It was inappropriate to compare the 10 minority language speakers to the 23 monolingual English speakers. Instead, we decided to conduct participant-to-participant matching procedures on the basis of chronological age (CA) as well as receptive language age (RLA), determined from the PPVT scores. A participant-to-participant matching procedure entails analyzing the data concerning the subjects, and selecting an equal number of participants from both groups to compare their results from each session. We chose to compare the bilingual participants and English Language Learner (ELL) participants separately against the English speaking participants. Figures 4-2, 4-3, and 4-4 display detailed results of the comparisons of each group.

Bilingual vs. English Monolingual

There were five bilingual participants, with four in the older group, ranging from 49 months to 58 months of age, and one in the younger group at 45 months of age. The five English subjects selected for the participant-to-participant matching task matched the bilingual participants on both CA and RLA. Pairs 2, 3, and 5 had very comparable outcomes. The participants within pair 1 also showed similar results; however, in this case, both subjects earned particularly low scores, including a number of 0% response accuracies each. Within pair 4, the English participant maintained higher accuracy responses than the bilingual subjects, particularly on the Probe Sessions (see Figure 4-2).

Figure 4-2: Bilingual vs. Monolingual English Results

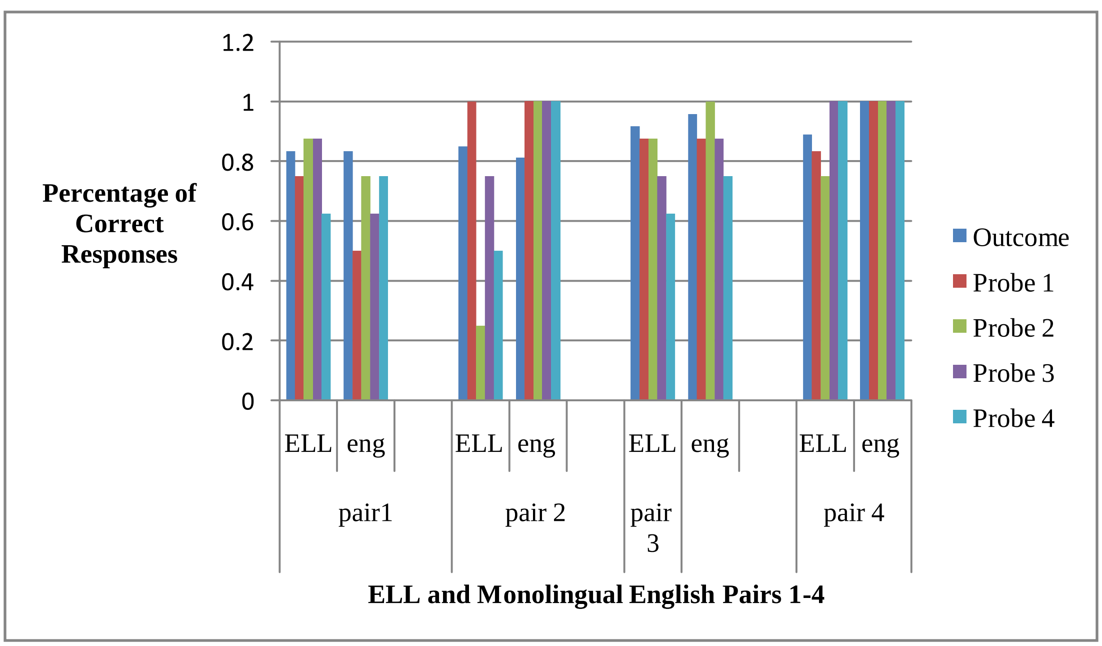


ELL vs. English Monolingual

Next, we compared the ELL participants. Within this group there were four Chinese and one Russian language user. For the Chinese language users, three were in the older group, ranging from 55 months to 58 months of age, and one was at the higher end of the younger group, at 47 months of age. The Russian speaker was 65 months of age. For the ELL children, we did two person-to-person matching tasks, one for RLA and one for CA.

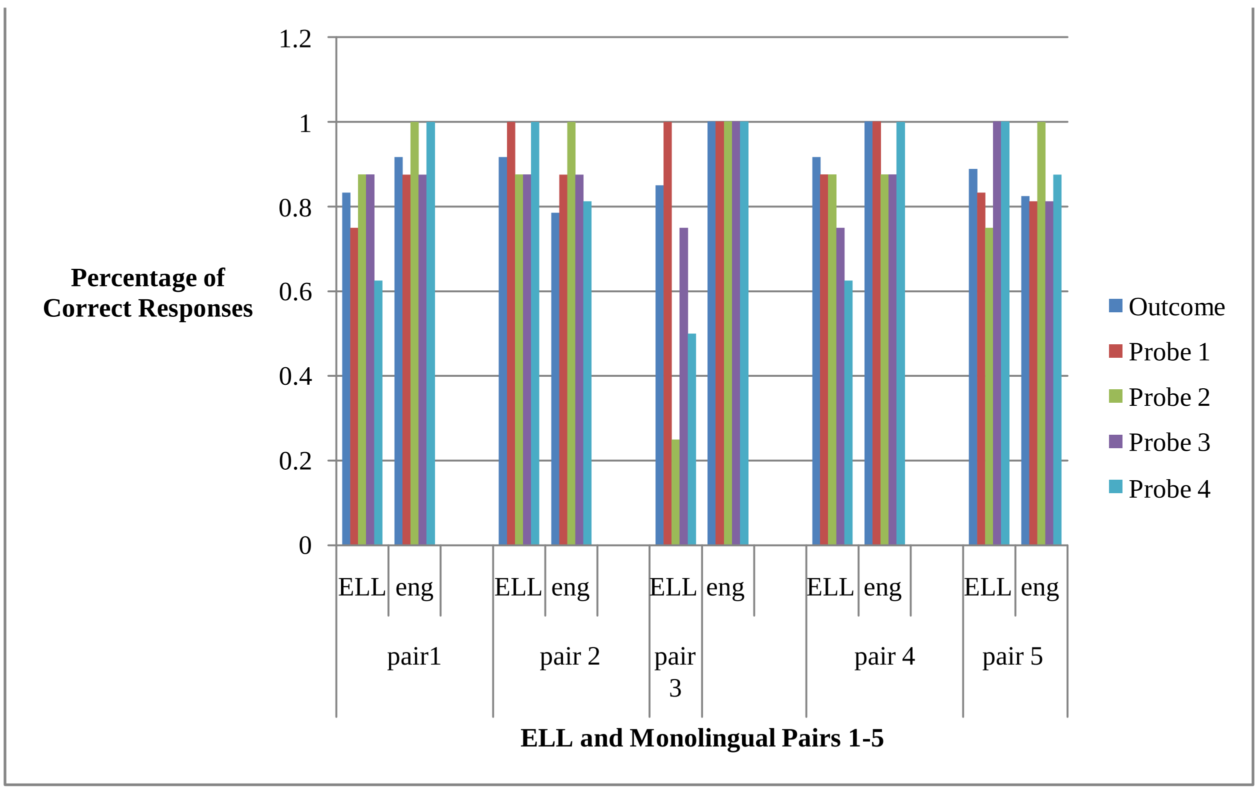
First, the ELL participants were compared with English language users with approximately the same RLA (Figure 4-3). Since one of the ELL learner's PPVT score was missing, the comparison only included four English language participants. For the most part, the pairs were extremely comparable; with only pair 2 showing completely different outcomes, again, especially in regards to the Probe Sessions.

Figure 4-3: ELL vs. Monolingual English Results (RLA)



We then matched five English participants with similar chronological ages to the ELL subjects for the CA comparison (Figure 4-4). This participant-to-participant matching task yielded varied results. For pairs 1, 3, and 4, the English language users had more correct responses during all sessions than the ELL participants. This is to be expected since the ELL children are still learning the English language, and primarily use a language other than English. The results from pairs 2 and 5 were more equivalent.

Figure 4-4: ELL vs. Monolingual English Results (CA)



Chapter 4: Discussion

All participants learned the two target novel words during the exclusion session, indicating that children did make word-referent connections by way of fast mapping. Even when the results were divided by age, as well as language status, the response accuracies for the basic outcome session remained high. Following this, the response accuracies for Probe Sessions 1 and 2, while lower than those for the outcome session, remained above average. In general, it appeared that children made strong connections during the initial exclusion session and were able to remember word meanings after only very brief exposure to them. Age-related differences emerged in the children's likelihood of extending the word meanings to variants, either in features or in the viewpoint that the pictures were presented in.

Basic Fast Mapping Processes

This evidence links to the research done by Markman and Heibeck (1987), Gershkoff-Stowe and Hahn (2007), and Golinkoff and colleagues (1992) reviewed within the fast mapping literature section of the introduction. Both the past data and the current data from this study offered support for fast mapping as an important and influential way of learning new words. As mentioned before, Markman and Heibeck (1987) conducted a research study on children between the ages of two and four to see if they were able to learn words through fast mapping. Just as all the children in the current study appropriately learned the two novel targets through fast mapping, all of the children in their study also gained information about the new words introduced to them through the same process.

Gershkoff-Stowe and Hahn (2007) examined the effect of repeated exposure on word-learning success for children ranging from 16-18 months. The findings from their study provided support for the concept of repeated practice, since the participants who were exposed to the novel terms during each session performed better than the participants who only heard the novel terms at the first and final sessions. In the same way, the participants in the present study continued to hear the novel terms during each separate session. These participants appeared to have benefited from this repeated exposure as is indicated in the relatively high percentages of learning that took place. Although those who participated in the research conducted by Gershkoff-Stowe and Hahn (2007) were younger than the participants of the present study, it is acceptable to compare the two groups. This is the case since on average, the older children performed more accurately than the younger children during all sessions of the current research, and therefore, children younger than these participants offer even stronger support for this learning process.

Similarly, Golinkoff and colleagues (1992) sought to see if children between the ages of 28 and 32 months could pick up on the meaning of unfamiliar terms through very brief exposure to those terms. As can be seen from the results, the participants made proper connections about the new words and their meanings, and in general, were able to choose the right object when being prompted with the appropriate novel word. Children also understood that a second novel term could not refer to a novel item that had already received a label. This corresponds to the current study since most of the participants comprehended that the second novel label heard could not be related to the first unfamiliar picture seen, since that had already been labeled “nove”.

The evidence from the previous fast mapping literature, in conjunction with the findings of the current research, lead us to believe that fast mapping is an extremely powerful word-learning process.

Extension of Fast Mapped Words

The results from the remainder of the sessions offered important information concerning whether children are able to extend word knowledge past initial word leaning instances. Here, the results varied across probe sessions, and also among participants' age.

Probe Session 1 was the first test of the participants' extension abilities. While proving that the children did learn the target words, it also showed that they were not simply choosing unfamiliar pictures, as might have been the case if they chose the novel distracters. Here, the novel targets were presented alongside a never-before-seen novel distracter. When looking at the results of the entire group, it can be seen that the participants maintained high response accuracies on average. Although the older children performed better, the younger children still averaged 72% of correct responses. It appeared that, in general, the never-before-seen novel distracter did not interfere in the younger children's decision-making processes when selecting from the three pictures on the computer screen.

Probe Session 2 presented a similar-looking novel distracter, further increasing the difficulty of the task. While both the older and younger groups maintained lower percentages of correct responses, they were still above chance levels. Results suggested that the similar-looking novel distracter presented more confusion for the two and three-year-olds. Still, essentially it seemed that the maps made by the participants during the initial exclusion session were strong enough to withstand an increasingly distractible foil. The majority of participants understood that because the terms “nove” and “jik” already referred to two specific stimuli, both the unfamiliar and similar-looking distracters could not receive the same labels.

During Probe Session 3, the participants were shown generalization variants of the original novel targets. Probe Session 3 tested whether participants understood that the generalization variants represented the original novel targets. The fact that the pictures displayed on the computer screen were not the same as those seen in the previous sessions did not generally hinder the participants’ abilities to make the right selections. Nevertheless, following the pattern of the first few sessions, the older group performed with much greater accuracy than the younger group. The younger participants still scored above chance levels, averaging 59% of correct answers. On average, the older children were able to accurately extend the meanings of the previously-learned novel targets to their appropriate categories.

Probe Session 4 was another categorization test, where the novel targets were shown in altered viewpoints. The older group maintained a high degree of response accuracy during this session, while the younger group continued to decline in appropriate responses. Again they maintained response performance above chance levels, averaging 55% accuracy. Older children seem to have comprehended that the pictures still represented the same novel targets with more precision.

Clearly the younger participants struggled more to extend word meanings to exemplars that differed from the original targets in some way. While they were able to perform at relatively high levels when tested with both never-before-seen and similar looking distracters, they had a much harder time when the targets were varied.

The second research question focused on determining how complete the children's understandings were from their initial exposure with the targets, and whether they understood that the exemplars shown were part of a category, rather than single exemplars. As just discussed, the performances of the majority of participants offered support for the idea that individuals can gain a strong understanding of word meaning through fast mapping. While considering this second research question, it is again important to reflect back on the previous research, which is discussed in the category learning literature section of the introduction.

For instance, the work of Ward and his colleagues (1989) concerning what attributes children determined as important for category membership relates to Probe Session 2. Ward and his colleagues (1989) observed how children make category decisions by introducing novel objects and further presenting them in varied forms, with changes made to the type and number of parts, body shape, or body size. The results showed that preschoolers predominantly used the single attribute rule, and gave equal preference to all three attribute changes. With that said, this work suggested that young children may focus on one specific attribute of an object when deciding upon categorization. In Probe Session 2 of the present study, children were presented with novel distracters that were similar to the original targets in either body shape or body color. Overall, the participants averaged a response accuracy of 78% for this task. The older group, who averaged 87% response accuracy, may be more appropriate to discuss in regards to Ward's study, since the preschoolers' mean age was four years, seven months-of-age. Given that most of the older children did not select the novel distracter, it might be said that they too found body shape to be a critical attribute for category membership.

Following this, Probe Session 4 can be discussed in relation to the viewpoint variance research completed by Tarr and his colleagues (1998). Tarr and his colleagues (1998) effectively refuted the theory that objects are viewpoint-invariant. According to the researchers, object recognition is highly dependent on viewpoint (Tarr et al., 1998). In Probe Session 4, the original novel targets were displayed in an altered viewpoint. Essentially, the targets were shown as if from the back. For this task, the participants averaged 73% response accuracy. While still providing responses above chance levels, the younger group received as low an average as 55%. This implied that they did not master this task, and that an altered viewpoint significantly impacted their selections. Nonetheless, the older children averaged 84% response accuracy. Perhaps older children had an easier time with this task due to their increased experience with object recognition, and typically stronger language skills.

Lastly, the work of Behrend and his colleagues (2001) on extension of novel words also relates to the present research focus. In their experiments, Behrend and colleagues (2001) introduced children to an unfamiliar household item and gave it a novel name. Children then participated in both a memory and an extension test. The findings revealed that children extended the novel word with great accuracy, regardless of age. Likewise, in the present study, children of all ages averaged relatively high response accuracies when asked to extend novel words during certain sessions. When given both familiar and novel distracters, children still were able to identify the correct targets. However, it is interesting to note that the older and younger group performed very differently throughout the whole experiment, especially in Probe Sessions 3 and 4.

These results indicated that all the children that participated in the study did in fact learn the two novel targets through the process of fast mapping. However, the younger participants were not able to extend the meaning of the novel words to the extent that the older participants were. The results of the present work suggested that the ability to extend novel words is a skill with very different mastery levels among different ages. The two and three-year-olds had trouble making the connection between the novel term and its corresponding referent when the exemplars shown varied in some way from the original stimulus. This is clearly seen in the results from the generalization and viewpoint sessions, in which the stimuli were varied in either their features or their displayed viewpoints. It is possible that younger children often do not make complete maps, as offered by the definition of fast-mapping, and as a result, can only extend word meaning to very specific representations. On the other hand, the older participants had much more success extending words to their relevant categories. Older children appeared more capable of forming more complete maps between new words and their meanings, and therefore made broader extensions. This can be seen through their mean scores as well as the standard deviations and range of variability for each session. Again, this success may be due to older children’s increased experience with language and generally larger lexicons. Perhaps these skills were still emerging for the younger children, which led to the larger degree of variability in their responses.

Descriptive Language Use

While the results of the language analysis were not particularly pertinent to the research focus of this study, they did bring up some interesting points. Most of the bilingual children performed similarly to their English matches. However, whereas the English matches maintained fairly consistent scores across sessions, the bilingual children showed much more variability. For instance, the bilingual participant in pair 2 performed worse during the basic outcome testing than any of the other sessions. Also, the bilingual participant in pair 4 earned a lower score for Probe Session 2 than for 3 and 4, which contradicts the general findings. It is possible that bilingual individuals required more practice to fully understand the meanings of new words, which would explain why some of their results went up throughout the experiment. For the most part, though, they seemed to be processing new words at the same rate as their same-age English peers.

Most of the ELL participants received comparable scores as their RLA matched English pairs. This is what we would expect since ELL children are typically not at the performance level as their same-age peers. English children of the same age have been learning the English language since birth, and are therefore usually fairly proficient language users. ELL learners are attempting to learn the English language, secondary to the language they already know. These children should, however, be at around the same performance levels as English children with the same mental age. Only the responses of the ELL participant in pair 2 of the participant-to-participant matching task were much less accurate than the responses of their English match. As Figure 4-3 shows, there was again variability in the sessions which proved the most challenging to the ELL participants, with some providing more correct responses in the beginning sessions, and others in the final sessions.

When being compared to English participants with the same CA, three out of the five ELL participants earned significantly lower percentages of correct responses than their corresponding pairs. Again, this is what we would expect to see. The other two ELL children performed at around the same level of accuracy as their English pairs, something we would not anticipate.

We cannot draw any conclusions from the results of this study concerning the impact of language status, since the number of minority language participants was so small. It is necessary to do more extensive research on the topic of language status and word learning procedures.

Summary

The current research was conducted to test fast mapping and determine its validity as an influential word learning process. The research also examined how complete children's understandings of new words meanings were, after quick, initial fast mapping exposures. These ideas were addressed through a testing procedure which first exposed two novel words, and then proceeded with Probe Sessions designed to see whether children could extend the novel words beyond the first exposure. Thirty-three children between the ages of two and five participated in the study, including monolingual English language users, bilingual language users, and ELL language users. All children easily understood the connections between the new words and their corresponding representations. Age did not impact initial learning. However, older children continued to respond correctly across probe sessions, while the number of younger children's correct responses began to decline. The younger children had the most trouble with the generalization and viewpoint sessions, where either the features or viewpoint of the representations differed from the original exemplars. Younger children appeared to have not comprehended category extension as completely as the older children. The current research indicates that while children are able to learn through fast mapping, older children are more likely to understand that new words refer to categories of items, and therefore make proper word extensions.

It is important to note that there were limitations to this study. The number of participants was fairly small and there were only 23 monolingual English language users. Considering this, it may be hard to generalize the findings, and further research may be useful. Also, there were 10 language minority participants, which is not enough to draw any concrete conclusions about the effect of language status on word learning. Lastly, all participants were typically developing. It would be interesting to observe whether the same results held true if testing involved children with language and learning disabilities. More extensive research on fast mapping and category extension may further support this research and its findings on word learning.

BIBLIOGRAPHY

Behrend, D. A., Scofield, J., & Klienknecht, E. E. (2001). Beyond fast mapping: Young children's extensions of novel words and novel facts. *Developmental Psychology, 37* (5), 698-705.

Gershkoff-Stowe, L., & Hahn, E. R. (2007). Fast mapping skills in the developing lexicon. *Journal of Speech, Language, and Hearing Research, 50* (3), 682-697.

Golinkoff, R. M., & Hirsh-Pasek, K. (1999). *How babies talk: The magic and mystery of language in the first three years of life.* New York, NY: The Penguin Group.

Golinkoff, R. M., Hirsh-Pasek, K., Bailey, L.M., & Wenger, N.R. (1992). Young children and adults use lexical principles to learn new nouns. *Developmental Psychology, 28* (1), 99-108.

Heibeck, T. H., &Markman, E. M. (1987). Word learning in children: An examination of fast mapping. *Child Development, 58* (4), 1021-1034.

Tarr, M. J., Williams, P., Hayward W. G., & Gauthier, I. (1998). Three-dimensional object recognition is viewpoint dependent. *Nature Neuroscience, 1* (4), 275-277.

Ward, T. B., Vela, E., Peery, M. L., Lewis, S. N., Bauer, N. K.,& Klint, K. A. (1989). What makes a vibble a vibble? A developmental study of category generalization.

Child Development, 60, 214-224.

ACADEMIC VITA of Jennifer Pollock

Jennifer Pollock
2389 Greensward N
Warrington, PA 18976
Jenpollock33@gmail.com

Education: Bachelor of Science degree in Communication Sciences and Disorders, Penn State University, Spring 2011
Honors in Communication Sciences and Disorders
Thesis Title: Fast Mapping and the Extension of Newly Learned Words in Young Children
Thesis Supervisor: Krista M. Wilkinson

Awards: Dean's List

Activities: National Student Speech Language Hearing Association
College of Health and Human Development Honor Society
Women's Club Volleyball

- Secretary 2009-2010
- 2010 THON Family Relations Chair and Dancer

Adult Literacy Tutor (Spring 2010)