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Rapid Assessment of Problem Solving for Kids (RAPS-K)

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RAPID ASSESSMENT OF PROBLEM SOLVING FOR KIDS (RAPS-K)

A Capstone Experience Project
Presented in Partial Fulfillment of the Requirements for
the Degree Bachelor of Science with
Honors College Graduate Distinction at Western Kentucky University

By
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ABSTRACT

The Rapid Assessment of Problem Solving (RAPS) is a clinical assessment of verbal problem solving skills created by Dr. Robert Marshall and colleagues (Marshall, 2003). The assessment, originally developed for adults, is based on the well-known twenty questions game. The clinician administering the assessment chooses a target picture and the participant asks yes or no questions to eliminate incorrect answers and, eventually, identify the target picture. Question asking efficiency, indicated by the number of choices eliminated, is considered to reflect levels of cognitive functioning, specifically problem solving.

Recently, the RAPS has been utilized with typically developing children and children with autism (Smith, 2015; Jones, 2018). Based on the results of these studies, two limitations emerged related to picture recognition and integration of information. Picture recognition refers to a child's ability to correctly identify a picture by name whereas integration of information is the ability to process all items on the picture board at once. This capstone project aims to directly address these limitations by developing a child-focused version of this assessment.

It is hoped that creating a children's version of the RAPS (RAPS-K) will address the limitations found in the original RAPS and, once piloted, set a normative baseline for future research. Additionally, the RAPS-K is intended to provide an accurate tool for

evaluating problem solving in not only typically developing children, but eventually in children with special needs such as autism spectrum disorder.

Keywords: problem-solving, children, autism, assessment, RAPS, CSD

I dedicate this thesis to my loving family and friends who have supported every crazy endeavor on which I have ever embarked.

And to my dog, Oakley, for the many late nights he stayed by my side and helped me grind this bad boy out.

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CHAPTER 1

INTRODUCTION

Every individual will have to problem solve in his or her life. It is inevitable that situations will arise with problems that must be solved. Consequently, it can be concluded that problem solving is crucial in all areas of life. Some of these most notable areas are the social, academic, and daily functioning realms of life. Neurotypical adults, those with normal cognitive abilities, often underestimate the importance of their ability to problem solve. However, those with deficits in this area understand an inability to efficiently solve problems has serious implications in all aspects of life.

The Rapid Assessment of Problem Solving for Kids (RAPS-K) is a concept that evolved from an already-existing assessment, the Rapid Assessment of Problem Solving (RAPS), created by Dr. Marshall and colleagues to be used with those with brain injuries and other cognitive differences (Marshall & Capilouto, 2007). The original RAPS contains nine problem solving boards with 32 pictures of common objects on each board. During administration, participants were instructed to formulate and ask yes or no questions to determine the target picture (Marshall & Karow, 2008).

Aside from the RAPS, there are a few other available measures of problem solving intended for children, most notably the Raven's Progressive Matrices Test (Raven, Raven, & Court, 1983), but they are not necessarily desirable for the target

populations (Smith, 2015). The Ravens is designed to test general cognitive ability specifically in the areas of non-verbal, abstract, and cognitive functioning (problem solving) through a series of geometric matrices. However, it has a longer administration time. The RAPS, on the other hand, has the potential to accurately assess problem solving in children with autism spectrum disorder (ASD) due to its shorter administration time; (Jones, 2018). However, several limitations such as limited picture recognition and difficulties with integrating large amounts of information have been identified when administering the original RAPS to this population. The RAPS would be better suited for the target populations with a few modifications such as adapted child-focused pictures and smaller amounts of information to be integrated. For populations with an ASD diagnosis, other assessments, such as the Raven's Progressive Matrices test, take too long and are not motivating enough to keep the participant engaged. The RAPS-K needs to be appealing in order to hold attention, be highly motivating by default, and have a quick administration time frame.

While the original RAPS is an accurate indicator of problem solving skills in adults, it lacks appeal to children leading to the limitations outlined above. That being said, accommodating for the limitations found when using the original RAPS on children will allow for the most accurate problem solving assessment in children.

CHAPTER 2

LITERATURE REVIEW

Marshall and Karow recognized that deficits in executive functioning, particularly in the area of problem solving, were common consequences of a brain injury. Consequently, assessments of problem solving could be too complex, over stimulating, or simply take too long to administer for those with brain injury. Marshall and Karow defined three parameters to be considered when selecting a clinical measure. First, the assessment needs to have easy-to-understand instructions to minimize confusion based on comprehension of the task itself. Second, the assessment needs to be motivating and able to sustain attention. Lastly, the assessment needs to have a short administration time to offset the effects of increased cognitive fatigue exhibited by individuals with traumatic brain injury (2003).

As a result, the original RAPS (Marshall and Karow, 2003) was based on Mosher and Hornsby's Twenty Question Test (20Q) in which a participant asks yes or no questions to identify a target picture with the goal being to ask as few questions as possible. (Mosher & Hornsby, 1966). The original RAPS is comprised of nine problem solving boards. Each board contains 32 pictures, consisting of one category of eight, two categories of six, and three categories of four. Half of the pictures on the boards are in color and the other half are in black and white. The colored pictures cannot touch each other adjacently on the boards and the same goes

for the black and white pictures. Pictures within the same category can also not touch each other adjacently on the boards. The clinician chooses a target picture and the participant asks questions that can be answered yes or no to determine which picture was chosen. Scoring is based on the number and type of questions asked as well as how strategic the participant is in eliminating non-targeted pictures. Marshall focused on three types of questions and explains them in the context of the clinician hypothetically choosing the piano picture:

1. Constraint-seeking (CS) questions (i.e. “Is it a musical instrument?”)
2. Hypothesis-scanning (HS) questions (i.e. “Is it the piano?”)
3. Pseudoconstraint (PS) questions (i.e. “Is it something with black and white keys?”)

CS questions eliminate more than one picture regardless of a yes or no answer, where as HS and PS questions only eliminate one picture at a time. CS questions indicate more strategic thinking. Individuals who consistently ask CS questions earn a higher question-asking efficiency score because they eliminate more pictures per question than others (2003). Marshall and Karow determined that younger adults performed better on the RAPS than older adults. It was concluded the RAPS is accurate in its assessment of problem solving skills and suggested that the RAPS is less stressful than other assessments for participants because of its game-like format and brevity (Marshall &

Karow, 2008). These findings indicated significant reason to be confident in the RAPS and the authors released the RAPS to the public domain as a result.

In 2015, Smith recognized a need for an assessment of problem-solving like the RAPS for children. For this study, the RAPS was administered to 73 typically developing young children between the ages of 7 and 9, 79 typically developing early adolescents between the ages of 10 and 13, and 77 adolescents between the ages of 14 and 17. Problem solving abilities were classified by types of questions asked and in what order they were asked by participants. Results showed differences between the group of young children compared to the early adolescent and the adolescent groups. The two older groups asked more effective questions whereas the younger group tended to guess more. This difference was considered to be due to younger children's inability to integrate and organize the larger amounts of information needed to effectively solve the RAPS.

The RAPS was originally used to test problem solving skills in those with brain injuries where deficits in executive functioning often result. Deficits in executive functioning are also one of the most common markers of those with autism. Therefore, it is intended that this assessment could also be used with those with autism. However, before assessing children with autism, neurotypical children must be assessed in order to provide a baseline that can serve as a comparison to the population of those with autism to be assessed in the future. Jones (2018) used the RAPS to assess problem solving in

typically developing children and children with autism. Twenty-seven children (12 with autism spectrum disorder and 15 neurotypical) between the ages of 10 years and 17 years 11 months were assessed.

Results revealed differences in scores between children with autism and neurotypical children were present indicating the two populations solve problems differently. The results also confirmed that the original RAPS had two known limitations when used on pediatric participants. First, children (under 7 years) expressed limited picture recognition and, second, they had difficulty integrating information on 32-item boards. It was concluded children could benefit from a RAPS assessment and protocol that more accurately reflects vocabulary and abilities expected in childhood.

Since this assessment methodology is proven to have limitations when used with child populations, a child's level of problem solving skills and executive functioning could be skewed. The previous research expanded the normative database and provided the foundation for the RAPS to include children with autism based on the standard assessment. Their results showed that those with autism performed lower than participants without autism. This is a prompt to continue the research with a children's version of the assessment because these results cannot be considered an accurate measure unless children have a fair chance at performing well without limitations present. Future

research will create the database for the new version of the assessment that is tailored to the cognitive abilities of a child.

This project directly aims to address the limitations found with the original RAPS when used on child populations. This was accomplished by the creation of smaller assessment board with new child-focused pictures. Development of the new pictures used on the RAPS-K assessment boards made the assessment more appropriate for a child's cognitive abilities and vocabulary and, as determined through this research, will allow for a more accurate assessment of abstract thought and their verbal problem solving skills. To address the limitations younger children have, leveled boards were created. This may allow the developmental span of problem solving for younger children to be investigated.

CHAPTER 3

PROCESS

Test Development

An outcome of Jones' (2018) research was the identified need to adapt the RAPS for children younger than ten years of age. That need was met by a student artist who created pictures for the assessment boards after a comprehensive list was created that entailed the vocabulary categories and target items within each category to be featured on the problem solving boards. One hundred twenty eight pictures were needed to accommodate the number of boards at each level for this assessment. The list was comprised of ten categories of eight items and eight categories of six items (see Figure 1.1 and Figure 1.2).

Two copies of each picture were printed, one in black and white and one in color, ensuring pictures could be used on the boards in either variation. Therefore, a total of 256 pictures (128 color and 128 black and white) needed picture recognition validation. These pictures were separated into two decks of picture cards so each participant was only administered a 128 item picture recognition test. Thirty-five college students in the Communication Sciences and Disorders (CSD) major evaluated all pictures for preliminary analysis of content validity. These students examined the pictures individually for recognition and then administered the picture recognition task to typically developing children. Forty-seven children between the ages of 5:0 and 9:11

participated. Data was collected regarding each child's ability to correctly identify the target pictures in both black and white and in color.

Based on the data, it was determined all pictures were recognized by the majority of typically developing children who were assessed. This process allowed necessary adjustments to be made. One category of six grew into a category of eight in order to have an adequate number of pictures to create twelve assessment boards. The artist was contacted to produce two more pictures for the "On the Beach" category. The two new pictures within the "On the Beach" category were "floaties" and "goggles."

Overall, only 63 incorrect answers were deemed significant out of 6,016 total given answers. Twenty incorrect answers were given for the following color pictures: harmonica (eight children incorrectly identified) and guinea pig (12 children incorrectly identified). Forty-three incorrect answers were given for the following black and white pictures: bean bag (15 children incorrectly identified), salad (13 children incorrectly identified), and guinea pig (15 children incorrectly identified). As expected, the black and white pictures were more difficult to recognize because the color of the item makes it more identifiable. Incorrect answers represented only 1% of the answers and a decision was made to keep the pictures in question. However, to limit confusion and to be mindful of children who may struggle with the pictures in the future, those pictures were only used on the 32-item boards (when possible) where they were necessary.

The original RAPS is comprised of nine problem solving boards with 32 pictures of common objects on each board. Yet, one identified limitation was that children struggled to integrate all of the information presented on a 32-item board (Jones, 2018). To adjust for this, three levels of problem solving boards were developed for the RAPS-K using the new pictures. These pictures were deemed age-appropriate and ecologically relevant for children through review by adult English language speakers and the picture recognition task. Therefore, the RAPS-K is comprised of four 32-item boards (see Figure 2.1), four 24-item boards (see Figure 2.2), and four 12-item boards (see Figure 2.3). For each level, two boards are deemed an "easy" level, one board a "medium" level, and one board a "hard" level of difficulty.

The original RAPS boards were developed following specific guidelines. First, pictures in the same category cannot touch on the top, bottom, left, or right. They can, however, touch diagonally at the corners. Pictures that are black and white cannot touch each other on the top, bottom, left, or right. However, they can touch corners. The same rule applies for color pictures. For all boards, half of the pictures on each board are in black and white and half are in color. Since there are four 32-item boards with 128 items total, each picture occurs one time on one of the four 32-item boards. For the 24-item and 12-item boards, every single picture was not needed to complete the boards.

The 32-item boards were comprised of one category of eight, two categories of six, and three categories of four. The 24-item boards were comprised of one category of eight, two categories of six, and one category of four. The 12-item boards were comprised of two categories of four and two categories of two. Categories of four and two were created by taking a section of the categories of eight or six.

Each board also has at least one new category of target pictures of STEAM (science, technology, engineering, art, and mathematics) vocabulary. The original RAPS did not focus on academic vocabulary as it was designed for adults well past school age. As children spend most of their day at school, they experience higher exposure to academic vocabulary. As such, these pictures provide opportunities for children to use this knowledge base during problem solving tasks.

Protocol

Overall, the instructions for the RAPS-K will match those of the original RAPS because it is written in child-friendly language. The original RAPS instructions were given only when the participant begins the first problem solving board unless directly requested again. The instructions are:

"We are going to play a question-asking game. I am thinking of one of these pictures. Your job is to figure out which picture it is by asking me questions I can answer with a yes or no. The goal is to do this with as few [the examiner emphasized the word few] questions as possible. When you are ready, go ahead and ask your first question" (Marshall, 2008, pg. 378).

The original RAPS protocol states the clinician cannot repeat the instructions unless specifically requested by the participant. Considering the RAPS-K is intended to be used with young children, this protocol will change so instructions are repeated at the beginning of each level or if the child asks or indicates, through behavior or nonverbal cues, a need for re-instruction. Behavior and nonverbal cues may be a look of confusion, silence, etc.

To begin administration of the RAPS-K, the clinician will select an "easy"-level, 12-item picture board and randomly choose a target picture. The participant will be given the instructions (above) to ask a series of questions to solve the problem board. The clinician will progress to more and more difficult boards as the participant solves the problems.

CHAPTER 4

PRODUCT

RAPS-K: 128 Stimulus Picture List

The complete product consists of the stimulus picture list and the twelve problem solving boards across three difficulty levels. Below is the list of the 128 pictures used on the RAPS-K assessment boards. There are ten categories of eight and eight categories of six. The following new STEAM vocabulary categories are electronics, transportation, musical instruments, medical equipment, plants, insects, and tools.

Figure 1.1: Categories of Eight

Zoo Animals	**Furniture**	**Sports Balls**
1. Hippopotamus	1. Bed	1. Volleyball
2. Tiger	2. Chair	2. Football
3. Penguin	3. Recliner	3. Tennis ball
4. Gorilla	4. Dresser	4. Basketball
5. Giraffe	5. Desk	5. Golf ball
6. Zebra	6. Bean bag	6. Baseball
7. Lion	7. Couch	7. Bowling ball
8. Elephant	8. Table	8. Soccer ball
Musical Instruments	**Food**	**Desserts**
1. Drum	1. Orange	1. Ice cream float
2. Violin	2. Hamburger	2. Popsicle
3. Saxophone	3. Salad	3. Banana split
4. Guitar	4. French fries	4. Ice cream
5. Piano	5. Hotdog	5. Cake
6. Trumpet	6. Baby carrots	6. Pie
7. Harmonica	7. Cooked eggs	7. Cupcake
8. Flute	8. Pizza	8. Cookie

Pets 1. Cat 2. Dog 3. Parrot 4. Rabbit 5. Potbelly pig 6. Horse 7. Guinea pic 8. Goldfish (in a bowl)	**Tools** 1. Shovel 2. Wrench 3. Screwdriver 4. Lawn mower 5. Rake 6. Axe 7. Hammer 8. Saw	**Clothing** 1. Scarf 2. Shoe 3. Shirt 4. Dress 5. Jacket 6. Pants 7. Socks 8. Bow tie
On the Beach 1. Bucket 2. Starfish 3. Sand castle 4. Shell 5. Waves 6. Beach umbrella 7. Floaties 8. Goggles		

Figure 1.2: Categories of Six

Plants 1. Grass 2. Flower 3. Bush/shrub 4. Oak tree 5. Palm tree 6. Evergreen	**Electronics** 1. TV 2. iPhone 3. Shuffle with earbuds 4. Laptop 5. Tablet 6. Game controller	**Accessories** 1. Necklace 2. Watch 3. Bracelet 4. Ring 5. Earrings 6. Glasses
Transportation 1. School bus 2. Plane 3. Sailboat 4. Passenger train 5. Truck 6. Car	**Toys** 1. Doll 2. Legos 3. Bubbles 4. Spinner 5. Puzzle 6. Hoverboard	**Insects** 1. Grasshopper 2. Ladybug 3. Bee 4. Cockroach 5. Ant 6. Spider

Body Parts	**Medical Equipment**	
1. Foot	1. Stethoscope	
2. Lips	2. Pill	
3. Ear	3. Band-Aid	
4. Hand	4. Shot	
5. Nose	5. Wheelchair	
6. Eye	6. Thermometer	

Figure 2.1: Below is an example of a 32-item board considered an "easy" level. It is comprised of 16 pictures in black and white and 16 pictures in color. The "Zoo Animals" category is the category of eight, "Electronics" and "Body Parts" are the categories of six, "Furniture," "Sports Balls," and "Clothing" are the categories of four. The STEAM category is "Electronics."

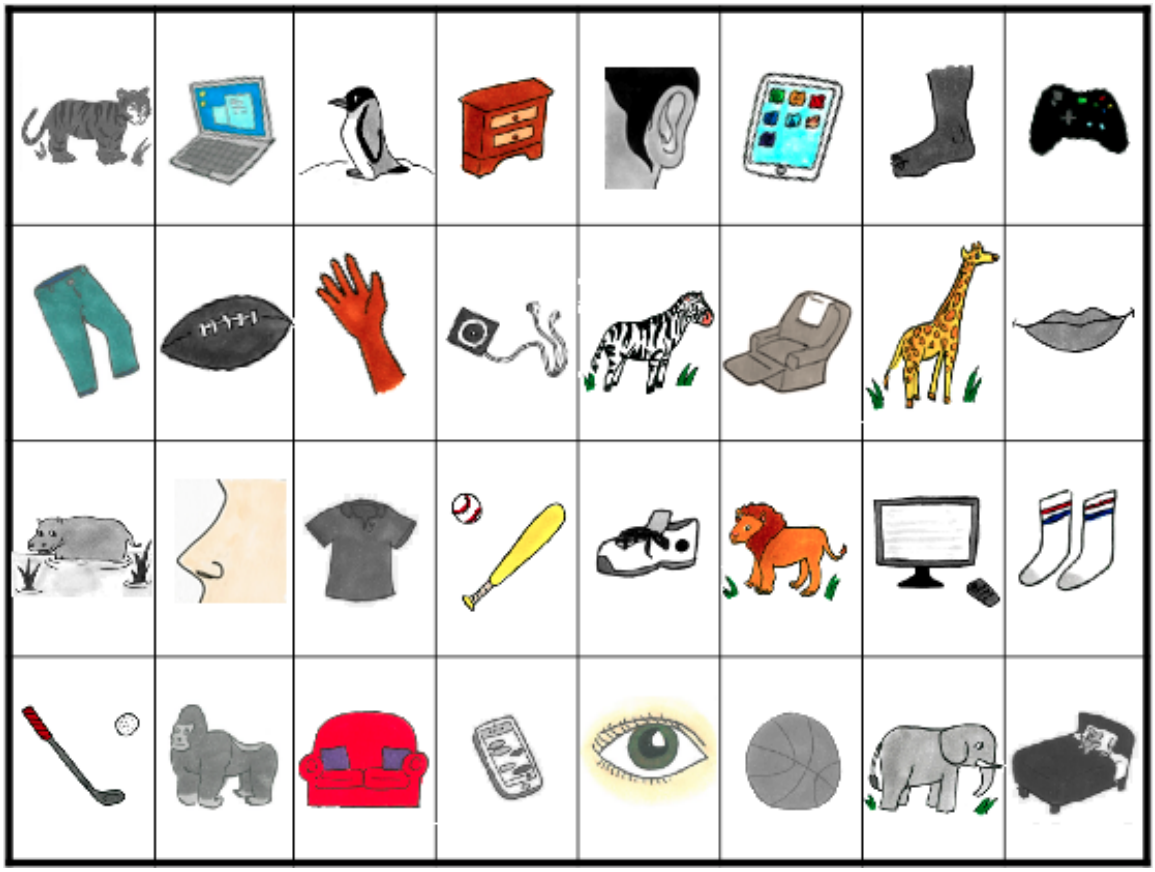


Figure 2.2: Below is an example of a 24-item board that was deemed “medium.” It is comprised of 12 pictures in black and white and 12 pictures in color. The “Pets” category is the category of eight, “Electronics” and “Accessories” are the categories of six, and “Musical Instruments” is the category of four. The STEAM categories are “Electronics” and “Musical Instruments.”

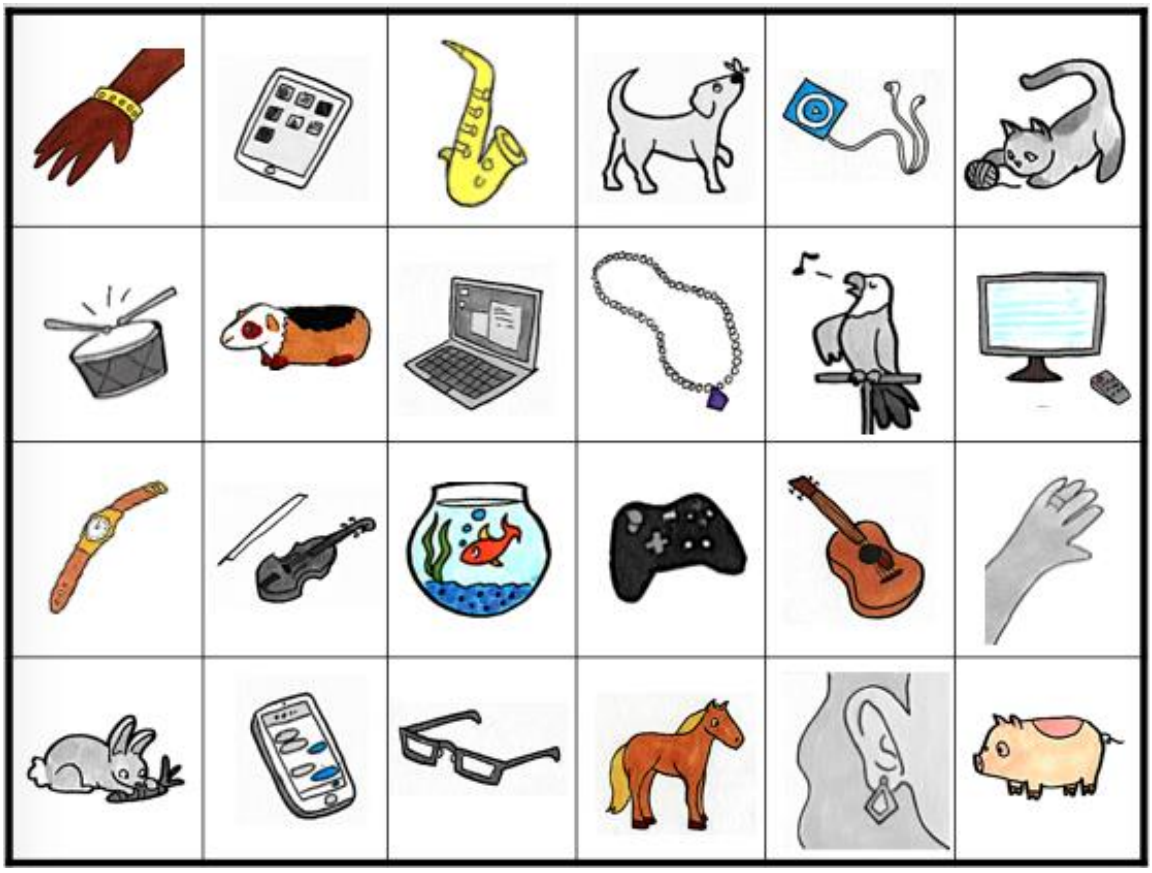
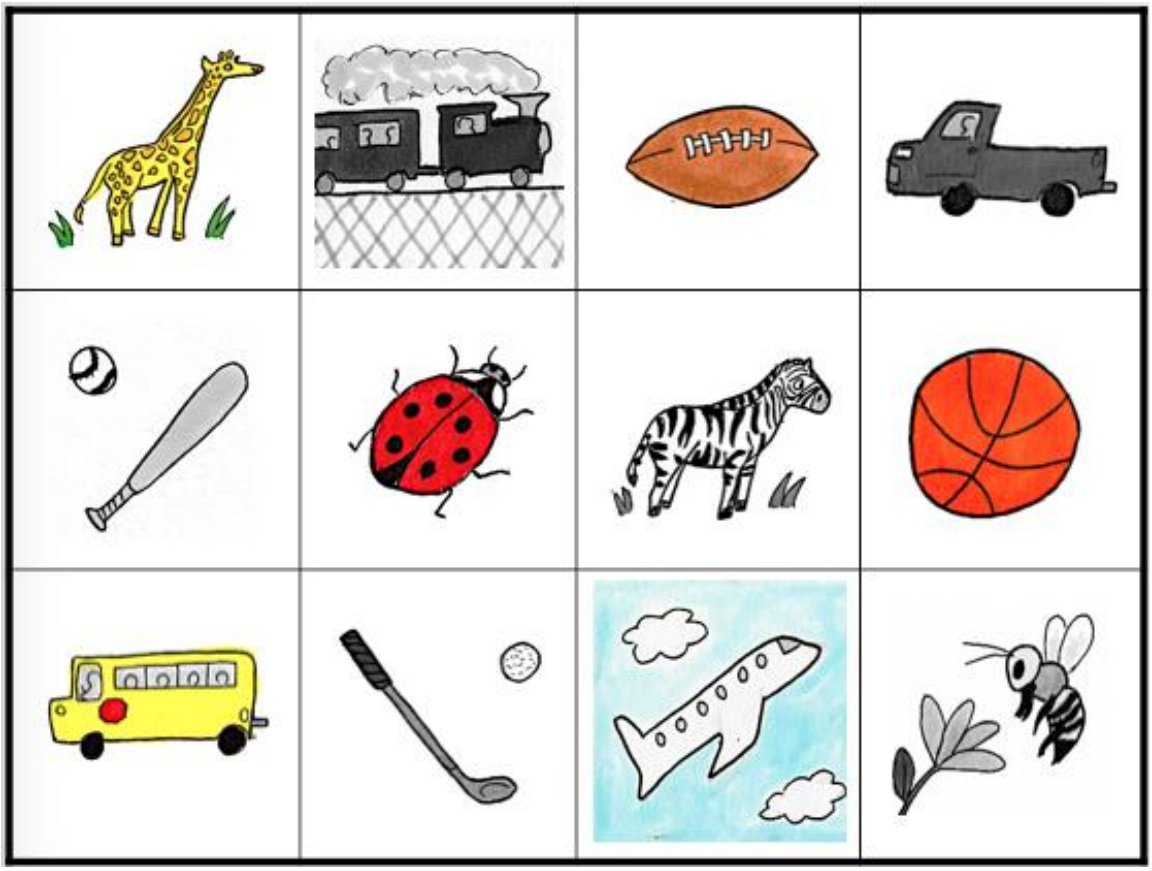


Figure 2.3: Below is an example of a 12-item board that was deemed “easy.” It is comprised of six pictures in black and white and six pictures in color. The “Sports Balls” category and the “Transportation” category are the categories of four; “Zoo Animals” category and the “Insects” category are the categories of two. The STEAM categories are “Transportation” and “Insects.”



CHAPTER 5

EXPECTED RESULTS AND SIGNIFICANCE

During administration of the RAPS using protocols designed for adults, limitations were discovered concerning children's correct identification of a variety of target pictures and ability to integrate large amounts of information. Additionally, a need was identified for age-appropriate and up-to-date picture representations from vocabulary expected to be known by children. Previous research with the RAPS used the standard assessment designed for adults with cognitive impairments on a population of children. The game board used was not "kid-friendly" and the pictures did not accurately represent objects children readily recognize.

Prior to this capstone project, there was no RAPS designed for children. This project adds a measure to the literature based on prior evidence. It will allow future researchers to more accurately investigate how children choose to integrate available information and use language strategically to solve problems. The pictures used on the RAPS-K are appropriate for a child's cognitive abilities and vocabulary in order to accurately evaluate their level of abstract thought and verbal problem solving skills.

Another limitation with the original RAPS was that younger children (under 7 years) were unable to effectively integrate larger amounts of information, such as on the 32-item board. Therefore, a need existed to create leveled boards so younger children might be presented with fewer pictures (a 12-item board) and have the opportunity to

progress to more complex boards such as the 24-item board and the 32-item board. This allows for investigation into the development of problem solving for these children.

The future steps of this project will involve piloting the RAPS-K on neurotypical children in order to create a normative baseline. Based on the findings from the pilot, the RAPS-K will be adjusted (if necessary). If no adjustments are needed, the study will continue with a pilot on populations of those with ASD.

CHAPTER 6

THE VALUE OF MY EXPERIENCE

While working to create an assessment of problem solving, I was able to harness and expand my own critical thinking and problem solving skills through this project. I had to learn to think quickly and efficiently when problems would arise in order to solve them. I learned about being the leader of a research team and coordinating other people. I was responsible for delegating tasks and ensuring they got completed in an efficient, effective way. Through this experience, I was able to create valuable relationships and connections with various faculty members and other student researchers such as Dr. Janice Smith and Dr. Leigh Anne Roden-Carrier. These people will grow to be my peers and my colleagues one day which will prove to be beneficial to me in my future academic, research, and career endeavors. I value these people deeply and will carry these relationships with me forward into my graduate studies at WKU and into my future professional career as a speech-language pathologist.

I presented my research in February at the Kentucky Speech-Language-Hearing Association Annual Convention. This was an incredible opportunity and allowed me to gain experience with presenting at a conference that will continue being important to me in my future career as a speech-language pathologist. At this conference, I was able to meet and speak with some of the nation's most well-known speech pathologists. Because of this experience, I will feel confident in my abilities to speak to them as a

colleague in the future. I also presented my project to an undergraduate class within the CSD major. Presenting to my peers is something I will continue to do throughout my career and this provided invaluable practice.

This project and the future research it will lead to is something I am determined to advance. Continuing this research with Dr. Smith was one of the biggest reasons I decided to pursue my graduate education at WKU as well. I am very excited to see where this project takes us in the coming two years.

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