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LANGUAGE-RELATED RULE LEARNING IN MONOLINGUAL CHILDREN

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ABSTRACT

The purpose of this study was to investigate abstract rule-learning abilities in multiple age groups of monolingual children. The ability to learn abstract rules is necessary in order to learn the rules of a particular language system. Past research has mainly focused on infants' and children's ability to learn and retain a single rule. The current study set out to add to the literature by investigating young children's ability to learn a single rule using eye-tracking technology, as well as investigating children's ability to learn single and multiple rules through a pilot study using a "Blicket-Detector" paradigm. The first experiment found that when presented with a violation of a rule and a non-violation of a rule, children between the ages of 18 and 22 months do not spend more time looking at the violation of the rule, leading us to believe that they did not learn the single rule. The second experiment found that children between the ages of 34 and 42 months did not perform above chance when learning a single rule, and that only one out of the two children who were exposed to a second rule performed above chance on the second rule task. The performance of children in both experiments differed from what is expected based on results of the current literature on causal reasoning.

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CHAPTER 1

INTRODUCTION

Rule learning, the learning of abstract relationships between items, is an important aspect of language acquisition. Language systems each have their own specific sets of rules that must be followed for successful communication. For example, in English, a plural noun in the subject position requires the use of a plural verb. This is one example among many other grammatical, morphological, and pragmatic rules that are essential for successful communication using the English language. The use of rules is equally important in other languages, such as the necessity for masculine and feminine nouns in Spanish to be combined with articles and adjectives that correspond to the appropriate gender. When learning any language, it is important for children to develop the ability to learn, understand, and use rules. Research has shown that even before children have mastered the use of spoken language, they are able to learn abstract rules (Johnson et al., 2009; Marcus, Vijayan, Bandi Rao, & Vishton, 1999). One approach for investigating this rule learning ability in children is through the lens of causal reasoning.

Causal Reasoning

Causal reasoning can be described as the ability to recognize properties of objects and events and then use this knowledge to make predictive inferences (Sobel & Kirkham, 2006). When a child understands and remembers that certain circumstances cause a certain effect, they learn a rule. For example, a child can be shown that a specific pattern (AAB) causes a desired outcome, and that other patterns (ABA, BAA) do not cause the desired outcome. After a few exposures to this relationship between the pattern and the outcome, the child recognizes the causal properties of the objects (patterns based on shape, color, etc.) and learns the rule that only AAB patterns can cause the desired outcome. When given a choice between an AAB pattern and another pattern, the child uses the causal knowledge of the objects' properties to make predictive inferences and choose the AAB pattern to elicit the desired outcome.

Such causal reasoning skills have been demonstrated in infants as young as eight months old (Sobel & Kirkham, 2006). For children as young as this, the paradigms used to test causal reasoning skills differ from the rule learning paradigm described above in terms of the nature of the relation between events. Instead of inferring whether or not an event would occur, the infants inferred the spatial location of the next event. They were shown that two events together predicted an outcome in a certain location, and then that one event alone either did or did not produce the outcome in the same location. They were then shown another event alone and eye tracking technology followed their eye gaze to determine whether they inferred the spatial location of the outcome. This is just one example of a method for investigating rule learning (i.e. one event causes the outcome on the left) through causal reasoning that can be used with younger subjects whose language and motor skills are not as developed as older children.

Learning Multiple Rules

Past studies have mostly investigated rule learning in terms of learning a single rule (Marcus, Vijayan, Bandi Rao, & Vishton, 1999; Sobel & Kirkham, 2006). While the ability to use causal reasoning to learn a single rule has been demonstrated at a young age, in order to successfully learn a language, children must be able to learn and retain multiple rules within their language. For example, English speakers need to know the previously mentioned plural vs. singular verbs concept as well as the requirement for a sentence to consist of both a subject and verb, and then use the knowledge of these rules to produce output that makes sense within the English language system.

Previous research has indicated that learning and retaining multiple rules is a more challenging task than learning and retaining a single rule. A study by Kovács and Mehler (2009b) demonstrated this by teaching 7 month old subjects that a speech cue (trisyllabic, meaningless word) predicted the appearance of a visual reward (a looming puppet) in a certain location (either the left side or the right side) on a screen. After learning this rule, the subjects were exposed to a new set of trisyllabic, meaningless words that predicted the appearance of the visual reward on the opposite side from what they had previously learned, thus requiring them to redirect their gaze based on this new rule. Learning was measured by recording anticipatory looks with eye tracking technology. It was found that monolingual subjects succeeded in learning the first rule, but not the second rule.

Effects of Bilingualism on Rule Learning

What is interesting is that the study described above (Kovács & Mehler, 2009b) was also done with bilingual 7 month old subjects, and this group did succeed in learning both the first and second rule. Other work by Kovács and Mehler (2009a) has also demonstrated the advantage that bilingual infants seem to have over monolinguals when learning multiple rules. Bilingual infants may outperform monolinguals on such tasks due to their experience learning multiple languages with distinct sets of rules. Preverbal infants living in a bilingual setting seem to be able to “tune in” to utterances from both languages and build a separate representation of each. This greater cognitive load leads to increased cognitive control abilities in terms of executive function (Kovács & Mehler, 2009b). Executive function is responsible for tasks such as “anticipation, goal selection, planning, initiation of activity, self-regulation, mental flexibility, deployment of attention, and utilization of feedback” (Anderson, 2002). All of these processes are relevant to the production and comprehension of language, and can provide an explanation for why bilingual children perform better on some language-related activities.

For example, anticipation and utilization of feedback are two elements of executive function that are particularly relevant to the present study. Both experiments will involve the utilization of feedback in order to anticipate outcomes. In order to teach a rule to a child, multiple stimulus items are presented. Some of these items create the desired outcome, while others do not. The child learns which examples are consistent with the rule by observing feedback (i.e., positive sound for consistent stimuli and negative sound for inconsistent stimuli). During test trials, the child needs to anticipate certain outcomes, taking into consideration what he/she learned from the provided feedback.

While these processes are relevant to the experimental tasks at hand, it is also important to connect these behaviors in the lab to real-world language examples. Consider a child that is learning both Spanish and English. If the child’s father only speaks English to the child, and the child’s mother only speaks Spanish, the child will learn which language to use in each situation based on the feedback provided by the parent. If the father always replies in English when the child speaks to him, the child will use this feedback to anticipate which language to use when speaking with the father, and will use English to communicate wants/needs with him, while doing the opposite with the mother. This is among many examples of the roles that elements of executive function play in language-related activities.

While bilingual language learners have demonstrated advanced executive functioning and therefore earlier success at learning multiple rules, at some point in their development monolingual language learners must also build up the cognitive ability to learn and retain multiple rules within their single language. The current study aims to investigate this rule-learning ability and the timeline along which it typically develops in monolingual language learners.

Current Studies

The results from this series of experiments with monolinguals will allow us to gain a better idea of their performance when they are tasked with learning and retaining more than one rule at a time. One goal of our research is to test rule learning abilities in a way that does not require expressive language skills to be fully developed yet. This allows us to access rule-learning mechanisms very early on and regardless of the children's ability to demonstrate their knowledge through spoken language. A way to test infant's and children's ability to learn abstract rules without requiring the use of spoken language is through the previously mentioned concept of causal reasoning. This type of pattern-based causal reasoning was tested in the present study using two different methods for two different age groups: eye tracking technology and an adapted "Blicket-Detector" paradigm.

Investigating Single Rule Learning with Eye Tracking Technology

The first experiment utilized eye tracking technology to determine whether monolingual children between the ages of 18 and 22 months were able to learn and retain a single rule. Eye tracking technology has been successfully utilized in previous studies to investigate cognitive gains in bilingual infants (Kovács & Mehler, 2009b). This technology provides researchers with a way to investigate the abilities of participants who are too young to have developed verbal language yet. It gives us clues as to what they are cognitively capable of without the need for verbal communication or advanced motor skills.

During the study, each child was presented with a video that consisted of patterns based on shape features and an animated duck that was also accompanied by a sound. This video was adapted from one that was developed for a previous study (Sobel & Kirkham, 2006). The children learned that a certain pattern caused an animated duck to appear at a certain location on the screen, and that patterns that did not conform to the rule caused the duck to appear in different locations. At test, the eye tracker monitored whether or not the child looked at the duck that appeared in the incorrect location longer. A longer looking time to the video that does not conform to the rule would indicate that the child recognized a violation of the rule. This assumption is based on findings dating back for decades that children tend to look longer at novel stimuli than familiar stimuli (Fantz, 1964). During test trials, a violation of the rule (i.e. the duck appearing in the wrong location based on the pattern of shapes) would be a novel occurrence to the subject, and therefore should elicit a longer looking time.

Investigating Multiple Rule Learning with a Blicket-Detector Paradigm

The second experiment utilized a strategy that was inspired by the "Blicket-Detector" paradigm, which has been extensively used to study causal reasoning in toddlers and preschoolers (see Sobel & Kirkham, 2007 for a series of examples). The more interactive nature of this paradigm allowed us to test older children, whose increased linguistic experience and cognitive abilities may allow them to learn multiple rules despite being raised in monolingual homes. In typical Blicket-Detector studies, participants are shown that certain combinations of elements (i.e. two objects of the same kind) cause the Blicket-Detector (a novel machine) to play music. At test, participants are asked to pick, from a series of presented options, which would also make the machine play music.

In the present experiment, the Blicket-Detector machine was referred to as a "Blicket Monster," with the goal of making it more enticing to the children. The Blicket Monster had a stand on top of it that his "food" (cards with patterns of colored rectangles on them) could be placed on. Only food consisting of certain patterns would cause the Blicket Monster to have a positive reaction. This paradigm is equally interactive in nature as traditional Blicket-Detector tasks. The rule learning trials demonstrated which patterns the Blicket Monster liked to eat, and which patterns it did not. The children were then tested on whether or not they had learned the rule, by getting the chance to choose which of two sets of patterns the Blicket Monster would like. After testing the first rule, a second rule was introduced through similar rule learning trials and then tested.

Research Questions

To summarize, a number of research questions are addressed in the experiments described here. We were interested in determining children's ability to learn and retain rules. First, we investigated young children's ability to learn and retain a single rule using the eye tracking experiment. This was the first part in what is planned to become a two-part study. After determining whether the paradigm developed for this study works with a single rule, a future experiment will add a second rule to determine young children's performance when presented with multiple rules. Next, we investigated children's ability to learn and retain multiple rules through their performance on the Blicket Detector task.

Hypotheses

Our expectations for the results of both experiments are included in the following hypotheses. For the first experiment, it was hypothesized that children between 18 and 22 months old would look at a violation of a rule longer than a non-violation, showing that they have learned and retained a single rule. This prediction is based on past research that has indicated the presence of causal reasoning abilities in infants as young as eight months old (Sobel & Kirkham, 2006). For the second experiment, it was hypothesized that children between the ages of 34 and 42 months old would demonstrate the ability to learn and retain two rules by consistently choosing the correct pattern. We expected children at this age to succeed in this task if causal reasoning abilities should have emerged in infancy.

CHAPTER 2

EXPERIMENT 1

Method

Participants: Participants included 15 children of Caucasian descent between the ages of 18 months and 22 months. The average age of participants was 19.5 months. The average age was calculated using age in months, disregarding days (i.e. a child that was 18 months and 20 days old was considered 18 months). Of the 15 participants, 8 were male. The children were recruited through the FIRSt Families Database, a university-wide research database for child and infant participants that is made available to researchers at the Pennsylvania State University and is funded by the Child Study Center and the Social Science Research Institute.

Materials and Procedures: The experiment took place in a soundproof room. The child was told that he/she would be watching some movies on the television screen and was buckled into a car seat which was attached to a chair. The use of the car seat helped to keep the child from moving too much, as eye tracking technology is very sensitive and requires the child to remain as much in the same position as possible. A sticker was placed on the child's head, which the eye tracking technology used to keep track of the location of the child's eye. A fun, distracting sticker was also given to the child to prevent the child from playing with or removing the sticker on his or her head. A bobby pin was provided to pin the hair out of the child's face as needed. The child's parent was directed to stand or sit in a chair behind the child. The parent was instructed to not direct the child's attention in any way, as we were able to gain data even when the child was looking away from the screen, but that it was fine to reassure the child that mom/dad was still there if the child started looking for or reaching for the parent. Once the child and parent were situated in the booth, the experimenter set up the eye tracking equipment, calibrated it, and then began the video.

The video consisted of patterns of shapes and a duck that had an accompanying sound. First, twelve trials were presented to teach the child the rule. Six of the trials were rules, six were non-rules, and they were presented in a randomized order. The rule was that when the pattern, (ABA or ABB, counterbalanced across participants), represented by shapes, appeared, the duck would appear in a certain location on the screen (left or right, counterbalanced across participants). When a different pattern was presented, the duck would appear in a different location (center of the screen).

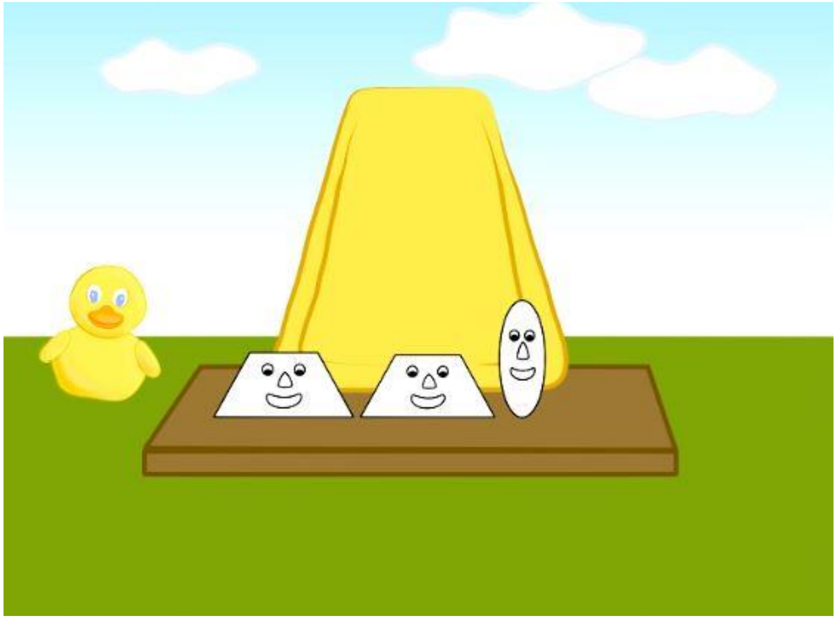

Figure 1: Still Image of Video from Experiment 1

After the rule learning trials, the test trials began. There were eight test trials, four of which tested learning of the rule and four of which tested learning of the non-rule. During each test trial, participants saw two videos presented side by side, one with the duck appearing in the correct location, and one with the duck appearing in the incorrect location (center for rule trials, right or left for non-rule trials). See Figure 1 for a still image of the duck appearing on the left side of the screen with an AAB pattern of shapes. As the patterns were presented and the duck appeared, the eye tracker tracked where the child was looking. This allowed us to see whether or not the child looked at the duck that appeared in the incorrect location longer, as this would be a violation of the rule that the child had just learned. A video camera, which was part of the eye tracker, recorded the participant's face so that experimenters could later code the eye movements.

Results

Whether or not the child was considered to have learned the rule was determined by whether or not he/she looked at the duck in the new location for a longer amount of time. The duck appearing in a new location would have been a violation of the rule and we expect children to look longer at novel stimuli (i.e. the duck in a new location) than at familiar stimuli (i.e. the duck in the expected location), based on evidence from previous literature (Franz, 1964). For the purpose of data analysis, the familiar stimulus is referred to as the “consistent video,” since it showed the location of the duck as being consistent with the rule that was taught to the child, and to the novel stimulus as the “inconsistent video,” since it showed the location of the duck as being inconsistent with the rule that was taught.

Descriptive statistics show that the mean looking time to the consistent video was 12784.67 ms (sd = 5476.77 ms) and the mean looking time to the inconsistent video was 13111.33 ms (sd = 3071.83 ms). While it appears that the participants looked longer at the consistent video, this was not statistically significant. We created a difference score to establish each participants’ looking preference by subtracting their looking time to the consistent video from their looking time to the inconsistent video. Using this difference score, a regression was done to determine whether age and condition predicted participants’ preference in looking time. The model was not significant: $F(2,13) = 2.716$, $p=0.106$. However, there was a marginal effect of age on looking time preference, $t(14) = -2.12$, $p=0.055$. A correlation shows that as age increases, participants were more likely to exhibit a preference for the consistent video.

Discussion

The results of the data analysis indicate that the subjects did not learn the rule, since overall they did not look longer at the violation of the rule. This is not consistent with the hypothesis. Based on previous studies, children can develop causal reasoning skills within the first 8 months of age (Sobel & Kirkham, 2006). With this information, we had expected the 18 to 22 month old children in the present study to successfully demonstrate these skills. One possible reason for the unexpected outcome of this study could be the differences in paradigms used to study causal reasoning skills between this experiment and past experiments. In the study mentioned (Sobel & Kirkham, 2006) the infants inferred the spatial location of an event based on exposure trials that taught them that stimulus items either had to be displayed together to cause an outcome in a certain location, or that stimulus items could occur together or separately to cause an outcome in a certain location.

While the present experiment similarly required subjects to make inferences about the location of an event based on the stimuli, it differed in terms of the nature of relation between stimuli. The amount of stimulus items presented was consistent throughout all trials. Instead of making inferences based on the number of items, subjects were to make inferences based on patterns of shapes. Perhaps this made the activity more difficult because the children were too young to understand the concept of patterns. Providing the same amount of stimulus items at all times may have made the similarities and differences in features of the items less obvious to the subjects.

As previously mentioned, this experiment is planned to be expanded to include a second rule. Based on these results, it would not make sense to move forward with this. If the children are not demonstrating the ability to learn a single rule, we would not expect them to be able to learn and retain multiple rules. One way to adapt this experiment for future research could be to change the pattern element of the stimulus items. Different shapes could still be used, but it might be more effective to use only two items rather than three, which would cause the relationship between them to be “same” or “different,” depending on which two items were presented.

CHAPTER 3

EXPERIMENT 2 (PILOT)

Methods

Participants: Participants included 10 children of Caucasian descent between the ages of 34 months and 42 months. Children were recruited through the same list of families that was used in Experiment 1. Of the 10 participants, one child was excluded due to differences in the presentation of test trials by the experimenter. Of the 9 subjects that completed the study, the average age was 38.2 months. The average age was calculated using age in months, disregarding days (i.e. a child that was 36 months and 18 days old was considered 36 months). 6 subjects were male.

Materials and Procedures: The materials used in this experiment included two “Blicket Monsters” as well as cards with patterns on them. The Blicket Monsters were made out of a small cardboard box that was covered in colorful wrapping paper. The front of the box was cut to show a Bluetooth speaker that lit up and played sound effects. On the top of the box, there was a metal stand for the pattern cards to be displayed on. Behind the box and out of the subject’s sight, a cell phone was used to control the sound effects of the speaker. The pattern cards were white strips of paper that had patterns made from colored paper cut into rectangles on them. See Figure 2 for an image of a Blicket Monster with a pattern card on top.

Figure 2: Blicket Monster Used in Experiment 2

The experiment took place in a soundproof room and was recorded with a video camera. The child sat at a table across from the experimenter and the Blicket Monster was on the table. The experimenter provided the following explanation: “This is a Blicket Monster and he is hungry so we’re going to feed him. There are certain things that he likes to eat, and certain things he doesn’t like to eat.” The experimenter then showed the child eight learning trials by placing one pattern card on the Blicket Monster at a time. The Blicket Monster made a happy sound if the pattern agreed with the rule (i.e. ABAB), or an unhappy sound if the pattern disagreed with the rule (i.e. ABBB). The sounds were controlled by the experimenter using a cell phone connected to the machine that was out of sight from the participants' point of view.

After eight trials, the child was tested on whether or not he/she learned the rule. At test, the experimenter said, "Now you can help me feed the monster. I'll give you two choices, and you can pick which one you think the monster will like." The experimenter presented two pattern cards at once, one with a correct pattern and one with an incorrect pattern (the side the correct pattern occurred on was counterbalanced across trials). The child made a choice, and the monster produced the happy or unhappy sound effect based on what the child chose. The child was tested four times.

If the child did not choose correctly at least three out of four times on the first monster, the experimenter provided another round of exposure (eight learning trials) and then four more test trials using the same rule. If the child then chose correctly at least three out of four times, the second monster was introduced to teach a second rule. If the child did not choose correctly at least three out of four times, the second monster was not introduced and the experiment was complete.

If the second monster was introduced, the experiment was repeated with a new rule (a different pattern, ABBA) and the child was taught that this monster preferred to eat different things than the first monster. The second monster was designed the same as the first, aside from different colored wrapping paper and different happy and unhappy sound effects. The child was again exposed to eight learning trials and then completed four test trials. If the child chose correctly three out of four times, the experiment was concluded. If not, the child was given another round of exposure and tested again, and then the experiment was complete.

Results

Rule 1: A t-test was done to determine whether the subjects performed above chance when learning the first rule. The test showed a mean of 2.00 out of 4 trials (sd = 0.87), which is not significantly different from chance: t(8) = 0, p= 1. An analysis to determine whether age in months predicted accuracy showed that R^2 = 0.4%, meaning that age did not account for a significant portion of the variance in the data, and did not predict accuracy, F(1,8) = .026, p=.88.

Rule 2: As participants were only advanced to the second rule if they had learned the first rule (operationalized as a minimum accuracy of 3 out of 4), only two subjects completed the second rule portion of the test. Due to the small number of participants in this group, there were not enough data points to complete an analysis. Descriptive statistics on this data show that these two subjects made accurate choices at an average of 2.50 (sd = 0.71), with one child choosing correctly 3 out of 4 times and the other choosing correctly 2 out of 4 times.

Discussion

The results of the data analyses indicate that the majority of children did not succeed at learning a single rule, as performance was not above chance level. Of the two children who received exposure to a second rule, only one learned the rule (chose accurately three out of four times). Based on their performance on the first rule, the other subjects likely would not have successfully learned the second rule, had they received exposure to it. These results are inconsistent with our hypothesis, as we had expected children at this age level to be able to successfully learn and retain multiple rules.

The fact that this experiment is still in the piloting stage is one explanation for this outcome. The materials and procedures need to be improved to elicit more accurate results. Subjects often became distracted by their parents or the environment during the experiment. Some children noticed that the experimenter was controlling the sound effects of the Blicket Monster and became distracted by that. These distractions likely affected performance on the task because children were inattentive to the exposure trials during which the rule was being taught, and this could be a reason that they did not grasp which patterns the Blicket Monster "liked" and "disliked." Others became bored with the activity and did not wish to continue, and therefore did not complete the second half of the experiment in which the second rule would have been taught and tested. This contributed to the lack of data on performance on the second rule.

Adaptations to the materials and procedures could improve the performance outcomes and increase the number of subjects that complete the full experiment. The Blicket Monsters should be improved in appearance in such a way that they would be more interesting to the children. One way of doing this could be to add facial features to make them look more like monsters and less like a decorated box. Another way to do this could be to convert this task to an activity that utilizes technology, such as the creation of a Blicket Monster iPad game, as children would likely be more interested in playing an iPad game. Additionally, a better strategy of operating the sound effects should be implemented to prevent the children from suspecting that the experimenter is controlling the Blicket Monster. This issue would also be eliminated by the creation of an iPad game, as the device would be programmed to produce the sound effects. This would also eliminate the possibility of experimenter error in terms of accidentally pressing the button for the incorrect sound effect and would increase consistency in the execution of the experiment as it would prevent the possibility of the experimenter straying from the script.

Aside from issues with the design of the experiment, another possible explanation for the outcome of this experiment was found in a series of studies by Walker, Bridgers, and Gopnik (2016) which investigated the trajectory of performance on abstract relational reasoning (i.e., making choices based on the relationships between items). These studies involved learning rules based on the concepts of "same" and "different." In the first experiment, children with ages ranging from 18 months old to 36 months old were exposed to four pairs of painted wooden blocks, two of which were the same and two of which were different, being placed on top of a box that played music depending on which blocks were used. Children in one condition were taught that two blocks of the same shape and color would cause the machine to play music, and children in the other condition were taught that two blocks of different shape and color would cause the machine to play music. In the test phase, the children were given a choice between two novel pairs (one same and one different) and were asked to point to the pair that would make the machine play music. The experiments that followed were adaptations of these methods.

Results of the experiments showed a U-shaped curve in performance on abstract relational reasoning tasks as subject age increased (assuming adults would succeed on such tasks). Subjects between the ages of 18 and 30 months old demonstrated the ability to learn relational concepts, while subjects between the ages of 36 and 48 months old demonstrated difficulty with such concepts. The researchers suggested that this decline in performance may be due to the older subjects considering the causal effects of individual objects, rather than paying attention to the relations between multiple objects.

The subjects in the present study (aged 34 months to 42 months) mostly fall into the age category that demonstrated difficulty with relational concepts. Perhaps the lack of success that was demonstrated by these subjects could be explained by a preference for attending to causal effects of individual pieces of the pattern cards (i.e. thinking pink rectangles cause the monster to react positively) rather than paying attention to the relations between the elements on the pattern cards (i.e. pink + purple + pink + purple = a pattern). Future adaptations of the study could attempt to control for this by providing stimuli that make the relation between objects more explicit to the children.

CHAPTER 4

GENERAL DISCUSSION

Overall, the findings of the current research did not confirm the hypotheses. There are a number of reasons that could explain these results. In Experiment 1, the unexpected results may have been due to the complexity of the relationship between stimulus items. In Experiment 2, the results may have been due to the subjects' lack of interest in the activity, flaws in the design of the Blicket Monsters, and experimenter error. It could also have been due to the U-shaped trajectory of performance on such tasks that was described by Walker, Bridgers, and Gopnik (2016).

In both cases, the experiments should not be advanced to the next level until these issues are addressed. Experiment 1 needs to be improved, possibly by adapting the stimulus items, and then executed again with a single rule. If an improved version of the experiment yields results consistent with the hypothesis, then a second rule could be added to the experiment in order to test rule learning abilities in this age group in terms of learning multiple rules, which would be helpful in determining how early on in childhood the ability to learn and retain multiple rules emerges.

Experiment 2 needs to be adapted to better attract the interest of subjects. With an activity that subjects are attentive to, it is easier to rule out the possibility of boredom as a reason for the children not learning the rule. If an improved version results in subjects completing the experiment and performing at a level that is consistent with the hypothesis, the experiment could be expanded to include bilingual language learners in the same age group. This would allow us to compare and contrast the abilities of monolingual and bilingual language learners on rule learning tasks.

While the results of both experiments were not consistent with the respective hypotheses, it should not be concluded that the children in these age groups are unable to learn and retain single and/or multiple rules, as experimental design could have affected outcomes, especially in regards to Experiment 2. Future research should take into consideration the suggestions mentioned above. A sounder version of each experiment is necessary to confirm or deny the accuracy of the current findings.

Another interesting direction for future research would be to further investigate the U-shaped curve in performance of abstract relational reasoning concepts based on age, which could have played a role in the results of Experiment 2 (Walker, Bridgers, & Gopnik, 2016). It would be interesting to get a deeper look into the performance of the 36 to 48 month age group and to investigate the reasoning between this variation in performance on this type of task. It is possible that there could be other explanations in addition to the one offered by the researchers. It would also be beneficial to further investigate this U-shaped curve in terms of determining the age at which performance begins to rise again, as this was not included in the previous studies. This research would contribute to our understanding of how and when children begin to develop and properly utilize causal reasoning skills.

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ACADEMIC VITA

Academic Vita of Melina Pinamonti
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Education

The Pennsylvania State University
Schreyer Honors College

- Bachelor of Science Communication Sciences and Disorders: May 2018
- Minor: History
- Certificate: Holocaust and Genocide Studies
- Honors: Communication Sciences and Disorders

Acknowledgements & Awards

- Dean's List: 7 Semesters (2014-2018)
- Riegel Gamily Trustee Scholarship (2017)
- Schreyer International Study Scholarship (2017)
- Juanita M. and Tony Decillis Scholarship (2014-2015)
- State College Women's Club Centennial Scholarship (2014)

Research Experience

Child Language and Cognition Lab at Penn State
(Fall 2016-Present)
Supervisor: Daniel Weiss

Honors Thesis: Language-Related Rule Learning in Monolingual Children
Thesis Supervisor: Carol Miller

- Investigated toddler's abilities to learn rules in relation to language acquisition
- Synthesized study findings and literature to compose thesis
- Learned to be flexible in the face of challenges

Research Assistant

- Ran experiments with participants ranging from children to adults to investigate language acquisition
- Met with colleagues weekly to discuss relevant literature

Coping and Regulation of Environmental Stress (CaRES) Lab at Penn State
(Summer 2015-Summer 2016)
Supervisor: Martha Wadsworth

Research Assistant

- Assisted with experiments focused on stress from low socioeconomic backgrounds
- Synthesized findings into a poster to present at a research exhibition
- Entered data into SPSS (Statistical Package for the Social Science) software

Presentations

Gender and Age Differences in Self-Reported Coping Styles of Children and Adolescents Facing Poverty-Related Stress
Vicentini, A., Harder, D., Pinamonti, M.
April 6th, 2016

- Presented research poster to peers and judges at the Penn State Undergraduate Exhibition

Relevant Experience

Communication Sciences and Disorders Study Abroad Program
Michigan State University
Summer 2017

- Engaged in discussions and observations with speech-language therapists and audiologists in England & Scotland
- Gained exposure to multiple field sites including hospitals, schools, and therapy groups
- Formed comparisons between health care in the UK and the US as it applies to speech-language-hearing services

Observation of Speech-Language Therapy (25 Hours)

- Penn State Speech, Language, and Hearing Clinic
- Park Forest Middle School
- Centre Crest Nursing Home

Volunteer Experience

Schlow Centre Region Library Literacy Events

- Conducted art activities with children at the local library

Hearthside Rehabilitation and Nursing Center

- Participated in activities with residents including nail painting and word listing games

Centre County PAWS

- Cared for dogs in local animal shelter

Leadership & Activities

Best Buddies (Spring 2015-Present)
THON Family Relations Chair 2016/THON Chair 2017

- Oversaw the organization's involvement in THON, the Penn State Dance Marathon which raises money for the fight against pediatric cancer
- Maintained a positive relationship with the organization's THON family, a family affected by pediatric cancer that is paired specifically with the Best Buddies organization
- Coordinated ideas with other executive members to organize club meetings and activities

- Fostered one-on-one friendships with individuals in the community with disabilities

National Student Speech Language Hearing Association (Fall 2015-Spring 2017)
Active Member

- Gained exposure to experienced professionals in the field of Communication Sciences & Disorders
- Participated in various community service activities
- Attended the 2016 American Speech-Language-Hearing Association (ASHA) Convention in Philadelphia, PA

The Dear Hero Program (Spring 2016-Present)
Fundraising Chair 2016/2017

- Organized fundraisers to benefit active service members and veterans

Ohana (Fall 2014-Present)
Active Member

- Raised money to support children and families affected by pediatric cancer
- Developed meaningful relationships with the children and families to provide emotional support

Work Experience

Baby's Burgers & Shakes (Spring 2016-Present)
Soda Jerk

- Prepared drinks, milkshakes, and desserts for customers

Kelly's Steak & Seafood (Fall 2012-Summer 2017)
Busser/Server

- Cleaned and set tables and assisted servers
- Served food and drinks to customers