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Using Contents and Containers to investigate problem solving strategies among toddlers

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USING CONTENTS AND CONTAINERS TO INVESTIGATE PROBLEM SOLVING STRATEGIES AMONG TODDLERS

An Abstract of a Dissertation

Submitted

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Education

Approved:

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ABSTRACT

This study focused on the use of problem-solving strategies among toddlers using a qualitative research approach, and more specifically the case-study research design. The following three research questions were investigated: (1) What behaviors do toddlers exhibit as they begin their exploration with Contents and Containers?; (2a) What intrapersonal differences, if any, do toddlers display in their problem-solving approaches with Contents and Containers materials over the ten-session period?; and (2b) What interpersonal differences, if any, do the three toddlers display in their problem-solving approaches with Contents and Containers materials over the ten-session period?

The participants of this study consisted of three toddlers ages 18, 21, and 23 months who attended a daycare center in a mid-size town in a Midwestern state. The toddlers interacted freely with Contents and Containers, which is an open-ended curriculum using commonly available materials including plastic containers of various sizes. The researcher analyzed existing data in the form of video recordings of the toddlers using materials twice each week for five weeks, yielding ten one-hour long sessions. The toddlers had been videotaped for a research project conducted by an early childhood center affiliated with a state university.

Findings from this study indicated that toddlers' problem-solving included a range of behaviors such as exploration, repetition, experimentation and finding solutions through strategies such as trial and error and means-ends analysis. Changes in problem-

solving strategy use, namely from trial and error to means-ends analysis were observed both within and between the toddlers over the ten-session period.

There were also themes that emerged from this study about problem solving including intentionality, competence, curiosity, perseverance, and reciprocal interaction between play and skills. Implications for parents, daycare providers and preschool teachers for fostering and supporting problem-solving thinking and behavior among toddlers are provided. Also, recommendations for future research directions to build upon and extend the findings of the present study are offered.

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CHAPTER 1

INTRODUCTION

As toddlers develop physically, socially, and emotionally, they are also making big strides in their ability to think and solve problems as well as communicate with those around them. Toddlers' inborn thirst to understand things and propensity to solve problems can easily be observed during play, which is their way to find out about and explore their world. Developmental psychologists (e.g., Piaget, 1965) have long pointed out that toddlers learn about their world through sensory experience. Children naturally explore the world around them and experiment with objects they encounter with their eyes, ears, noses, mouths, and hands in order to make sense of and organize their world. Toddlers wonder what things are called, how they work, and why things happen. The toddler, in a sense, acts like a miniature scientist—loves to conducts "experiments" with cause and effect. Like scientists, they also do not believe results the first time they try something—they repeat and repeat to see if results are consistent. The daily-life settings become their laboratory in which they carry out their experiments. For example, while sitting down for a meal, toddlers will experiment with their food, mashing and squishing it with their fingers, throwing it repeatedly around from their highchairs, and watching what will happen (DeAngelis, 2014). This natural way of learning presents parents and early childhood educators with the opportunity to nurture children's curiosity and support their natural tendency to inquire, explore, and solve problems. Promoting and fostering toddlers' sense of curiosity about the natural world around them can engender a lifelong

interest in it. The aim of this study is to investigate problem-solving strategies toddlers (18 to 23 months of age) use during free play with contents and containers.

Statement of the Problem

Problem solving is an important skill that develops in a variety of ways early in life. Toddlers have an innate desire to explore their worlds, and during their exploration, they often encounter many ways that could help them in their quest for knowledge and skills (Babbington, 2003, 2006). Toddlers' problem solving skills and competence develop through actively engaging in experiences, and they need the opportunity to solve the problems they encounter on their own. The natural exploration of toddlers can be fostered or impeded by adults depending on what they do for or to toddlers. Toddlers see the adults in their surroundings, like parents, daycare providers, and early-childhood educators, as both magical and all powerful (Lansbury, 2014). Adults can create or deprive toddlers of the opportunity to solve problems by what they do. For example, if a toddler is trying to open a container or is trying to put a lid on it and the adult intervenes in the child's struggle to accomplish his/her goal, the adult deprives the toddler of a valuable opportunity to figure the solution out on his/her own. By so doing, the adult reinforces the toddler's perception that adults are all-powerful and magical and may gradually lead him/her to rely on adults to solve problems instead of doing it him/herself (Santrock, 2011). The adult, therefore, needs to believe in toddlers' capabilities and allow them to experience frustration as they attempt and fail and attempt again to open the jar or put the lid on it. Through repeated attempts and no interference from adults, the

toddlers will surprise the adults and show them that they are indeed capable of more than what the adults expects. In many cultures, adults might find it counter intuitive to not offer assistance to toddlers when they are struggling with a task, but it is precisely this valuable learning opportunity that toddlers need to solve the problem on their own. Thus, adults need to be aware of the toddlers' innate desire and ability to explore, experiment, and solve problems and create an environment that is conducive to their natural thirst to learn and discover.

The environment may be a home setting or a daycare center. In the United States, about 11 million preschool children spend an average of 35 hours a week in some type of daycare setting (Child Care Aware of America, 2012). The availability of quality care varies in many ways including experiences and activities provided by the center that may or may not promote optimal learning and problem solving in children. The quality of the daycare, in other words, matters greatly for fostering problem-solving skills in toddlers. According to researchers at the University of Carolina (Belsky & Steinberg, 1978), good quality daycare settings emphasize the provision of choice, hands-on and experiential learning, fostering of a climate of collaboration among daycare children, and teachers' use of a variety of approaches to interact with and engage children in fun and educational activities that support the development of young children's autonomy and cognitive skills. Not all home settings and daycare centers have these positive characteristics. Thus, programs and activities are needed to ensure healthy and successful development of young children, especially those programs that emphasize active problem solving.

The adult's task is to provide toddlers with the opportunities and open-ended activities that will help them to interact directly and learn through discovery. Such a setting takes into account that the toddler is an eager learner and the environment needs to address his/her desire to learn and start life with a solid sense of self-efficacy. The research on toddlers (i.e., Keen, 2011; Micsinai, 2011; Van Meeteren, 2013; Webster-Stratton, 2015) that has been conducted over the last few decades shows that children enjoy stimulating learning environments especially those that promote problem solving. One age-appropriate activity that promotes problem solving in toddlers is Contents and Containers. The purpose of this study is to investigate problem-solving strategies used by toddlers ranging in age from 18 to 23 months as they engage in free play with contents and containers.

Significance of the Problem

Toddlers encounter problems in their environments every day. As toddlers explore their surroundings, they deal with problem solving situations from the moment they wake up until the moment they go to sleep. As toddlers acquire problem solving skills, they gain confidence in their ability to make decisions for themselves. The converse is also true; that is, if toddlers lack opportunities to practice their natural propensity to solve problems, they may avoid doing anything to try and resolve issues and problems they encounter as they get older (Perry, 2001).

The early childhood years, especially the first three years, are key to a child's future learning. Many cognitive skills emerge during this period, and problem solving

begins to develop at a very early age (Fancourt, 2000; Newberger, 1997). Bruner (1973) asserted that from the earliest months of life, children are natural problem solvers as manifested by how they make sense of their world in a way that is meaningful to them. Given the many advantages that problem solving has for children, their natural curiosity and interest in solving problems must be encouraged and enhanced early on in life. Problem solving has been found to be fundamental to children's successful adaptation to their environment, and to their development in academic skills (Goffin & Tull, 1985). Also, problem solving forms the foundation for toddlers' future competency in numerical understanding, reasoning, logical, computation, estimation, spatial awareness and meta-cognition. Moreover, toddlers' natural eagerness to explore and invent can lead them to STEM ideas and skills that are currently a prominent focus and a priority in many educational programs in the United States. Through early exposure to STEM-related activities and given their experience-dependent and the in-born intellectual dispositions, toddlers can be encouraged to engage in and develop interests in STEM-related areas such as physics, engineering, math, biology and botany through hands-on experiments and exploration activities (DeAngelis, 2014).

Theoretical Framework

A constructivist framework for how toddlers think and solve problems, based on Piaget's theory, will be described in this section. The discussion will include how the framework describes the nature of thinking, reasoning, and problem solving during

toddlerhood. It will also focus on describing contexts or environments that stimulate and foster toddlers' emerging cognition.

During the toddler years, physical development slows down, but new thinking skills begin to emerge all the time. Toddlers become capable of forming mental images for objects and actions they are familiar with, which, in turn, helps them to recall more events from memory, helps them to solve problems in their heads, and their play will seem more purpose-driven. Another emerging cognitive ability in toddlers is the ability to understand relationships between objects which are reflected in the toddler's ability to sort and categorize objects. The toddler will also begin to engage in make-believe play by imitating the actions of others and later put together more actions to create a logical sequence. Moreover, toddlers begin exploring cause and effect relationships due to their understanding of how they can make things happen (Galinsky, 2010).

Piaget (1936/1952) theorized that children actively construct their world by using schemas, which are concepts or frameworks that exist in a child's mind to help him/her to organize and interpret information. Children adapt their schemas through two processes: assimilation and accommodation. According to Piaget, assimilation occurs when a child incorporates new knowledge into existing knowledge, and accommodation happens when the child changes the cognitive structure because of the new information. A child's new learning and experiences are organized into a higher-order, more smoothly functioning cognitive system. Organization allows children to group or arrange items into categories that improve their long-term memory. In addition, children shift from one stage of

thought to the next through a mechanism Piaget referred to as equilibration. Piaget proposed that assimilation and accommodation work in concert to produce cognitive conflict, or disequilibrium, as children try to understand the world around them. The child eventually resolves the conflict and reaches equilibrium of thought. Thus, Piaget's perspective of learning centers on the efforts of the child to constantly resolve cognitive disequilibrium so that he/she reaches a higher level of thinking and reasoning. In the context of Piaget's development of logical thinking, problem solving behavior is a manifestation of a child's efforts to mobilize thinking in order to restore equilibrium. The child's continuous attempts to solve problems reflect his/her ongoing adaptation to the environment and maintaining a sense of equilibrium through goal-directed sequence of cognitive operations. That is, cognitive disequilibrium motivates toddlers towards a solution to the problems they encounter.

Piaget (1936/1952) asserted that although the emerging cognitive skills are biologically based, they require an environment that encourages, stimulates, and fosters their development. The environment mediates learning but does not produce it. That is, the child constructs his/her own knowledge and understanding, which is often displayed in their play behavior. Also, play is the vehicle via which children experience their world, practice new skills such as problem solving, and internalize new ideas (Paley, 2004). According to Elkind (2007), toddlers learn about the world and engage in activities that encourage their cognitive, emotional, and social development through play.

Teachers and parents can build on children's play and observe their problem solving behavior by providing engaging materials.

Within this theoretical framework, the current study's focus and methodology are situated. That is, use of Contents and Containers during free play will provide the opportunity for toddlers to experiment, explore, and solve problems as they encounter them. The overarching emphasis of the study is predicated on the constructivist's assumption that toddlers are meaning makers and are active problem solvers and constructers of knowledge (Olsen, 1999).

Definition of Terms

The following definitions of terms will be used throughout the manuscript:

Toddler: A child between the ages of 1 and 3.

Age-appropriate: Developmentally appropriate for the particular age group.

Constructivist approach: A learning approach that is based on student activity to construct students' own meaning.

Cognitive development: Refers to development in cognitive abilities in toddlers.

Assimilation: Children's adaptation of new information, based on existing information.

Accommodation: Children change existing cognitive structures, based on newly acquired information.

Schema: Meaningful interconnections and sequences of actions that children use.

Equilibrium: Fit in the existing information schema; restored balance.

Intentionality: "Acting with intention on a course of action or an aim that one intends to follow; a plan to achieve; setting a goal" (Webster, 1995, p.1386).

Competence: Having adequate and appropriate actions to meet the demands of events children encounter in their environment (Baumrind & Black, 1967). The child displays a degree of optimism and persistence in the face of difficulties or problem-solving situations.

Curiosity: Interest children have in their environment by exploring new materials, identifying problems and seeking solutions, and exhibiting persistence and determination (Perry, 2001).

Perseverance: It is related to how a toddler carries out a task, action, or a plan that he or she believes will produce a desirable result or solution. It is also characterized by sticking to a task and not quitting no matter how challenging it is (Polya, 2004).

Reciprocal interaction between play and skills: Play serves as a medium for children to acquire skills and practice them until they become proficient in them. As children play, they gain skills; and as they gain skills, they put them to use during play. In that way, play and skills are reciprocal (Pepler & Ross, 1981).

Trial and error strategy: A strategy in which a toddler randomly tries a number of different solutions to a problem and then rules out those that do not work. A strategy is considered trial and error if a toddler makes three or more attempts to solve a problem as operationalized by Micsinai (2011).

Means-ends Analysis: The means-ends analysis is a problem-solving strategy where a toddler envisions an end, or an ultimate goal, and then determines the best strategy for attaining that goal. A single attempt resulting in a solution was considered as a Means-Ends solution in accordance with Micsinai's (2011) operational definition.

Hill climbing strategy: Hill climbing is described as a problem-solving strategy in which the toddler chooses the operation that appears to bring him/her closer to the desired goal (Dunbar, 1998). The strategy is called hill climbing because it resembles the problem solver whose goal is to climb a hill by taking any steps that would take him/her to the hill top without paying any attention to how efficient the steps could be. Two to three attempts resulting in a solution were considered as reflective of Hill-Climbing in accordance with Micsinai's (2011) operational definition.

Contents and Containers: an open-ended curriculum using commonly available materials including plastic containers of various sizes.

Research Questions/Hypotheses

The following questions guided the study:

1. What behaviors do toddlers exhibit as they begin their exploration with Contents and Containers?

2a. What intrapersonal differences, if any, do toddlers display in their problem-solving approaches with Contents and Containers materials over the ten-session period?

2b. What interpersonal differences, if any, do the three toddlers display in their problem-solving approaches with Contents and Containers materials over the ten-session period?

Organization of the Study

In addition to this chapter, there will be four more. The second chapter will provide a literature review related to the main topics of the dissertation. In Chapter 3, the methodology that will be used in the study will be described. Chapter 4 will report the findings of the study. The fifth and final chapter will first present a discussion of the results followed by a summary of the central themes of the study, and concluding with recommendations for practice and implications for future research.

CHAPTER 2

REVIEW OF LITERATURE

This chapter presents a review of the literature, and is organized in nine sections. The first section provides various definitions of problem solving and concludes with an operational definition of problem solving. The second section focuses on a description and discussion of models and theories of problem solving. In the third section, an historical overview of how interest in problem solving as a field grew will be presented. Early conceptions of problem solving will be described in section four. An analytical review of how thinking and problem solving develop in children will be offered in section five. The sixth section will build upon the discussion in section five by elaborating Piaget's theoretical views on children's thinking and its relationship to problem solving. The seventh section of the paper will focus on a description and a discussion of types of problems children engage in. Developmental changes in problem solving will be discussed in section eight. The ninth and final section explores the relationship between play and problem solving. The chapter concludes with a summary of all the above sections of the paper.

Definitions of Problem Solving

Problem solving is defined differently in the literature reflecting the various theoretical views related to the topic. Before giving specific definitions, it is worth noting that problem solving is considered to be one of the most important human cognitive activities, both in everyday and professional contexts. The two words

comprising the phrase “problem solving” refer to, respectively, the situation where a person has a goal but does not know how to achieve it. This situation motivates the person to look for solutions to resolve it. In this way, problem solving can be used to gauge an individual's critical thinking skills. Also, problem solving is an important area in the field of cognitive psychology, where its underlying processes have been investigated and elaborated. In this section, the various definitions, their commonalities and differences, as well as a synthesis of the definitions will be provided.

Problem solving was defined by Anderson (1980) as a sequence of cognitive operations that are goal directed. Similarly, Mayer and Wittrock (2006) conceived of problem solving as an active cognitive process aimed at achieving a goal. Both of these definitions share a number of points. The first and second points are that problem solving is both cognitive and a process. The third common dimension is the fact that problem solving is goal directed. The fourth and final common theme in the two definitions is that problem solving is personal where the person mobilizes his/her knowledge and skills to solve the problem.

The sequence in problem solving involves discovering the problem, analyzing it, identifying the obstacles, and then finding a solution to the problem. The discovery part of the process includes first finding out information about the problem, referred to as the “given state” (Mayer & Wittrock, 2006). That is, the problem solver proceeds systematically by gathering as much information about the nature of the problem as possible so that later steps including the generated solutions would be based on solid

knowledge of the problem. The discovery phase is followed by analyzing the causes of the problem and the appropriate actions that the person needs to take to address the problem. Causes of the problem overlap with the obstacles one faces when brainstorming possible solutions. As the individual generates possible solutions to the problem, he/she must also anticipate the potential obstacles or downside of each proposed solution.

In addition to the above cognitive factors, there are emotional, attitudinal, and motivational factors that impact the problem solving process. Funke (2010) referred to the affective and motivational factors as the problem solving competency, which comprises the problem solver's cognitive processing capacity to accurately and completely understand the nature of the problem and come up with a solution to the problem that did not seem obvious at the beginning. The competency also includes the personal dynamics of willingness, willfulness, and sense of urgency to achieve a resolution to the problem at hand.

The essence of problem solving is further defined by examining the various theories that focused on it. Thus, it is to a discussion of theories of problem solving that we turn next.

Theories of Problem Solving

Several theoretical frameworks have contributed to our understanding of the problem solving process, and in this section, a number of theories are examined including the cognitive, information- processing, behaviorist, and Gestalt theories. Common across all the theories is that problem solving is a process, is goal directed, and is the most

important learning outcome for life (Jonassen, 2000). Each theoretical perspective is considered in more detail next.

Cognitive Theory

The cognitive developmental perspective of problem solving has been heavily influenced by the work of Jean Piaget. Piaget's theory of cognitive development addressed the topic of problem solving in three ways. The first, Piaget defined intelligence as one's ability to solve problems. The second, Piaget's four stages of cognitive development have problem solving correlates. In the first stage, sensorimotor stage, the infant from birth until age two exhibits problem solving ability through trial and error. The later part of this period is a focus of this study—18 months of age. In the second stage, the preoperational stage which encompasses a portion of the age range focused on in this study, toddlers display problem-solving skills by sorting by shape, size, color, and texture of materials used in activities they engage in. The third stage, concrete operational stage ranges from seven to 11 years when children also sort materials in activities but they do so by function. The fourth and final cognitive stage, formal operations, which corresponds to adolescence and older, utilizes deductive reasoning and engages in hypothetical testing (Piaget, 1964).

The third way in which Piaget addressed and explained problem solving is through the process of equilibrium or equilibration. Piaget conceived equilibrium as a dual process of combining assimilation (incorporation of new events into pre-existing cognitive structures) and accommodation (modifying existing structures to fit new

information in) to advance the child's understanding of the world and competency in it (Keen, 2011). In other words, equilibrium refers to the balance between mind structure and the environment, with a congruency between the two that would provide children with their own conception of the universe. According to Piaget (1964), equilibration was one of the biggest factors in explaining why some children advance more quickly in terms of logical intelligence than others do. Piaget's concept of equilibrium is based on the idea that a child seeks a balance between his concept of the world and what he sees, hears, or feels about the world, his perception of the world. In a problem solving situation, a child develops concepts or schemas that explain what he/she experiences in order to match the data perceived, like characteristics of objects such as size, color, texture, and material (Chen & Seigler, 2000; Greeno, 1978). Equilibrium is restored in the toddler's mind when he/she resolves the tension and conflict by finding a solution to the problem being encountered.

The other contribution from the cognitive realm to problem solving is in identifying mental stages people go through when they engage in problem solving. For example, Polya (1954) developed a model of problem solving in which he elaborated four stages of problem solving. The four stages were: (1) preparation in which the problem is defined and relevant information to the problem is collected; (2) incubation, during which an individual thinks about a problem at a subconscious level; (3) applying the plan to solve the problem; and stage (4) which is called verification where the problem solver confirms that the solution one chooses is indeed the correct one. Moreover, Polya (1954)

is credited to have coined the term problem solving heuristics, which he considered as general problem-solving strategies and which are the key to both problem solving expertise and performance.

The information-processing model also contributed to theorizing about problem solving by explicating how the problem solving thinking is processed in the mind. The next section provides the information-processing perspective of problem solving.

Information-Processing Model

The information processing model developed by Newell and Simon (1972) also sheds light on the problem solving process. The process pretty much follows the computer metaphor advanced by the theorists in that a problem solver's mind operates in the same way a computer processor does. That is, in a problem solving state, a person carries out a sequence of mental computations or representations both to understand and solve the problem. The series of computations includes perceiving, interpreting, storing in memory, thinking about the problem, and finally solving the problem. At each station, the mind carries out a qualitatively different but related operation that is pivotal to solving the problem. The ending step or computation in the process entails a heuristic known as means-ends analysis in which the problem solver generates a solution that best meets the challenge or problem.

Behaviorist Theory

In general, behaviorists view problem solving as a process that develops through positive and negative reinforcement mechanisms. Within this theoretical framework, an

early approach known as horizontal-vertical model is used to describe the problem-solving process. The model developed by Kendler and Kendler (1962) consists of two aspects. The first is that behavior, including problem solving, is a continuous process of stimulus-response associations. The second aspect which relates more directly to the process of problem solving is that behavior includes an integration of individual habits of associating one behavior chain to another. That is, an individual combines what he/she learned on separate occasions to solve a problem he/she faces later.

Another early model of problem solving was offered by Staats and Staats (1963) which consists of three stimulus-response steps in which a stimulus elicits a particular verbal response from the individual. The response, in turn, elicits a chain of verbal responses that are used in problem solving. The third and final step in their model involves producing the needed behavior to solve the problem.

Trial and error also plays a major role in behaviorist theorizing about problem solving. This model posits that an individual over time learns from previous trials an appropriate response to use on another problem solving situation. Campbell (1960) asserted that the trial and error behavior occurs as a result of "blind variation and selective retention" that the problem solver engages in. His model explains the assumptions that underlie the trial and error model. What appears to be a simple or not a viable solution may accidentally turn into a strategy that one would actually use later to solve problems.

Gestalt Theory

The two theorists who elaborated the Gestalt theoretical perspective on problem solving are Duncker and Lees (1945) and Wertheimer (1959). They both contended that problem solving occurs as a result of a flash of insight the problem solver experiences when faced with a problem to solve. The "flare of insight" was described by Mayer (1995) as the situation where a problem solver goes from a state of not knowing how to solve a problem to knowing it. The transition from not knowing to knowing entails a process of representing the particulars of the problem. The Gestalt thinkers posited that a problem solver experiencing a flare of insight goes through a number of steps. The first step includes developing a schema in which all aspects of the problem are put together in a well-integrated representation. In the second step, the problem solver experiences a sudden recognition of the visual information related to the problem or issue in question. The problem solver going through the third step begins to restate the goal of the problem in a new way thereby gaining a newer and fresher perspective of it. In the fourth and final step, the problem solver recognizes the obstacles standing in the way of solving the problem and begins to apply the insight gained to bring resolution to the problem.

Historical Background

Empirical focus on problem solving began in the early 1900s mostly as a result of the work of mental philosophers (Humphrey, 1963; Mandler & Mandler, 1964), and experimental work of Gestaltists in Germany (Wenke, Frensch & Funke, 2005). This foundational work was built upon in the 1960s and 1970s by continuing to use lab

experiments in order to discern steps problem solvers use when engaged in problem solving. The problems used in the lab, such as the Tower of Hanoi, were thought to capture problems that human beings encounter in their everyday life. That is, the problems reflected real life, the approach is reflective of how people approach problem solving, and the steps they use are traceable. The Tower of Hanoi, which is also known as the Tower of Brahma or Lucas' Tower, is a math-related game. The game, or puzzle, includes three rods, and a number of disks of different sizes which can slide onto any rod. A player starts the game with the disks in a neat stack from biggest to smallest on one rod, with the smallest disk placed at the top, thus making a cone shape.

In the puzzle, the player must move the entire stack to another rod, by following three rules: (1) only one disk can be moved at a time; (2) each move consists of taking the upper disk from one of the stacks and placing it on top of another stack i.e. a disk can only be moved if it is the uppermost disk on a stack; and (3) no disk may be placed on top of a smaller disk. Moreover, with three disks, the player can solve the puzzle in seven moves. The minimum number of moves required to solve the puzzle is 2n - 1, where n is the number of disks (Hinz, 1997).

The lab problems served the purpose of convenience for the experimentalists, but their experimental approach came increasingly under the critical eyes of researchers in the 1970s who mainly focused on the difficulty of generalizing lab results of simple problems to the more complex type of real life situations.

From the 19th century on, three theoretical frameworks focusing on problem solving emerged: the early conceptions, associationism, and Gestalt psychology. Each of these approaches is discussed next.

The Early Conceptions Approach

This approach has its origin in the work of Wilhelm Wundt (1980), who established the first psychology lab in Leipzig, Germany. Wundt was training a cohort of experimental psychologists and was exhorting his students to avoid studying problem solving because he considered the topic too complex or messy to study. His students, known as the Wurzburg group, however, did not heed Wundt's recommendation and became even more curious about the subject of problem solving. The group began to ask their lab participants to describe their thought process as they were solving word problems. The result of their study presented a challenge to the dominant paradigm of the day, mental philosopher, in that their empirical evidence showed that not all thinking involved mental imagery (Groner, Groner, & Bischof, 1983).

Associationism

From the early 1920s to the middle of the century, serious scientific approaches to the study of problem solving emerged and gave birth to associationism. According to this approach, cognitive representations of ideas and actions in an individual's mind are formed in ideas and links between these ideas. Thus, cognitive activity is nothing but a chain of associations emanating from one idea and going to the next (Mayer, 1992). Based on this line of thinking, problem solving is a matter of trial and error, and

serendipitous success leads the individual to use the successful approach again in another context. The challenge to this approach was in its inability to account for transfer of skill or strategy. That is, associationism could not posit a plausible explanation for how an individual devises a creative or an innovative solution to a problem that has not been used before. Gestaltists took on that challenge in their conceptualization of problem solving.

Gestaltists

This theoretical framework was developed in the 1930s and 1940s as a reaction to the associationists. To the Gestaltists, cognitive representations formed a coherent structure, not individual associations as their protagonists believed. The Gestaltist approach focused on the nature of insight as pivotal to explaining problem solving. They contended that insight explains problem solving since the problem solver moves from a state of not knowing how to solve a problem to knowing how to do so. A classic study by Kohler (1925) in which he observed a hungry ape stack crates in order to reach a banana hanging overhead is used to illustrate the insight phenomenon. The critique of this approach was directed more to its lack of precision.

These early conceptions paved the path to later models and approaches to problem solving in general and to problem solving among children; especially among toddlers. Kohler considered that problem solving was not merely a process of trial and error, and insight was a required construct for problem solving (Luo & Niki, 2003). The insight enables the problem solver to see relations (Kohler, 1959) and at this point, insight needs to be defined. Kohler (1959) stated that insight is about being aware of relations;

however, a solution through insight only may not be possible (Kohler, 1959). In his experiments with apes, Kohler did not think that a simple association explained a chimp's solution to a problem (Mason, 1976). Gestalt psychologists viewed a problem as the generators of "a state of cognitive disequilibrium" (Olson & Hergenhahn, 2013). This cognitive disequilibrium existed until a solution to the problem was provided. According to Gestalt psychologists, cognitive disequilibrium motivated the individual towards a solution (Olson & Hergenhahn, 2013), thus, reaching a goal. Stambak, Sinclair, Verba, Moreno, and Rayna's (1989) study results also showed that children from 16 months to two years were able to organize their actions towards a desired goal. Children's beginning actions which were indistinguishable later became more complex and organized to reach a goal. It can be concluded that being aware of associations (Kohler, 1959) may lead to organized actions around a goal in toddlers.

Process of Problem Solving

The above section provided an historical sketch about problem solving, and in this section, the process, types of knowledge needed in solving problems, and types of problems encountered in problem solving will be elaborated. The process of problem solving has been conceived as one that unfolds in phases, steps, or stages. Polya (1965, 2004) described four phases of problem solving. The first phase includes understanding the nature and particulars of the problem, which leads to the next phase. Devising a plan of action to solve the problem is the focus of the second phase. Here, the problem solver develops a method or a solution that matches what the person understands about the

problem. With a plan developed, the problem goes to the third phase of carrying out the plan. That is, the problem solver begins to implement and test the proposed solution(s) to the problem. Looking back is the description Polya gave for the third phase as it entails careful assessment, examination, review, and reflection of how the carried out plan addressed the problem. The problem solver attempts to find out how effective the plan of action was. If the plan was not successful based on the "looking back" review, the problem solver goes back to the drawing board and generates a newer plan.

Although Polya (2004) thought that a problem solver does not necessarily go through this process every time he/she solves a problem. He/she may use a variety of approaches including a heuristic including thinking of a problem that is similar to the one the person is working on, dividing the issue or problem into manageable parts, and going over the specifics of the problem. Based on these characteristics, Polya believed that problem solving is a skill that a person can learn through imitation and practice.

Problem-Solving Strategies

Strategies that people use to solve problems are divided into two types: knowledge intensive and knowledge lean. The knowledge intensive strategies are thought of as domain specific while the other operates across domains. The assumption behind the role of knowledge in problem solving lies in the thinking that a person's domain knowledge increases one's chances of solving the problem. The content knowledge helps to mobilize all attention and focus of the problem solver's attention on the issue (Chi, Glaser, & Rees, 1982; Chronicle, MacGregor, & Ormerod, 2004).

The knowledge lean strategies cut across domains and fall within three categories: the trial and error, hill climbing, and means-ends analysis. Depending on the level of challenge of the problem, the individual engages in one of these strategies going from the least complex approach (trial and error) to the most complex (means-ends analysis). The complexity involved in each one of these strategies resides in the cognitive functions that are or need to be mobilized such as generating, ordering, and remembering the pertinent information needed to solve the problem (Chronicle et al., 2004).

Types of Problems

Jonassen (1997) uses a four-pronged description for a problem. Each problem has a domain, a type, a process or a way to solve it, and a solution that suits it. Further, the nature of problems a person encounters can be described as either well-defined or ill-defined. The well-defined problem is one that Mayer and Wittrock (2006) describe as one that has "a clearly specified given state, a clearly specified goal state, and a clearly specified set of allowable operations" (p. 288). Such problems require the use of what Jonassen (1997) describes as a "finite number of concepts, rules, and principles" (p. 68). Also, they are dependent on the domain of the problem. In addition, the well-defined problem is clearly stated, the information the person needs to solve the problem is available to him/her, and the problem has one definite pathway to solving it. An ill-defined problem, on the other hand, lacks these three qualities. The problem is often vague or broad, and as thus the solutions will follow a broad approach. Some elements or goals of the problem are unknown, and these are the types of problems that one

encounters in everyday life. That is, they are situated in one's daily life and require a solution that a person may or may not have used before. This unpredictable nature of the problem makes such situations much more interesting and challenging to deal with. Thus, the unclear goal, missing information needed to solve the problem, and the potential pathways leading to solving the problem all contribute to the complexity and intrigue involved in ill-defined problems (Mayer & Wittrock, 2006).

It is generally believed that solving the ill-defined problem takes longer and is much more difficult than solving the well-defined. The set of obstacles that enhance or complicate the problem solution hinges on a number of factors. The inexperience of the individual is indeed a reason, but there are other cognitive factors including what Bohlin, Durwin, and Reese-Weber (2009) refer to as functional fixedness, response set, and belief perseverance. Functional fixedness refers to the problem solver's inability or unwillingness to use an object in a way other than the familiar one. If the problem solver is not flexible and does not allow him/herself to consider other solutions, then he/she will be limited in how the problem is solved. The second cognitive factor is response set which is how a person is accustomed to responding to situations. It is the habitual response a person gives when faced with a problem. Like functional fixedness, a person does not use the mind in flexible ways to solve problems. The third and final cognitive factor deals with belief perseverance and refers to one's unwillingness to change one's beliefs even when the evidence contradicts them. The common thread across these three factors is lack of flexibility to solve problems.

Developmental Changes in Problem Solving Ability

As children get older, they tend to use accumulated knowledge and tried strategies as well as strategies they discover through trial and error. Preschool children's knowledge and strategy use in problem solving is just emerging. They are also hampered by their tendency to solve problems too quickly and that is often at the expense of accuracy. Younger children are not able to regulate their attention and focus it on one activity for very long so they usually are not able to inhibit an activity and focus on another. Moreover, children may have an understanding and knowledge of a rule but often fail to use it (Bjorklund, 2005; Santrock, 2011).

Review of Related Studies

In the last decades, a number of empirical studies investigating problem solving among children have been conducted. Two studies, a dissertation study and a thesis study, which are directly related to problem solving among toddlers will be reviewed in this section. The two studies are reviewed here because of their relevance to both the aim, methodology, and eventually, the results of this study.

The first work is a dissertation study which was by Geiken (2011). The study investigated the following questions: (1) What actions can be observed as toddlers (18 through 24 months old) engage with the research materials that were used which were clear cylinders and plastic spheres?; (2) What types of problems do toddlers encounter or construct for themselves?; and (3) How do toddlers solve the problems they set for themselves? These questions were answered by observing eight toddlers ranging from 18

to 24 months of age in one classroom of a child care center located in a small Midwestern rural town. The observation was focused on evidence of construction of knowledge as toddlers engaged in free play with clear cylinders and plastic spheres.

The study took place in one classroom of a child care center located in a small rural town in the Midwest. Eight children 18 through 24 months old participated in the study. The research materials consisting of clear cylinders and plastic spheres were available to the toddlers for two hours each day during activity time. The children were allowed to play freely with the materials, and no instructions on how to play were given by adults. The teacher and her assistants gave support when needed and the children themselves directed this free-play activity. The observations were recorded with two video cameras that captured every toddler in the room as they were playing. The researcher kept field notes of toddler's actions with the materials. The collected data were analyzed in order to answer the three research questions of the study. More specifically, the focus was on identifying toddlers' actions and sequences of actions that indicated their construction of knowledge or problem solving (Geiken, 2011).

The results of the study showed that the toddlers tended to organize in a step-by-step manner their actions as they explored the spheres and cylinders, identified problems, and worked to solve those problems. The study also revealed that when toddlers were accorded more time to play freely with the research materials, they persevered in their problem solving attempts, often working on one problem over several days. With respect to the problem solving process, Geiken (2011) discerned five components to the problem-

solving process: exploration, contradiction, repetition, experimentation, solution. The types of problems children set for themselves and worked on were related to Piaget's (2013) categories of reality: space, time and causality.

The thesis study, conducted by Micsinai (2011), also explored problem solving of young children. More specifically, the study compared two groups of children, the first ranging in age from 18 to 22 months and the second from 27 to 36 months. The study investigated four hypotheses: (1) the younger children will need more support either in the form of verbal clues or in modeling an approach than the older group; (2) children in the older group will exhibit more advanced strategies to solve the problems presented compared to the younger group; (3) in comparison with the older group of children, the younger children will use less cognitively complex and hence less successful strategies in solving the assigned problem-solving tasks; and (4) when needed, verbal clues from the experimenter would help children to successfully solve the problem.

Both groups of children were presented with a series of tasks that required the use of objects to retrieve an object the child likes. The results of the study showed that both groups of children had similarities as well as differences in their use of strategies as well as success in retrieving the desired objects. The younger and older children came up with and used a number of strategies that were successful and at times unsuccessful. The children’s choice of strategy for retrieving the object(s) reflected their understanding of the task’s objective. There were differences in both quantity and quality of success in task completion. More students in the older group used means-ends analysis in their

problem solving strategies thereby increasing their rate of successful problem solving events. Some children in both groups first used one or two unsuccessful strategies before they were able to determine the right one—an indication of the hill-climbing strategy. More children in the younger group used unsuccessful strategies which indicated that they were primarily using the trial and error strategy. The experimenters offered support to children who were not successful, with modeling being effective and desired by the younger children and verbal clues and hints as preferred and more effective with the older children (Micsinai, 2011).

This study showed that children as young as 18 months are active problem solvers and use strategies to solve problems, and as they get older, the children's strategy use gets more cognitively complex. They move from trial and error to hill climbing to means-ends analysis strategies (Micsinai, 2011).

Constructivist Education

The term constructivism refers to the process that individuals follow to acquire or utilize information, resources, and help from others in order to develop their own ideas and to apply what they learn to solve problems they experience (Woolfolk, 2007). The principles of constructivist thinking according (Barnett, 2013; Barnett, Carolan, Fitzgerald, & Squires, 2012; Hein, 1991; Olsen, 1999) include the following:

1. Learning is an active, not passive, process.
2. Children learn to learn as they learn; they construct meaning and systems of meaning.

3. Meaning construction occurs in the mind of the learner.
4. Language influences learning.
5. Learning is a social activity and occurs through connections and interactions with others (this is an example of social constructivism which is based on Vygotskian theories.
6. Children learn in contexts.
7. Children's new knowledge builds upon their prior knowledge.
8. Children need time to learn. They revisit ideas, repeat actions, ponder them to try them out, play with them and use them.
9. Motivation both helps learning and is essential to it.

Central to the constructivist process is the child's interest in the activity presented to him/her. In various works of Piaget (1937/1954, 1969, 1979, 1981), he consistently pointed out that interest is the crux of the constructive process. Unlike adults who can put forth effort toward an activity even when they do not exhibit a high level of interest, children's productivity and engagement is directly related to their level of interest. Thus, any constructive attempt must mobilize and take into consideration the child's interest so that he/she can more effectively construct knowledge, develop intelligence and moral thinking and behavior. Teachers can use interest as the way to maximize a child's engagement in a lesson or an activity. The extent to which the student will make sense of the experience depends highly on his/her level of interest in the substance of the

experience. Therefore, methods that need to be used to promote a constructive climate must appeal to the child's interest so that he/she is naturally drawn into it.

The focus of this study is on the toddlers ranging in age from 18 to 23 months. This age span corresponds with the transition between Piaget's preoperational stage to concrete stage during which the toddler uses emerging language, images, drawings, and forms stable concepts which he/she in turn adds to his/her mental structures (Seigler, Eisenberg, Deloache, & Saffran, 2014). The toddler also begins to reason but his/her thinking is characterized by egocentric thinking. Egocentric thinking is a by-product of emerging cognitive abilities in the toddler. In this stage, children acquire motor skills that express their cognitive growth; toddlers' thinking lacks logic and tends to be egocentric. Egocentric thinking is manifested by inability to perceive others' points of view as different from their own. In addition, toddlers tend to fixate on just one property of an object at the expense of other features of the same object. They may often come to inaccurate conclusions about the features of the objects. Piaget pointed out that despite the new cognitive abilities of the toddler, he/she is still incapable of operations or reversible mental actions.

Moreover, in the preoperational stage, the child goes through some sub-phases. The toddler goes through the sub-stage of symbolic function in which the child gains the ability to represent an object mentally that is not present. The child's imagination is also reflected in his/her drawings. The toddler exhibits egocentric thought by his/her inability to separate his/her perspective from that of others. Additionally, the child displays

animistic thinking by thinking that inanimate objects have human-like qualities (Seigler et al., 2014). Below is an example of constructivist education that shows how, in a natural setting, children construct relationship knowledge for a better understanding.

As is stated in the brief description of Piaget's sensorimotor and preoperational stage, children in the sensorimotor stage construct mental relationships primarily through their senses. Swann (2008) examined children's constructions of relationships as they explored objects in their environments. Swann used the findings to explain the Reggio Emilia approach in Northern Italy. Infants and toddlers in the Bellelli School discussed in the article established relationships with the physical properties of the materials they were given by using their bodies, twisting and rolling, constantly changing and modifying their approaches to encounter and explore. That is, children exhibited an impressive range of possibilities for creating a more complex level of understanding by using their bodies as a tool for exploring their environments. Their hands twisted, rolled, pinched, folded, creased, crumbled, and transformed. Gradually, the children became selective and intentional in their actions on the objects of the environment and their focus was more on resulting relationships. Piaget would say that these children have assimilated and accommodated their actions thereby advancing their intelligence (Piaget, 1936/1952, 1953).

Swann's (2008) study explored howthree- and four-year-old children constructed knowledge by exploring art media in an American constructivist preschool program. Twelve out of the 14 children participated in the study. As children were exploring, the

authors looked for any manifestations of the defining feature of this stage which is discerning the effect of one action on another (Forman & Kuschner, 1983; Piaget, 1937/1954). The art media, collage papers, observed in this constructivist setting was similar to that in the Bellelli School that she included in her review of the literature.

The findings of this study (Swann, 2008) showed how the Reggio Schools approach and method which primarily focused on constructivist activities involving numbers, now include in its repertoire the expressive media of the art studio as the central focus (Edwards, Forman, & Gandini, 2011). The Reggio Emilia approach is now considered as neo-Piagetian with some new directions in methodology. The two camps, Piagetian and neo-Piagetian Reggio scholars, agree that as children become more expressive, they begin to discern the affordances of the media and become adept at creating relationships with confident intentionality. Swann (2008) pointed out that the emphasis of the Reggio approach on aesthetics, imagination, and expressive charm of the learning environment and the artwork of the children has maintained the appeal of the movement especially in constructivist education.

Constructivism and Toddlers

The issue of development and learning among toddlers has been a focus of theorizing and research for many years. According to the Piagetian theoretical perspective, the toddler learns as a result of stimulation in the environment. The stimulus could be a person such as the daycare provider or teacher, the parent, or objects with which the child plays (Swann, 2008). In the Piagetian realm of thinking, learning is

subsumed under development. That is, learning occurs in the process of development, and is limited by the context in which it takes place. The implication of this line of thinking is that the child's environment needs to attend not only to the ways in which the child is stimulated to learn but also how the specific learning of the toddler contributes to and is shaped by the overall cognitive development of the child (Hegland, Peterson, Jeon, & Oestrerreich, 2003).

With respect to the view of the toddler as a constructor of knowledge, Piaget (1965) believes that the toddler's actions as stimulated by objects or people in his or her environment are key to cognitive development. As the toddler acts on objects, his/her elaboration or representation of the universe expands. Also, the toddler's cognition develops as he/she assimilates and accommodates the events, objects, and interactions in his/her daily life. Given Piaget's view, the toddler's environment needs to provide age-appropriate toys and objects that would allow the toddler to act on them, represent them, and integrate them into his/her existing cognitive structures. For the purposes of the present study, the focus is on materials and objects in the toddler's immediate setting that would afford him/her the opportunity(ies) to problem solve.

Obstacles to Problem Solving Among Toddlers

Research related to problem solving among toddlers mentions the many manifestations of problem solving during this phase of development. The research also points out some motor, not cognitive, obstacles that limit some problem solving tasks that require motor actions of which the toddler is not yet capable. Toddlers differ in their

reaching kinematics, with some who are skilled and thus able to reach for objects with no difficulty while others are unskilled and thus demonstrate immature patterns of movement (Chen, Keen, Rosander, & Von Hofsten, 2010). It follows, then, that toddlers would differ in their performance on tasks that require mature movements. Any challenges in the performance could be due to motor limitation and not necessarily to thinking patterns about the task. The observer of toddlers, therefore, must record observations of problem solving situations carefully, and interpret the toddler's performance with reaching kinematics in mind. The observer needs to consider how the task demands, toddlers' skill level, and object size affect their motor actions that may be necessary to solving the task at hand. The following is one study that investigated movement among toddlers using a tower-building task.

Chen et al. (2010) examined reaching kinematic skills of 35 toddlers ranging in age from 18 to 21 months engaged in building towers and placing blocks into an open container. The first task, building a tower, was designated as the precise task because it requires placing and balancing blocks on top of each other to erect a tower. The other task was considered as the imprecise task because it does not require the precision and coordination of the first task. The researchers hypothesized the following: toddlers who are able to place the blocks and build a high tower would take their time placing the blocks and thinking about what they are doing. They will be slower in their moves in building the tower but not when putting blocks in the container. It was also hypothesized that toddlers will adapt their reaching kinematics to the task difficulty by slowing their

movements even more when building a high tower. In a follow up study a year later, the researchers investigated a segment of toddlers to see if their developing motor skills affect their performance on the tasks used in Study 1. The researchers also paid attention to continuity of skill level among both lower- and higher-tower buildings (Rosander & von Hofsten, 2011).

The materials the researchers used consisted of ten, 2.5 inch wooden blocks, ten 1-inch wooden cubes and two large open containers with sizes that match block sizes. The researchers indicated their rationale for using Gesell's blocks rather than Bayley's by saying Gesell's blocks were made out of wood rather than the plastic blocks that are in common use in the Bayley Scale (Bayley, 1993; Gesell, 1929). The toddlers' hand movements were recorded using two cameras placed on either side of the toddlers at a distance that would allow proper recording without being intrusive. The experimental activity started with the imprecise task—the blocks and container before the working on tower building, with the experimenter modeling movements for throwing blocks in the container or tower building. The toddlers were instructed to take a block and throw it in the container or place it on the first block of the tower that the experimenter placed (Chen et al., 2010).

After the data were collected and analyzed, the researchers (Chen et al., 2010) found that of the initial 35 toddlers chosen for this study, four did not build a tower in the small-block condition so their data were excluded in the analysis. The results reported by the research were derived from the 31 toddlers who completed all experimental

conditions—15 participated in the lower-tower condition and the remaining 16 worked on the high-tower group. The findings revealed no gender differences among toddlers in either the approach or placement phases of the study. In the lower task compared to the imprecise task, the researchers reported longer deceleration as the toddlers' hands approached to pick up the blocks. The researchers mentioned that the deceleration reflected planning for the second movement. Also, the researchers found that the more skillful toddlers who were able to build high towers exhibited a longer deceleration phase when placing blocks on the tower compared to the low-tower builders. In the follow-up study, the researchers (Rosander & von Hofsten, 2011) found that the kinematic differences between the two groups remained and all children were able to build high towers.

The upshot of this research that relates to the present study, which is focused on toddlers ranging in age from 18 to 24 months of age who will be participating in the content-and-containers materials, is to see any potential obstacles that may be caused by motor and not cognitive limitations. The difference between the participants of the Chen et al. (2010) study and the present one is that the research design is not an experimental one where children are given clues and instructions in a laboratory setting. The present study will investigate problem solving among toddlers in a constructivist class room. The activity they will participate in is a part of their daily constructivist activities. The following are the research questions that will be investigated:

1. What behaviors do toddlers exhibit as they begin their exploration with Contents and Containers?

2a. What intrapersonal differences, if any, do toddlers display in their problem-solving approaches with Contents and Containers materials over the ten-session period?

2b. What interpersonal differences, if any, do the three toddlers display in their problem-solving approaches with Contents and Containers materials over the ten-session period?

This chapter provided a review of the related and relevant literature on problem solving among toddlers. The methodology that will be used in the study is described in the next chapter.

CHAPTER 3

METHODOLOGY

In this chapter, the methodology that was used in this qualitative study is described. This includes participants and study materials, coding and instrument, inter-rater reliability, video recording, procedures, research design as well as how data was collected and analyzed.

Participants and Study Materials

This study used existing data from a study conducted by the Regent's Center at a child care center in a mid-size city in Iowa. The data was in the form of data recordings from approximately two years ago. The lapse of time from when the data were collected until now do not allow for triangulating the data for a number of reasons. First, the teachers may not be working at the same place. Also, the toddlers are now elementary school-age.

The participants of this study consisted of two male and one female toddlers ranging in age from 18-23 months, who were videotaped for one of the Regents Developmental Center's research projects. The pseudonyms of Sara, Jake, and Mark were used for the three toddlers in this study. Their ages during the video recording were as follows: Sara was 18 months, Jake was 23 months, and Mark was 21 months. The toddlers were selected based on how frequently they appeared in the videos and how actively engaged they were in the Contents and Containers free-play activity. Also, within this consideration, attention was paid to selecting toddlers from different classes as

well as different genders. Ten sessions of toddlers were videotaped for one of the Regent Center's research projects. The toddlers who participated in the Regent Center's study were drawn from a child care center located in a mid-size city in Iowa. The center is managed through a partnership between the community school district and a local hospital in the city. The mission statement of the chosen center which appears on the center's website reads, "The primary purpose is to provide a safe, healthy, caring and nurturing environment, with highly qualified staff to educate and protect the children we care for." Children who attend the center are multi age and range in age from 6 weeks to students attending the fifth grade (10 or 11 years of age). The center also has a room for infants through age 1 just for employees of the company that houses the center. Children age 2-5 can enroll in the before and after daycare program at the center as long as they are children or relatives of employees of the company. The center advertises their half-day preschool and summer camp programs are open to employees of the company and the general public only if space is available. The center prides itself in having well-trained, caring, and enthusiastic staff who provide a warm, nurturing, and developmentally appropriate environment for infants and toddlers. It also provides entertaining and educational field-trips to supplement and enhance children's development and nurture each child's natural inclination for discovery and their sense of self confidence. The above describes the context or environment of the toddlers who were randomly selected for this study.

Permission to conduct the study by the University of Northern Iowa (UNI) Regent's Center for Early Developmental Education was obtained through an IRB (Institutional Review Board) approval from UNI, and by securing parent consent letters for toddlers to participate in the study and to be videotaped. The two toddler classrooms of the child care center were used.

Each class participated in 10 sessions over a five-week period, and all the sessions were videotaped. Each session lasted 40 to 50 minutes while the toddlers engaged in the contents and containers activity. For each session, materials for the contents and containers were set up for the toddlers and the children were completely free to interact with the materials in any way they liked. Teachers were asked to make the materials available to the toddlers every day over the next five weeks to ensure that all toddlers had equal opportunity to engage with the materials. The teachers were welcome to stay in the center while the sessions were videotaped, and were asked to encourage toddlers to play. If the teachers chose to stay, they were asked to follow the toddler's lead, to encourage them, comment on what they are doing, ask questions, or just merely observe toddlers playing. The researchers asked teachers to avoid forcing toddlers to use the contents and containers in a particular way unless they were unsafe. Teachers were encouraged to allow toddlers to be creative and were told that it was okay for toddlers to bring other materials to use with the provided contents and containers to another play area. Further, the teachers were instructed that on days when the researchers were not videotaping, the materials were to be made accessible to the toddlers to play with.

All the sessions were videotaped following the aforementioned instructions. Neither the teacher nor the researcher interfered in the play activity of the toddlers. When the 40-50 minute session was over, the contents and containers were put away in a special storage area at the center and the cameras were turned off and stored at the center as well. The teachers could make the materials accessible to the toddlers and play with them at will. The instrument that was used to analyze data in this study is described next. (See the List of Materials in Appendix B, p. 159)

Coding and Instrument

After securing the required IRB approval, the researcher began watching the videos and started coding the sessions using a coding system used by Geiken (2011). The events or behaviors that were observed using this coding system are the following: (1) nesting (3 objects or more); (2) filling (one by one or pouring into); (3) emptying (dumping, taking out one by one, or un-nesting); (4) body as a content; (5) body as a container; (6) stacking (three or more objects); (7) opening (lids, latches, flip, snap or unscrewing); and (8) closing (lids, latches, flip, snap or screwing). In this study, the two events of "Look" and "contradiction" used in Geiken's study were eliminated following the suggestion by the Puckett Institute in North Carolina. Their recommendation was made because no themes emerged using the previous version of the coding scheme. Along with these eight events, the coding system focused on the following dimensions of toddlers' play: exploration, repetition, experimentation, solution, and no solution.

The coding process underwent at least 3 revisions until more data were collected and clear patterns emerged. The patterns were subsequently called coding events. A copy of that coding scheme which was used in this study is described next.

Exploration

This event was coded as E1 which stands for a toddler who is interacting and acting with an object or objects with no apparent goal in mind. Exploration can be of three different types. E1a type is where a toddler performs a variety of actions on a variety of objects. E1b exploration is the type where a toddler performs a variety of actions on one type or class of object such as using multiple bowls or similar containers. The third type of exploration, E1c, is where a toddler plays with different types of materials, such as putting an object from a specific class into a different type of object such as putting a rubber bracelet in an egg carton.

Repetition (R)

It is the type of action the toddler repeats three times or more without changing anything about the action. If a toddler repeats an action without changing anything about the action, he/she is displaying behavior more consistent with trial and error within an experimentation context. Repetition was coded once regardless of the number of times a toddler repeated an action unless a time lapse of 60 seconds occurred between actions.

Experimentation (E2)

The toddler varies his/her actions in some way but is focused on one or the same object. The action varies by degree or intensity. This is different from repetition in that

the child keeps one object constant such as trying a different size lid on different containers. The constant here is the lid regardless of size.

Solution (S)

This stands for the time when a toddler stops experimenting when the objects do what he/she wants them to do. Based on this description, the observer makes the judgment in regard to the toddler finding a solution.

No Solution (NS)

If there is no solution, the coder notes that by writing (NS) and means that the toddler has for whatever reason abandoned the problem before he/she finds a solution (See the Coding Instrument in Appendix A, p. 157).

Inter-Rater Reliability

Because of the multiple changes to the coding instrument, reliability was tested after the final modification to the coding instrument. To provide reliability, the coding on the final instrument was done by three doctoral students: the researcher (Coder 1), another doctoral student at this institution (Coder 2), and a doctoral student at a different institution (Coder 3). Reliability between coders on the actions taken by the toddlers and the Coding Events section were the following: Inter-Rater Reliability between Coder 1 and Coder 2 was 93%. Inter-rater reliability between Coder 1 and Coder 3 was 87%.

Video Recording

The teachers of the classes chosen for this study presented the materials to the toddlers as a center or choice in the room and the toddlers were free to play there. The

teachers did not give the toddlers a lot of instructions because the aim of the study was to see what the toddlers would do on their own. This study used ill-defined problems rather than well-defined problems because the problems were not pre-identified by the adults and given to the toddlers to solve. The toddlers were presented the materials and were told they were free to play with them. The purpose was to see what the toddlers could and would do with the materials. The general instruction given to the teacher to share with the toddlers was this: "this is free play time and you can use any of the contents and containers to play with."

There were 30 recorded sessions total for the original study. This number of sessions was deemed sufficient enough to observe toddlers' interactions with the materials. Each session was approximately one-hour long and took place over a period of five consecutive weeks. This timeframe was the minimum exposure to the materials requested for this study. The teacher was told that she was welcome to make the materials accessible to the toddlers beyond this amount of time as they chose. The procedure that was used in this study is described in the next section.

Procedure

The contents and containers that were presented to the toddlers at the study site were predicated on the premise that infants and toddlers learn by acting on objects, observing the reaction of objects, experimenting, and connecting new information to what they already know thereby strengthening their existing schema. Thus, toddlers need to have activities that provoke their imagination and learning. The contents and

containers activity is similar to those in the Regent Center's physical science training in that they are producible, observable, immediate and varied. Toddlers interact with the different objects in myriad ways producing infinite and varied ways and uses for the objects. Given the description of the study site above, the classroom environment was set up in accordance to constructivist ideas where the toddler is believed to have the desire and interest to interact and experiment with his/her environment, and interacts with peers while experimenting. In the course of experimentation, the toddler sets up and solves problems. The toddler may set up the problem, try to solve it, and may or may not persist. If after assimilating the problem, accommodation occurs, the toddler will construct new knowledge thereby increasing his/her thinking and intelligence.

According to Geiken (2011), toddlers can learn to: (1) accumulate; (2) distribute; (3) collect; (4) nest; and (5) do one-to-one correspondence. When accumulating, toddlers fill a container with a variety of objects, empty the containers with other objects, and then dump the objects and go on to other objects. Toddlers distribute by repeating the same action on several objects that are similar. The toddler may stir with a spoon in several sizes of cups or containers, and puts the same objects in several different containers. In the third action, collecting, toddlers tend to put together the objects that belong together. They intentionally look for objects that look similar and put them in the same place. The toddlers also nest objects by putting them inside each other by size. The toddlers may initially put two or three objects inside each other, and gradually put the full set into a larger set. In addition, toddlers do one-to-one correspondence while playing with

contents and containers by matching one object to one container and matching one object to one section of a multi-section or layer container such as a muffin tin or an egg carton or one container to one lid.

While toddlers are playing with contents and containers, the observer followed this sequence in documenting toddlers' behavior: observe toddlers' actions, document the actions, code the actions that have been observed and documented in terms of how they fit the different events such as emptying, filing, stacking, etc. (Geiken, 2011), then analyze the data. The same sequence was used in this study to focus on situations where toddlers are interacting with objects and are engaged in problem solving. How toddlers interacted with the materials, the problems they encountered, how they dealt with the problems over the duration of the 10-session period were documented and the data were used to answer the research questions of the study.

Research Design, Data Collection and Analysis

The research design, data collection and analysis used in this study are described in this section beginning with the research design.

Research Design

The qualitative research methodology was used in this study. The qualitative approach is "a systematic approach to understanding qualities, or the essential nature, of a phenomenon with a particular context" (Brantlinger, Jimenez, Klingner, Pugach, & Richardson, 2005, p. 195). According to qualitative research experts (i.e., Berg, Lune, & Lune, 2004), when qualitative methodology is used in a particular context, it could lead

to results that can: inform knowledge, contribute to the understanding of the phenomenon being investigated, and eventually practice of beneficial processes within the context or construct being studied.

The specific research design that was used in this study was the case study method. Berg et al. (2004) described the case study method as one that "involves systematically gathering enough information about a particular person, social setting, event, or group to permit the researcher to effectively understand how the subject operates or functions" (p.251). Moreover, the case study method allows the researcher to capture nuances, patterns, and more details that other approaches overlook (Gall, Borg & Gall, 1996). The case is defined by Miles and Huberman (1994) as, "a phenomenon of some sort occurring in a bounded context. The case is, "in effect, your unit of analysis" (p. 25).

Also, the approach of this study is similar to Yin (2003) who based his approach to case study on a constructivist paradigm. As was stated in Chapter 2, constructivists claim that truth is relative and that it is dependent on one's perspective. This paradigm "recognizes the importance of the subjective human creation of meaning, but doesn't reject outright some notion of objectivity. Pluralism, not relativism, is stressed with focus on the circular dynamic tension of subject and object" (Miller & Crabtree, 1999, p. 10). Yin (2003) asserted that the case study design should be considered by researchers when: (a) the focus of the study is to answer "how" and "why" questions; (b) you cannot manipulate the behavior of those involved in the study; (c) you want to cover contextual

conditions because you believe they are relevant to the phenomenon under study; or (d) the boundaries are not clear between the phenomenon and context. This study meets the recommendations made by Yin.

Data Collection

With regards to data collection in qualitative studies, the data can lead to a deep and full understanding of how processes work or what people think. In the context of this study, deeper and fuller understanding about how toddlers solve ill-defined problems can be achieved through the qualitative approach which has not been done before. Bogden and Biklen (2003) emphasized that if investigators aim to "understand the way people think about their world and how those definitions are formed they need to get close to them, to hear them talk and observe them in their day-to day lives" (p. 31). In this research study, the qualitative research approach was chosen as the methodology to gain insight into toddlers' problem-solving thinking and behavior. Data collection in this qualitative research was conducted primarily through observation of DVDs of sessions in which toddlers interact freely with contents and containers. The observation is not direct as in the case of participant observation which is one of the main ways in which more qualitative inquiry gathers its information (Ferguson, Ferguson, & Taylor, 1992). The main goal of conducting an observation is to be familiar with the study setting, its participants and their behavior. The observer also "seek(s) to make the strange familiar and the familiar strange" (Glesne, 2011, p. 67).

The data collection that was used in this study was in the form of careful observation of DVD sessions of three toddlers interacting with free play with contents and containers. By gaining a deep understanding of toddlers' problem solving, the focus of the qualitative research considers the issue of problem solving from the toddler's point of view rather than measuring it on their behalf, as is the case in quantitative research (Becker, 1967).

Observed activities were recorded on the coding instrument described above. Actions of the toddlers were identified based on the coding categories described earlier in this chapter.

In this study, the unit of analysis consisted of three toddlers interacting in free play with contents and containers. More specifically, the focus is on what the toddlers do with the contents and containers, how and why they do what they do to solve problems they encounter.

Data Analysis

In qualitative research, "data analysis involves organizing what you have seen, heard and read so that you can figure out what you have learned and make sense of what you have experienced" (Glesne, 2011, p. 184). The data collected were organized and reflected on in order to discover what it has to say and to make the current study more relevant and profound. The researcher followed Brantlinger et al. (2005) quality indicators in analyzing the data. These indicators include sorting and coding the results in a systematic and meaningful way, providing sufficient rationale to explain what was

and was not included in the finding, and making connections with the related research (p. 202).

In analyzing the current study, the researcher reviewed the data repeatedly to highlight coding events from observations of toddlers' responses immediately after transcribing the data as well as during data analysis. For the first research question, the behaviors that each toddler exhibited in all the sessions were thoroughly described. How the toddlers interacted with the contents and containers and solved problems over the 10 sessions was noted, namely the differences in their problem-solving strategy use. A summary table was used to display the events the toddler displayed (such as closing, stacking, emptying), coding events (such as exploration, experimentation, and solution), and problem-solving strategy used in each session. This helped in answering Research Question 2 where the focus was on the extent to which the toddler exhibited and met criteria for a particular problem-solving strategy (either trial and error or means-ends analysis). The criteria were culled from definitions and descriptions found in the related literature (Dunbar, 1998; Duncker & Lees, 1945; Funke, 2010; Wenke et al., 2005) and from the operational definition used by Micsinai (2011). The criteria are also listed in Table 1 below. The question was also answered by providing relevant quotes from each toddler, and making connections with the related research. Similarly, Research Question 3 was addressed by noting similarities and differences on how each toddler solved problems they encountered over the 10 sessions.

Table 1

Criteria of the Strategies

Trial and Error Strategy (T/E)	Means-Ends Analysis (MEA)
Trial and error problem solving is a gradual process the toddler is motivated and interested in the tasks (curiosity) The toddler is intentional but makes random and variable actions/behaviors Some of the toddler's actions/behaviors accidentally lead to the desired goal/solution With the increase in number of trials the toddler makes, the desirable actions/behaviors will be strengthened and repeated Persistence on task may not be sustained if a systematic strategy does not emerge The time it takes a toddler to repeat the desired solution decreases with successive trials.	The toddler begins by envisioning the end, or ultimate goal, and then determines the best strategy for attaining the goal in his/her current situation The toddler is interested in the activity and motivated to solve the problem (curiosity) With the goal in mind, the toddler engages in a sequence of actions that lead to a desirable goal The toddler varies his/her approach as they operate on the object The toddler persists on the task The toddler chooses solutions that are relevant to the task.
T/E: Three repetitions or more Micsinai (2011)	MEA: Only one repetition Micsinai (2011)

Finally, the researcher categorized and defined patterns and themes based on the manner in which the toddlers interacted with the contents and containers and how they solved problems initially and over the entire 10 sessions. At the heart of qualitative data

analysis is the task of discovering themes. By themes, we mean abstract, often fuzzy, constructs which investigators identify before, during, and after data collection. They come from reviewing the literature, from the characteristics of the phenomena being studied, from already-agreed-upon professional definitions, from local common-sense constructs, and from researchers' values, theoretical orientation, and personal experience with the subject matter (Bulmer, 1979; Maxwell, 1996; Strauss, 1987).

The emerging themes were created first by looking at characteristics and dispositions displayed by the three toddlers in this study. That is, the researcher observed and then noted the patterns of behavior that seemed to be common across the three toddlers. Then, the researcher used the following strategies to generate the themes: (1) an analysis of words (word repetitions, key-indigenous terms, and key-words-in contexts); and (2) a careful reading of larger blocks of texts (compare and contrast, social science queries, and searching for missing information (Ryan & Bernard, 2003).

The following five themes emerged and are described in detail in the final section of Chapter 4: intentionality, competence, curiosity, perseverance, and reciprocal interaction between play and skills.

CHAPTER 4

RESULTS AND DISCUSSION

The research questions of the study were: (1) What behaviors do toddlers exhibit as they begin their exploration with Contents and Containers? This question was answered by observing and identifying the behaviors of problem solving from the DVDs. Those behaviors are clearly described for each toddler in this chapter. The first part of the second research question investigated in this study was: (2a) What intrapersonal differences, if any, do toddlers display in their problem-solving approaches with Contents and Containers materials over the ten-session period? The second part of research question two was: (2b) What interpersonal differences, if any, do the three toddlers display in their problem-solving approaches with Contents and Containers materials over the ten-session period? Likewise, changes among the toddlers were identified by looking at similarities and differences in problems solving.

The findings of the study are organized as follows: First, a detailed description and a summary of the data gathered along with a summary table of the events, coding events, and problem-solving strategy/frequency for each of the three toddlers are reported. This is followed by a combined analysis for the growth and development in problem solving thinking and strategies for all three toddlers. Individual changes in problem solving over the ten-session period for each participant is reported.

Research Question 1: What Behaviors Do Toddlers Exhibit as They Begin Their Exploration with Contents and Containers?

The data related to the central research question of the study are organized in three ways. First, the behaviors of problem solving for each of the 10 sessions for each toddler are described. The data description summary includes discussion and interpretation of the results. Also, a summary discussion table follows the 10 session descriptions for each toddler. Worthy of mentioning is that some of the sessions are brief and some are long due to the fact that the camera was fixed in one area of the classroom and was not moved. The three toddlers had the choice to engage with the materials or not, so some video transcripts may be shorter because the toddler chose to work with other materials. If the toddler moved out of the camera's range where the containers were, then his/her actions were not captured in the video. The data for toddler 1 are presented next.

Toddler 1: Session 1

Initial problem-solving attempts were symptomatic of early exploration and experimentation. The toddler, Sara (18 months), began by approaching the items in the Contents and Containers and acting on them without any apparent goal in mind such as walking toward the container, emptying, filling in a container, and abruptly leaving the containers all together. All of these actions reflect Level 1 of the Exploration (E1a) in which the toddler displays a variety of actions on a variety of objects. Six minutes into the first session, the toddler exhibited an action that aligns with the description of the second level of Exploration (E1b) in which Sara took out a ball and a bracelet from a

canister and then looked for a lid to use as a cover for the canister. She looked around for a lid, grabbed one, and put it on the canister but decided that it was not the right size lid. She kept looking for what she believed would be the right size cover but did not find one. The toddler all of a sudden quit her search and walked away.

Three minutes or so later, Sara came back to resume her activity. This time, she grabbed a box and a cover from one of the two containers that have various items as contents. She tried to cover the box with the cover she grabbed, but it did not fit the box. Sara went back to the big container and emptied its contents.

The next action seemed to be unrelated to her search for a box cover as she proceeded to empty a tin muffin pan that was filled with plastic balls of varying sizes. Minutes later (approximately three and a half minutes) the child picked a lid that was lying on the floor and used it as a box cover, opened the box, and filled it with balls and bracelets and put the cover back and shook it. The toddler's focus seemed to be squarely on finding a lid for the box, which is a sign of purpose-driven (i.e., finding a lid for the box) problem solving). However, the toddler's next action indicated a level of experimentation with stacking of boxes that she took out of the big container. She began by stacking and unstacking of three boxes, took the lid off from one of the boxes and emptied the box and filled it again with plastic balls. After filling the box, she re-stacked the boxes and filled the top box with balls as well. The child left and came back about three minutes later and added a fourth box to the stack and also filled the fourth box with

balls. She went back and forth emptying and filling some of the boxes and took two boxes from the stack.

Summary of Session 1

The toddler's actions ranged from looking and exploring to experimenting by finding a lid size to cover a box to stacking boxes and filling them with balls. The search for a lid is a clear indication of the toddler's persistent efforts to find the right size lid to cover the box. The child, however, stopped the search and engaged in a different task. That task was stacking boxes and filling them with balls. There was no obvious problem to be solved other than seeing what happens when a box is filled and when it is empty and how an empty versus full box affects the stack she was working on.

Toddler 1: Session 2

In this session, the toddler, Sara, continued and expanded her exploration and experimentation, and acted upon items from the two large containers that she had not touched or played with in the previous session. The toddler began her exploration by grabbing a medium-size box and a ball from one of the two containers and put them on the floor. Sara then walked to the second container and took out a bandana from it and on her way back to the spot on the floor where she put the other two items, she grabbed a plastic bowl and a small box that were lying on the floor and put them with the other items. As if these items were not enough, Sara went back again to one of the containers and took out a bowl and put blocks and balls in it. She reached for a medium-size box and put two small boxes in it and started shaking the box making a rattling sound. She

put the box down and reached for a bandana and a small box from the container and then tried to put the box in one of the spaces of the muffin pan but Sara found out that the box did not fit in any of the spaces in the pan. Since she did not have any success fitting the box in the muffin pan, Sara moved on to experiment with balls and small lids to see if they would fit in the muffin pan slots, and placed them in the pan. Intrigued by putting items in the muffin pan or in boxes, Sara now grabbed a big box from the container and put a bowl and balls in it. She left the box alone and once again tried to fit the small-size box into the cavities of the muffin pan. But the box would not fit. Even though the muffin slot size did not change and the size of the box she tried earlier and now did not change, Sara still was experimenting to see if the box would fit.

Next, Sara went back to figure out if a lid she took out of the container would fit over a big box. The lid would not fit. Then she went back to the small boxes and tried to fit them in the muffin pan but they would not fit either. Again, this shows that Sara is using the trial and error to solve the problem. She made an adjustment which is using two boxes to fit into the pan instead of one as if using two would make it work. Sarah switched from this task to moving the balls and small boxes she placed on the pan to a medium-size box. She soon embarked upon two new paths of experimentation. The first one was placing the muffin pan upside down, stacking two plastic cups on it, and shaking the pan with the stacked cups on it. She repeated this action more than three times. This action meets the E2 description of at least one object remains constant—the muffin pan. Before Sara moved on to the second path of discovery, she moved a small bowl and a ball

from a box and put them in a pitcher, emptied the box into a big bowl, and then put a small bowl into a bigger one. These actions followed each other in seemingly rapid succession. The second path of discovery occurred when Sara flipped a box and put a ball on top of it but the ball rolled down to the floor. She tried the same action but using a bowl and a block instead of the ball to see if anything different would occur. Neither item rolled down like the ball.

Summary of Session 2

In this session, Sara exhibited more advanced experimentation of some actions and solutions of issues encountered during play. She used more than one item in her experimentation and problem solving. Sara's problem solving, however, still reflected trial and error as shown in her efforts to find a lid to the big box and trying to fit the small-size boxes into the muffin pan. Her flipping the pan upside down shows a new direction of experimentation and a new level of curiosity to see what different outcomes might occur if she changed one thing such as using the bowl or block instead of the ball to see if they roll down the box like the ball did. These actions show that Sara was trying to solve the problem using trial and error because she seemingly did not adjust her initial strategy at all.

Toddler 1: Session 3

Sara was absent on this day so there was no video of her to include.

Toddler 1: Session 4

In this session, Sara's preoccupation seemed to be again with finding a lid that fits one of the boxes she grabbed from one of the containers. She also exhibits interest in items that she previously only looked at or explored for a short while. Although, she alternates from small boxes to big ones, sits on a box, puts bandanas in a bowl, puts items in a bowl and shakes the content, her mind soon goes back to finding a lid and see if it fits. It can be safely concluded from Sara's previous sessions and this session that the focus of her problem solving is locating the right lid for the box she selected. Her approach to the solution is still characteristic of trial and error. She does not exhibit any systematic approach in her problem solving—at least not yet. The specific exploration and experimentation that Sara displayed in this session is described next.

Sara began her exploration by walking toward one of the two containers and scanning its contents as though she was deciding which one she wanted to play with. She took out a small box as well as three boxes that were stacked into each other (a small box into a medium size and the two in a bigger box). Seeming not content with what she had, Sara went to the big container again as if to see what else to pick up. She sat on one of the boxes and put the big container in her hands. She soon left the container to grab a bandana with which she covered the box that she sat on. She took the bandana off and then back on again. She went back to the other big container and looked at the contents inside it and grabbed a bracelet which she put into a bowl. She threw the bracelet on the floor and grabbed a small lid and covered the bowl with it. This is the primary

preoccupation Sara has been exhibiting all along—finding the right size lid to the box but going about it in a trial-error manner.

Sara continues her going back and forth to the containers and this time grabbed the bandana that she dropped on the floor earlier and used it as a box cover, grabbed a second one from the container and put it on the same box, and then grabbed a third but this time seemed to want to use it as a cover for the box. She found a fourth bandana that she put on top of the other three. Although it seemed as if Sara was engaging in a stacking game, there was not an obvious plan or reason for this action or type of exploration as evidenced by what she does next. She started taking the bandanas off the box that she was using as a cover and placed them on the floor, took one of them in her hands and walked away. She came back for the other three bandanas and tried using them as covers for two muffin pans that she took out of the container. Sara did this again and again. Her fascination and constant trial and error to find the right covers for the pans or boxes are quite apparent.

Shortly after, Sara walked around the containers and grabbed a pitcher and began pretending as if she was pouring water from it into a box. She then started pouring the four bandanas one after the other onto the floor. Once the bandanas were on the floor, Sara grabbed them from the floor and put them back on the box. The next action seems unconnected to the chain of actions exhibited earlier as Sara stepped on a bowl and then sat on it, placed a smaller bowl inside the first one, and then sat on both of them. These actions are indicative of general exploration and experimentation. She went back again

to the bandanas she was playing with earlier and picked two and walked around with both of them in her hands. She went back to the muffin pans and again tried to use the bandanas as covers for them. Sara switched from the muffin pans to the small box she played with earlier and put it in her hands and kept holding it. She started looking for a cover for the box, found one which she put on the box but it did not fit, then stopped trying. Instead, Sara grabbed a small cup, put a ball in it, and started shaking it as she did an earlier session.

Summary of Session 4

In this session, Sara moved back and forth from bandanas and trying to use them as covers for boxes, stacking items, sitting on objects, but there did not seem to be a thoughtful and systematic action to find a cover that would fit the small box that Sara was concentrating on. She continued to use the trial error strategy as a way to solve problems.

Toddler 1: Session 5

Sara began this session by walking to the big container and taking a lid and placing it on a box that was lying on the floor. The lid was not the right size. Sara's action further illustrates her constant trials to find a lid that would cover the box, but she is going about it in a trial-and- error fashion. Her picking up a bandana to use as a cover suggests that Sara knows that something fits the box, but what is it? That is the search that she seems to be engaged in but in a very unsystematic way. As she was trying to fit the bandana on top of the box, Sara got distracted by something else. That distraction was an item inside the big box. As she was grabbing an item out of the container, Sara

took out a cover and gave it to another student who was also using the contents at the same time. After giving the lid to her classmate, she sat on the container, stood up and grabbed a bandana from the container she was sitting on. She also found a canister full of bandanas, balls, and bracelets. She took all the bandanas out of the canister except for one, but she went back to it later and took it. She put the bandanas on her head and walked toward the container and took out a pitcher and put one of the bandanas in it. She picked up a lid from the floor, threw it, and walked away. She picked up a bandana from the floor, put it on her head again and walked toward a big box that had a ball in it, and emptied the box by holding it upside down to let the ball out of it. This action suggests that Sara knows the concept of filling and emptying, and what needs to be done to carry out both actions.

Sara picked up a medium-sized box from the floor and put it on a bigger box, stacked a small box on top of the two that were already stacked, placed a bandana on the boxes, grabbed more bandanas to cover all three stacked boxes. Then, all of a sudden, Sara decided to take the bandanas off and threw them on the floor. This behavior, which was observed earlier, suggests that Sara is trying hard to find a right cover, and when she could not locate one, she used items like bandanas as a substitute cover. Since Sara already did the same action in an earlier session and did not adjust her problem solving strategy from random stacking and placing bandanas, she is still exhibiting the trial and error problem-solving strategy.

Next, Sara picked a canister filled with balls, she took the canister cover off and emptied the balls out of it, put them back into the canister, and put the lid back. She repeated this many times. This could be perceived as the genesis of a systematic problem solving as Sara is emptying the canister, putting the balls in it and putting the lid—which fits properly—back on the canister. Whether Sara transfers the awareness she gains from the repetitive action with the canister to the small box remains to be seen.

Next, Sara went back to the container and picked up a lid and walked around with it until she found a canister that did not have a lid so she tried the lid that was in her hand on the canister. The lid fit perfectly on the canister. Sara found a solution to the problem.

Summary of Session 5

Sara continued with her active exploration, experimentation and problem-solving. She repeated some actions several times revealing her incessant quest to find a solution to challenges during her play activity. Her inclination is still toward trial and error rather than going beyond that to thoughtful and systematic problem solving. Toward the end of this session, Sara started filling the canister with balls and putting the lid on it. She would empty the canister and put the balls in it again. The repetition of this sequence of action shows that Sara is deliberately thinking about each step, which is one of the criteria for systematic problem solving. Sara exhibited what can be thought of as an initial step toward more methodical problem-solving.

Toddler 1: Session 6

In this session, Sara displayed behaviors and actions that are very similar to ones she exhibited in the previous sessions including emptying boxes of their contents, searching for lids to boxes, experimentation with bandanas, bracelets, and pitchers. In all of her explorations and experimentations, Sara seemed intent on finding the right size cover for a box. Her approaches to finding the right size cover have not changed from the trial and error type. Sara searched a couple of times for a cover, then she stopped searching for a while to play with something else, only to go back to continue her lid-cover search haphazardly repeating some earlier actions and moves.

As Sara began her experimentation with the contents of the containers in this session, she started by taking some balls out of the box and put them in a canister, and then took one ball out of a container and put it in another canister. A moment later, Sara took the bandanas that were on the floor and walked away with them. This type of play or seemingly haphazard behavior, indicates Sara's persistent experimentation with how smaller items fit and look in bigger ones—whether they are boxes or canisters. Also, Sara continues experimenting with what she started earlier but when she seemingly faces a challenge she stops what she is doing and moves on to something else.

Next, Sara put one of the bandanas she picked up from the floor on the muffin pan. She soon removed the bandana from the pan and transferred balls from a canister into the muffin pan. She did this apparently to experiment with how the bandana will look as a cover for the pan with the balls in it. Sara's search for a cover for a box

continues as she left the covered muffin pan and grabbed a box from the floor and put a lid on it and then took it off. She did this a couple of times before she flipped the box and walked away. She went to the covered muffin pan and took another bandana she was holding in her hands and put it over the one that was already covering the pan. She again grabbed a cover and put it on top of a bowl, held the bowl in her hands for a moment and put the covered bowl on the floor.

Sara shifted her focus from the covered bowl to a canister which she moved from where it was and placed it somewhere else. She took a bandana from the container and walked away. Sara then threw the bandana she was holding and grabbed another which she used to cover her face. This action reveals that Sara has a good understanding of the concept of covering something whether an inanimate object or animate. The fact she used the bandana as a cover for a container a couple of times before using it as a cover for her face shows her advanced experimentation and transfer of an effect or act of covering from the objects to herself.

Sara's next action also shows a different and perhaps advanced experimentation with the muffin pan which had balls in it. Sara emptied the pan by stepping on the edge of the pan which made the balls fall out of it. Sara's act of stepping on the muffin pan illustrates that she has knowledge of its effect or outcome. She repeated the action of collecting the balls and putting them in the pan and then emptying the balls and throwing the pan on the floor.

The emptying routine that Sara was engaged in was now transferred to another object—a pitcher. She took one of the balls from the floor and put it in the pitcher and started shaking it like a rattle. The ball fell out of the pitcher, so Sara put the pitcher down, and grabbed a small bowl and walked away. She grabbed another ball and placed it in the pitcher and started shaking it like she did a while ago. Sara repeated this action 11 times before she quit. Repetition is consistent and persistent in Sara's play, exploration, experimentation, and problem solving.

She varied her experimentation with the pitcher by taking a pitcher with a ball inside it and started pouring the ball into a muffin pan by focusing the ball into a particular hole in the pan. Sara repeated this action several times (more than five times). Sara used a different strategy. She used her hands instead of the pitcher to see if she can land the ball in one of the holes in the muffin pan. The ball landed perfectly into one of the holes in the pan. She took the ball out and put it in the pitcher and began to shake it as she did before. She grabbed another ball and placed it in the muffin pan and sat on the pan. She flipped the pan and sat on it again. She got up and placed some bracelets on the flipped pan. Sara's actions go back and forth between finding out and exploring new functions for items she takes from the container. The act of sitting on the pan is something that is novel and had done it once before with the boxes.

Toward the end of the session, Sara went back to the action that she seemed so focused on—searching for the right lid. She picked up a plastic cup and covered it with a lid, then grabbed a muffin pan from the container and filled it with balls. Then she

grabbed a bandana and a canister and placed the bandana inside the canister. The session ended with Sara putting a bracelet around her wrist.

Summary of Session 6

Sara showed her ability to transfer what she learned from one experimentation and exploration with one or two objects to a different set of objects. This is indicative of both Sara's ability to remember the outcome of her first experimentation as well as her desire and curiosity to see if she would get the same result if she repeated the same action pattern with different objects.

Toddler 1: Session 7

Sara was absent on this day so there were no data to analyze for this session.

Toddler 1: Session 8

Sara's search for a lid continues to reflect the trial and error problem solving strategy. In this session, Sara explores and experiments with more or less the same items as before, but she moved from one activity to another relatively quickly. Sara began by taking a lid from the container, held it in her hand and walked with it for a while in an apparent search for something to put it on. She put the lid on a box that was filled with balls. No sooner had she done this than she left to grab a bandana, put some bracelets on her wrist, and reached for a ball that was on the floor. She took off the bracelets and walked away to grab a bandana which she put on her head. Sara then grabbed a canister from the floor, put four bandanas in it, and then reached for a lid to cover the canister with. She grabbed the cover and put it on the canister. Afterwards, Sara took off the lid,

took the bandanas out, and placed the lid back on the canister. She kept holding the bandanas in her hands, and later used one of them as a cover for the big box. She used the other bandanas to cover the rest of the box.

Summary of Session 8

This was a breakthrough session because Sara exhibited manifestations of problem solving thinking and actions that go beyond trial and error. The going-beyond trial-and-error problem solving was demonstrated in Sara's use of several bandanas to cover the big box. She had a goal, which was to cover the box, and used as many bandanas as she thought she needed until she achieved her goal.

The bandanas appeared to be her creative solution. This seems to be the beginning of Sara's venturing beyond mere trial and error. Sara's use of more than one bandana to cover the big box suggests that she is beginning to employ the mean-ends strategy of problem solving. It is an emerging quality of means-ends analysis as judged by the criteria of envisioning a goal or an ultimate action. Perhaps, future sessions will shed more light on how consistent Sara is in her use of the new strategy. Consistency is also another criterion for the means-ends analysis.

Toddler 1: Session 9

Sara started her experimentation by sitting next to a container, grabbing a lid from it, sitting up, and walking around. She closed a canister with the lid she grabbed from the container. Sara was searching for something when she looked at the container again but then she stopped and grabbed something else. She grabbed a small red lid from the floor

and went back to the container and grabbed a box from it. Sara tried to place the small red lid on the box as she was walking away from the container. Next, Sara tried to open the container by pulling, pushing, and twisting. When she could not open the container, she picked it up and took it to another place. She sat next to the container and tried to open the container again. She put a bandana on the floor and put a canister on it. Sara tried again to open the canister and put the bandana on her head.

Summary of Session 9

In this short session, Sara exhibited actions similar to ones before. The constant is her search for a lid that would fit the box she was playing with during almost every one of the previous session. Sara is searching for a lid to the box that she took out from the container. The break through is Sara's thinking in a means-ends manner as demonstrated by an envisioned goal, interest, varying her approach for finding a lid, and persisting on the task. Sara's approach to problem solving builds on the new thinking that Sara displayed in the previous session.

Toddler 1: Session 10

This new session builds on the previous one by Sara standing and holding a bandana in her hand which she then placed on the same muffin pan she was playing with in previous sessions. She picked up another bandana and used it as a cover for another muffin pan. She put more bandanas on the second muffin pan. She soon removed the bandanas off the muffin pan and dropped them on the floor only to pick them up

moments later. No sooner had she picked them up than she put them back on the muffin pan. She repeated this action (experimentation) several times.

Sara stopped her experimentation and switched her focus to her favorite fascination: boxes. She grabbed two bandanas and walked away and put one of them on her head. She reached for a canister that was on the floor and walked away with it. She started putting bandanas into the canister. From bandanas into the canister, Sara shifted her attention once more to the box which she held in one hand and the canister was in her other hand. She then reached for a bracelet from the container, covered her legs with some bandanas and kept holding them in her hands. She repeated this action several times. Toward the end of the session, Sara sat on the floor and placed a box in her lap and started putting balls and bracelets into the box.

Summary of Session 10

Throughout this session, Sara showed her understanding of concepts such as covering something, using different objects as cover, and experimenting with different functions for some objects such as using bandanas as a cover for a box or a canister. Her preoccupation with the box and search for something to cover it seemed to have been transferred to other objects such bandanas and bracelets. Sara's approach and thinking about problem solving transformed from trial and error (as demonstrated by random or aimless search) to the beginning phases of means-ends analysis characterized by a clear goal and an idea of what to do to achieve it. This was a major breakthrough in her problem-solving strategy use.

Toddler 1 Summary Table Description

Each summary table is organized in four columns: Column one lists the session number; Column two describes the events the toddler engaged in or manifested; Column three lists the coding; Column four indicates the type of problem-solving strategy the toddler used during the session.

The events that each toddler engaged in and/or behaviors she manifested that were observed followed the list of events and behaviors described in the coding section of the methodology chapter which includes the following: (1) nesting (3 objects or more); (2) filling (one by one or pouring into); (3) emptying (dumping, taking out one by one, or un-nesting); (4) body as a content; (5) body as a container; (6) stacking (3 or more objects); (7) opening (lids, latches, flip, snap or unscrewing); and (8) closing (lids, latches, flip, snap or screwing).

In addition to the eight events and/or behaviors that were observed, the coding system focuses on the following dimensions of the toddler's play: exploration, repetition, experimentation, solution and no solution. Exploration, abbreviated as E1, stands for a toddler who is interacting and acting with an object or objects with no apparent goal in mind. Exploration can be of three different types. E1a type is where a toddler performs a variety of actions on a variety of objects. E1b exploration is the type where a toddler performs a variety of actions on one type or class of object such as using multiple bowls or similar containers. The third type of exploration, E1c, is where a toddler plays with

different types of materials, such as putting an object from a specific class into a different type of object such as putting a rubber bracelet in an egg carton.

Repetition, denoted by the letter R, is the type of action the toddler repeats three times or more without changing anything about the action. The third dimension is experimentation, and is abbreviated as E2. The toddler varies his/her actions in some way but is focused on one or the same object. The action varies by degree or intensity. This is different from repetition in that the child keeps one object constant such as trying a different size lid on different containers. The constant here is the lid regardless of size. The fourth and last dimension is solution and is represented by the letter (S). Solution stands for the time when a toddler stops experimenting when the objects do what he/she wants them to do. If there was no solution, the coder noted that by writing (NS) and means that the toddler had for whatever reason abandoned the problem before he/she finds a solution. These events were engaged in by the three toddlers in this study as they interacted with the experimental objects regardless of which problem solving strategy they used. There were qualitative differences in the frequency and length of engagement in these actions depending on which problem-solving strategy the toddler used.

The fourth column identifies the problem solving strategy used by the toddler. The two strategies that were used by the three toddlers were trial and error and means-ends analysis. Hill climbing, which is the third type of problem solving strategies described in the literature, was not observed in any of the toddlers' sessions. Trial and error is a strategy in which a toddler tries a number of different solutions to a problem

and then rules out those that do not work. The means-ends analysis is a problem-solving strategy where a toddler envisions an end, or an ultimate goal, and then determines the best strategy for attaining that goal. Hill climbing is described as a problem-solving strategy in which the toddler chooses the operation that appears to bring him/her closer to his/her desired goal. The strategy is called hill climbing because it resembles the problem solver whose goal is to climb a hill by taking any steps that would take him/her to the hill without paying any attention to how efficient the steps could be (Dunbar, 1998). Hill-climbing behavior did not occur in this case or any other part of the data for the three toddlers. The criteria that were used to determine the trial and error and means-ends problem-solving strategies are shown in the table below. The criteria were culled from definitions and descriptions found in the related literature (Dunbar, 1998; Duncker & Lees, 1945; Funke, 2010; Wenke et al., 2005).

Table 2

Toddler 1 Summary

	Events	Coding Events	Problem-Solving Strategy
1	Closing Stacking Filling Emptying	Exploration (E1b) Repetition (R) Experimentation (E2)	Trial and Error
2	Opening Closing	Exploration (E1a) Repetition (R) Experimentation (E2)	Trial and Error
3	None	None	None
4	Closing Stacking Body as Content Closing	Exploration (E1a) Experimentation (E2)	Trial and Error
5	Filling; Emptying Closing	Exploration (E1c), Repetition (R)	Trial and Error
6	Filling Emptying Body as Content Closing	Exploration (E1c) Repetition (R) Experimentation (E2)	Trial and Error
7	NONE	NONE	NONE

(Table continues)

8	Closing Opening	Exploration (E1c) Repetition (R)	Means-ends Analysis
9	Opening Closing	Repetition (R) Exploration (E1b and E1c) Experimentation (E2)	Means-ends Analysis
10	Opening Closing	Exploration (E1a, E1b, E1c) Repetition (R) Experimentation (E2)	Trial and Error

Table 3

Problem-Solving Type: Toddler 1

Strategy	Se 1	Se 2	Se 3	Se 4	Se 5	Se 6	Se 7	Se 8	Se 9	Se10
T/E	X	X	----	X	X	X	---			X
MEA							---	X	X	

T/E: Trial and Error, MEA: Means-Ends Analysis; Se: Session

Research Question 2a for Toddler 1: What Intrapersonal Differences, if any, Do Toddlers Display in Their Problem-Solving Approaches with Contents and Containers Materials over the Ten-Session Period?

As shown in the table above, Sara has moved slowly from using trial and error to means-ends strategy. The trial and error that Sara exhibited throughout the study is indicative of how toddlers use it as a dominant mode of solving problems they encounter in their daily lives. This strategy is characterized by seemingly aimless search but with an interest and persistence on the task until a discovery is made or an insight about a clear direction to pursue is found. An example of this from one of Sara's session as follows:

> Since she did not have any success fitting the box in the muffin pan, Sara moved on to experiment with balls and small lids to see if they would fit in the muffin pan slots, and placed them in the pan. Intrigued by putting items in the muffin pan or in boxes, Sara now grabbed a big box from the container and put a bowl and balls in it. She left the box alone and once again tried to fit the small-size box into the cavities of the muffin pan. But the box would not fit. Even though the muffin slot size did not change and the size of the box she tried earlier and now did not change, Sara still was experimenting to see if the box would fit.

Even though trial and error is the initial approach, it is still within the general framework of problem solving that Jonassen (2000) described as goal-directed process. Sara's actions throughout the sessions described above also align with Piaget's definition of intelligence as one's ability to solve problems, and in the sensorimotor stage, problem-solving ability is exhibited through trial and error. Sara's age falls within the end of the sensorimotor and beginning part of the preoperational stage. The different actions that Sara displayed such as putting a lid on a box, exploring and experimenting with bandanas and bracelets all resonate with Piaget's description of the preoperational thinking and

behaving including sorting by shape, size, color, and texture of material. Viewing Sara's behaviors in terms of Piaget's concept of equilibrium, in every session, Sara was combining assimilation and accommodation to advance her understanding and eventual control over her environment. Sara's seemingly repetitive actions attest to Piaget's concept of equilibrium as she was engaged in a purposeful effort to balance her concept of the world around her, which in this case consists of a multitude of toys contained in Contents and Containers (Keen, 2011). The following is an excerpt from one of the sessions that illustrate this:

> Sara continues her going back and forth to the containers and this time grabbed the bandana that she dropped on the floor earlier and used it as a box cover, grabbed a second one from the container and put it on the same box, and then grabbed a third but this time seemed to want to use it as a cover for the box. She found a fourth bandana that she put on top of the other three. Although it seemed as if Sara was engaging in a stacking game, there was not an obvious plan or reason for this action or type of exploration as evidenced by what she does next. She started taking the bandanas off the box that she was using as a cover and placed them on the floor, took one of them in her hands and walked away. She came back for the other three bandanas and tried using them as covers for two muffin pans that she took out of the container. Sara did this again and again. Her fascination and constant trial and error to find the right covers for the pans or boxes are quite apparent.

In the latter sessions, Sara exhibited actions that relate to some criteria of the means-ends analysis such as a clear goal, an idea of how to achieve it along with interest and curiosity, persistence. The emerging understanding of a clear cause-effect leading to the envisioned or developing goal for the sequence of actions she was involved in. Here is an example of this from the ninth session:

> Sara began by taking a lid from the container, held it in her hand and walked with it for a while in an apparent search for something to put it on. She put the lid on a

> box that was filled with balls. No sooner had she done this than she left to grab a bandana, put some bracelets on her wrist, and reached for a ball that was on the floor. She took off the bracelets and walked away to grab a bandana which she put on her head. Sara then grabbed a canister from the floor, put four bandanas in it, and then reached for a lid to cover the canister with. She grabbed the cover and put it on the canister. Afterwards, Sara took off the lid, took the bandanas out, and placed the lid back on the canister. She kept holding the bandanas in her hands, and later used one of them as a cover for the big box. She used the other bandanas to cover the rest of the box.

It is possible that Sara's problem-solving thinking has gotten more goal-oriented and her intentional behavior as a result was channeled toward achieving the envisioned goal or solution. The summaries of observations of the second toddler's 10 sessions are reported next.

Toddler 2: Session 1

The session began with Jake (23 months) standing and holding a canister in his hands. He tried to take the lid off but decided to move on to something else. Apparently, Jake was searching for some items to put inside the canister as he grabbed and stacked two muffin pans and then grabbed a third one and placed it alongside the other two. Jake's attention turned to a small box that another toddler had and opened it by twisting the lid off and took a ball out of it. Then Jake grabbed three small boxes that were stacked with their lids on so he first tried to take the lids off and then unstacked the boxes. He also took off the lids and started putting a lid on each of the three boxes. So far in this session, Jake exhibited exploring and experimentation behavior with these items, with a hint of finding associations between the items such as lids and boxes or lids and canisters. Jake has this basic understanding of what items belong together, but

whether he is trying to solve a problem, and what specific problem, it is premature to say.

Jake moved to another activity where he took some balls that were in a bowl and placed them on a muffin pan and then took the balls again and placed them back in the same bowl he took them out of it earlier. He grabbed more balls that were lying on the floor and put them in another bowl. He quickly changed focus and began to grab two stacked measuring cups and unstacked them, and reached for a canister and put some bracelets and balls in it. He also took one of the boxes and put some balls in it. He took one box from the big container, tried it to open it by twisting the lid off, but could not. He then grabbed a lid and used it as a cover for the canister. He then grabbed a bowl from the floor and two more bowls from the container. He placed all three bowls next to each other, and then he walked toward a big box and tried to open it but he was not successful. He saw a plastic cup which he grabbed and started filling it with balls, which he soon removed from the canister and transferred them to a muffin pan. While he was at it, he also took some bracelets from a canister and put them in a box. He then tried to cover a box with a lid by trying different size lids and finally found the one that fit the box. This was probably the first attempt of Jake that matches the description of trial and error that is goal-directed.

Jake began unstacking four boxes and took their covers off and moved the balls from a muffin pan onto two boxes, and then took some of the balls from a medium-sized box and put them into a smaller one. Afterwards, Jake took a block and three small bean bags from the container and put them on top of a muffin pan. He soon placed the same

items back into the box and placed a bandana on top of the box. He grabbed more bandanas from the big container and used them as box covers. He took the bandanas off and emptied the boxes of their contents. All of these actions are examples of active exploration and experimentation with the available materials in the big containers. Continuing his experimentation, Jake took a small cup and placed a ball in it and then covered a bowl with a bandana. He reached for a box that was lying on the floor and filled it with balls. He also took a box from one of his playmates and tried to open it but could not. He collected bracelets and balls from one of the boxes and placed them into a bowl which he later emptied out. Jake repeated this action several times: emptying balls from boxes and then placing them back. He did the same thing, but by adding bracelets to the balls into a box and from there to a muffin pan. He repeated this action twice. He collected bean bags and started to put them into a bowl and emptied the bowl only to place contents in another bowl. This was also repeated a few times. He then emptied the contents from the bowls into a canister, and emptied the canister into a box.

Summary of Session 1

In this session, Jake exhibited a range of exploring and experimentation behavior. Through repetitive actions reflective of trials and errors, he was able to ascertain that the canister could hold more items than a box does. Jake was able to arrive at this conclusion by employing the trial and error strategy. A striking feature of Jake's behavior in this session is his seemingly thoughtful reflection on what he is doing: "what happens if I did

so and so?" as seen in his discovery of the canister's holding capacity exceeding that of the box.

Toddler 2: Session 2

This session began with Jake holding a small box in his hands. The box had a ball in it and Jake was trying to take the ball out of it, but he could not. He thought he would be able to open it if he used his mouth, so he put the box on his mouth and apparently forgot what he was going to do. He instead put the box on his mouth and started to make a sound.

From there, Jake saw a bowl filled with balls, mini bean bags and bandanas which he grabbed. He took one ball out of the bowl and threw it against the wall. He took another box which was covered and tried to take the cover off, and after some effort and a few trials, he was successful in getting the cover off.

Jake moved on to the bowl and decided to empty the items that were in it into a box. As he poured the items into the box, they seemingly overflowed the box. How could he put the cover on the box with some items protruding out of the box! Jake solved this challenge by shoving the items lower into the box and making sure that the cover would fit on top of the box without a problem. Jake's action aligns with the description of the means-ends problem solving strategy.

Noticing two muffin pans on the floor, Jake went to the pans, dragged them on the floor and put them side by side. He then took out a measuring cup and put it on his mouth and started making sounds—as he did before when he put the small box on his

mouth. All of these actions are indicative of Jake's active exploration of different functions of items he is interacting with.

Jake turned his attention to blocks by building a tower. He would build a tower and as it gets taller, it starts to wobble and crashes. Jake was intent on building the tower in a way that would not fall, so he tried building the tower many times. He would begin by making sure that the foundation is nice and straight but then as the tower gets taller, he loses control over the direction and how solid the tower is. Again, these actions are indicative of two problem-solving strategies: trial and error which Jake initially used over and over until he realized that there are somethings that he could do to stabilize the tower.

Jake switched from tower building to exploring and experimenting with other items. He took a box and put a bowl on it as a cover. He then moved to pretending as he was pouring water from a measuring cup into a box.

Summary of Session 2

In this session, Jake exhibited both trial and error and means-ends problem-solving strategies. His play is explorative and focused on experimenting with functionality of different items. It is impressive that this toddler was displaying thinking consonant with means-ends analysis in the second session of this study. Toddler 1 displayed hints of means-means problem solving in session 8 and manifested more solid indicators of it in sessions nine and ten. This point will be emphasized more in the comparison of the three toddlers section later.

This is an example of intentional action with a goal in mind where Jake set out to achieve something, persisted on the task, and achieved his goal: getting the cover off the box. What makes this action an intentional one is the clear outcome that Jake wanted to pursue and achieve.

Toddler 2: Session 3

In this session, Jake was observed as he was interacting with material in the Contents and Containers. His exploration and experimentation are very few. Jake started the session sitting on the floor and interacting with all the items around him, touching, grabbing, and holding. He took out a small box and threw it back on the floor. He repeated the same action with a box cover which he picked up from the floor and threw it back as quickly as he picked it up. He continued with this action using other items: picking the item from the floor and throwing it back on the floor. There was no apparent goal for this activity. Perhaps he was experimenting with what sounds the items would make as they hit the floor.

Summary of Session 3

This short session concluded with Jake putting the handle of a measuring cup in his mouth and using it as a musical instrument. He was blowing on the handle and making different sounds with it. By so doing, Jake was transferring an action (blowing) that is usually used on a whistle, toy flute or other similar wind instruments to the handle of a measuring cup. The action also shows Jake's fertile imagination and make-believe play.

Toddler 2: Session 4

Jake began this session by sitting on a muffin pan, and then crawling on the floor to another spot where he started to build a tower with blocks—as he did in Session 2. He seemed distracted as he did not focus on building the tower. Instead, he held a muffin pan in his hands and then threw it on the floor. He moved on to a bowl filled with balls, emptied it on the floor, and put the bowl on his head as if wearing a hat. This is a creative action where Jake pretends the bowl is a hat that goes on one's head. He put the bowl down and grabbed a ball from a muffin pan and placed it inside a bowl. He put the bowl upside down which caused the ball to fall on the floor. Jake quickly grabbed the ball and put it in the muffin pan. He switched his attention to a lid which he grabbed and put on his face. But soon, Jake returned to taking a ball out of the muffin pan and put it into a box. He then unstacked two boxes and moved the ball from one box to the next. He even put his head into the box and quickly started emptying the balls out of the box and instead filled it with blocks.

Jake took out a small box and tried to open it but could not. He did not quit though; instead, Jake employed some strategies to help him open the box such as pulling and twisting the cover. Still, Jake is using a strategy but aligns more with trial and error which helped him open the box. After opening the box, Jake placed the box and its cover on a bigger box which he filled with bracelets and bandanas.

The filling and emptying behavior that Jake was exhibiting continued. Jake put a ball in a bowl and flipped the bowl and the ball fell down. He grabbed the ball and put it

into a small plastic cup and quickly moved the ball into a muffin pan. He then placed the box on his head as if he was wearing it as a hat.

Seeing that a classmate of his needing help, Jake left what he was doing and went to help him fill a box with balls. Jake, however, pushed the box and threw the box on the floor. He did this action several times: filling the box with balls and emptying it. He took over the box that the other toddler was playing with. Repetitive behavior is a characteristic that Jake exhibited many times in this session.

Jake grabbed another ball and threw it on the floor and did this over and over again. Perhaps, he was experimenting with the ball trajectory as he was throwing it out of the box onto the floor. He switched his focus to the three muffin pans that were on the floor and placed a box on them as if he was using the box as a cover for the muffin pans. Jake went back to the measuring cup he was playing with in a previous session, and stuck the cup's handle in his mouth and started blowing on it and making sounds. Jake ended the session by picking up a bowl and putting it on his head as a hat. He also took a box that had balls in it and started emptying it into a bigger box.

Summary of Session 4

In this session, Jake displayed a range of behaviors while he was engaged in his active play with particular contents, especially boxes, bowls, balls, blocks, and muffin pans. He encountered some challenges for which he used trial and error strategy and was fond of emptying and filling containers. He apparently was engaged in intentional

behavior that is seemingly driven by a goal as he repeated this action more than once and with more than one item.

Toddler 2: Session 5

Jake started this brief session holding a box and emptying its contents, then placed a bowl, smaller boxes and muffin pans into the box. He then placed a bracelet on his wrist and put a bowl on his head. These actions show that Jake is continuing to experiment with functions of items and experimenting or pretending that the items are things they are not such as a bowl become a hat or a helmet. This is a manifestation of creative play. He then put the canister on top of the boxes that he has already nested and repeated this action several times. In many of Jake's actions, repetition is frequent and could be because he's either trying to understand something, or he's enjoying the effect of his experimentation or both.

Next, Jake joined another toddler on building a tower, not with blocks this time, but with play items in the container such as boxes of different sizes, bowls, measuring cups, canisters, and bean bags. They placed the items on each other until the tower collapsed. Jake and his classmate repeating building the tower many times, trying to balance it so it would not collapse, but they overloaded the tower and did not follow a systematic approach to keep it from collapsing.

In most of these sessions, the toddlers interacted with the experimental items independently, but there were times in which one or more of the toddlers interacted with one or more of the other children in their classroom.

Summary of Session 5

Still, Jake is using trial and error as a major problem solving strategy. Trial and error necessitates repetition which was manifested throughout this and the previous four sessions. Also, Jake exhibited social play as demonstrated by his interactions with another toddler in building a tower.

Toddler 2: Session 6

This session is even briefer than the previous one. Jake started with tower building using blocks using a muffin pan as a base. He did not continue with this activity. He left the tower building and picked up a bandana from the floor and put it in a box. He picked up more bandanas and put them in the same box. As he was trying to grab more bandanas, another toddler was interested in playing with bandanas as well. The two engaged in a bit of a conflict over who is going to take more bandanas. Jake seemed determined to move on with his ambitious grab for more bandanas which he placed in a bigger box, and then moved them to a bigger box yet. Not content with the bandanas in the biggest box, Jake moved them to the first box they were in and tried to place a lid on the box but it did not fit. This was Jake's last action in this session which continues to show Jake's dominant trial and error approach to problems he encounters. In this case, he was trying to see if the lid would fit on top of the box, and when it did not, Jake did not manifest any actions that would suggest that he was thinking about why the lid did not fit and what would be the best way to achieve his goal of getting the right lid for the box.

Summary of Session 6

Through his active exploration and experimentation in this brief session, Jake showed intentional behavior and thoughtful steps in his problem-solving approach. His behavior included actions such as seeing if some items would fit on or in a box, and whether a lid would fit properly on a box or not. Behind this deliberative action, seemingly, lies a type of thinking that is consistent with means-ends problem solving more so than trial and error.

Toddler 2: Session 7

Jake continued his exploration and experimentation with various contents of the container. He began by holding a bowl and then placed it on top of a box and covered his face with both of them. Then he put a bowl on his head as a hat; he repeated this same action using a box and a canister. He repeated this action many times—covering his face with the box or a bowl. In trying to make sense of Jake's actions, the explanation that was given earlier that he was trying to see the impact of his experimentation on himself. That is, Jake was interested in seeing what the different effect is as he changes the object covering his face. Repetition of this action suggests Jake's continuous use of trial and error to explore and discover.

Jake placed a bowl in a small box and covered them with a lid. The bowl nested within the box was then used by Jake as a hat which he put on his lap and later put into a bigger box. Then, he grabbed two boxes from the canister and put them on the floor and left. He then grabbed a block from the container and used it as a stick to beat on the

muffin pan. While he was using the muffin pan as a drum and beating on it as a drum, he placed a bowl or a box on his head as a hat. This action seems to be mimicking the role of a musician playing his/her instruments.

Instead of covering his head with a small box, he reached for a medium-sized box and put it on his head. He found out that this box partially covers his head while the bigger box covers both his head and face.

Summary of Session 7

In this session, learning by discovery characterizes Jake's mode of thinking. As an elaboration on the same theme, Jake put a bandana on his neck as a tie and continued experimenting with it. As stated before, Jake exhibited actions that were characteristic of creative and imaginary play as well as learning by discovery. As he learns, he incorporates his new insights into his play thereby expanding his thinking and problem-solving repertoire.

Toddler 2: Session 8

On this day, Jake showed up at the end of the session, and had no interest in playing with the Contents and Containers. No observations of his play were made.

Toddler 2: Session 9

This session began with Jake putting a box cover into the big container. He then took out two covers from the container and put his foot in the container. He kept his foot in the container and sat on the edge of the container. Slowly, Jake put his whole body into the container and quickly went out. He turned the container upside down and

covered himself with it. Perhaps this action reveals Jake's curiosity regarding what happens to items when they go into the container. He had to get a taste of what it feels like to be inside the big container. He extended his experimentation by covering himself with the container to probably, again, see how it feels to have the container be on him instead of him being inside it. At any rate, Jake is actively exploring and experimenting.

As slowly as Jake got himself into the container, he got himself out of it. As soon as he did, Jake put the container upside down and covered himself with it for a short while and then put it down. He then walked toward the other big container and tried it to flip it but could not because it was too heavy due to the many items that were inside it. When he could not, Jake walked back to the first container, sat down, and turned it over and then put it over his head and shoulders. The container seemed to cover most of his body except his feet. Jake stood up and took the container off, and engaged in an interesting experiment. He flipped the two containers sideways so the bottom or opening of each was placed on the other. It seemed like Jake was trying to see what putting the two boxes together would look like. This lasted for approximately two minutes, after which Jake took one of the two containers to the spot that it was in originally. Still exploring and experimenting with the containers, not their content, Jake took one of them and emptied its contents, and while he was sitting, he put the container over himself. He saw another child doing the same thing as he was, so he put the container he had on him off. Then he joined the other toddler by going under the container with him. The container was used as an umbrella covering both of them. This was a joint pretend play

and reflects the active exploration of the toddlers, especially of Jake as he repeated this action many times.

Jake now moved to the two containers and, with the first one facing down, placed the second one on top of it. He then sat on top of them. He then unstacked the two containers and sat in one of them. He got out of the container and grabbed the two content covers and put them beside the containers. With the two containers stacked, he took one of the covers and put it on top of the top container.

The final action that Jake was involved in was picking up balls from the floor and then throwing them back on the floor. This was followed by Jake grabbing bandanas and bowls and placing them into a box, covered the box with the right size lid, shook the box and then put it in the big container.

Summary of Session 9

In this session, Jake seemed to be fascinated by boxes as he was experimenting with them by stacking them, nesting them, sitting in them, and even covering himself with them. He also experimented by placing two boxes together as if to make one. However, there did not seem to be a clear-cut problem to be solved or a specific goal to be achieved. Jake's actions during this session can be characterized as active and creative exploration and experimentation. The repetitive nature of some of the actions suggests that Jake was involved in trial and error play.

Toddler 2: Session 10

This session began by Jake stepping on top of a muffin pan and while he was doing that, one of his mates needed help putting a bracelet on, so he gave him a hand with it. After helping his classmate, Jake continued to step on the muffin pan. He moved on to doing something he attempted in the earlier session which was flipping one of the containers. He was successful in doing that. He emptied all the items off the container and sat inside the container. This action can be seen as a means-end strategy where Jake set out to use the container as a place to sit and explore what is around him through the transparent walls of the container. Jake repeated the same action with another container. This is a good example of a transfer or application of strategy to another context.

Also, Jake repeated a similar action to the one he did in the previous session which was placing two containers horizontally as if he was making one. Jake found out that it was not possible to put the two containers together if he was sitting in one of them, so he got out of the one he was in. Now, he was able to put the containers closer together. He repeated this action several times indicating a means-ends strategy use. Jake ended the session by placing one of the containers on the floor and sitting in it, putting a box on his head, beating on another box as if it were a drum set, and stacking two boxes.

Summary of Session 10

All of the behaviors that Jake exhibited in this session are similar to ones that he displayed throughout the previous sessions. Jake demonstrated use of both trial and error

shown through repetitive behavior, and also means-ends strategy use through his systematic experimentation with the containers and putting them closer together as one. Jake demonstrated the understanding and use of the means-ends problem-solving strategy in session 2.

Table 4

Toddler 2 Summary

	Events	Coding Events	Problem-solving Strategy
1	Opening Closing Filling	Exploration (E1a, Elc) Repetition (R) Experimentation (E2)	Trial and Error
2	Stacking Body as a content	Exploration (E1b, E1c) Experimentation (E2) Repetition (R) Solution (S)	Trial and Error Means-ends Analysis
3	Nesting	Exploration (E1c, E1a) Experimentation (E2) Repetition (R)	Trial and Error
4	Stacking; Filling Opening; Closing Body as a container Body as a content	Exploration (E1a, E1b, E1c) Repetition (R) Experimentation (E2) Solution (S)	Means-ends Analysis
5	Stacking	Exploration ((E1b) Experimentation (E2) Repetition (R) Solution (S)	Trial and Error

(Table continues)

6	Closing Opening Emptying	Exploration (E1b,E1c) Repetition (R) Experimentation (E2) Solution (S)	Means-ends Analysis
7	Nesting; Filling; Stacking Body as a container	Exploration (E1b, E1c) Experimentation (E2) Repetition (R)	Trial and Error
8	None	None	None
9	Stacking Nesting Closing Body as a content	Exploration Experimentation Repetition	Trial and Error
10	Stacking Filling Emptying	Exploration (E1b, E1a) Experimentation (E2) Repetition (R)	Trial and Error

Table 5

Problem-Solving Type: Toddler 2

Strategy	Se 1	Se 2	Se 3	Se 4	Se 5	Se 6	Se 7	Se 8	Se 9	Se 10
T/E	X	X	X		X		X	----	X	X
MEA		X		X		X		----		

T/E: Trial and Error, MEA: Means-Ends Analysis, Se: Session

Research Question 2a for Toddler 2: What Intrapersonal Differences, if any, Do Toddlers Display in Their Problem-Solving Approaches with Contents and Containers Materials over the Ten-session Period?

As the table above shows, Jake's actions, behaviors, thinking, and problem-solving gradually became more consistent, sophisticated, and systematic. Although Jake demonstrated use of the means-ends problem-solving strategy in session 2, he resorted to trial and error quite often in later sessions. Resorting to the trial and error strategy perhaps points to the possibility that it is a strategy they fall back on when they are unsure of how to solve the problem at hand. Here is an excerpt from session 2:

> From there, Jake saw a bowl filled with balls, mini bean bags and bandanas which he grabbed. He took one ball out of the bowl and threw it against the wall. He took another box which was covered and tried to take the cover off, and after some effort and a few trials, he was successful in getting the cover off. Jake moved on to the bowl and decided to empty the items that were in it into a box. As he poured the items into the box, they seemingly overflowed the box. How could he put the cover on the box with some items protruding out of the box! Jake solved this challenge by shoving the items lower into the box and making sure that the cover would fit on top of the box without a problem.

Jake's action aligns with the description of the means-ends problem solving strategy in terms of meeting the criteria of an envisioned goal, purposeful approach or a well-thought out approach and persisting on the task until the goal is achieved. The search is not aimless but goal directed. Jake's actions also show how his exploration, repetitions, and experimentation are plan-full. Further, these action show that at this stage of development as is the case in advanced stages, children do not completely abandon the use of one strategy just because they now have mastered or discovered a different or a more effective one. Quite the contrary, children's repertoire of problem-

solving thinking and strategy use expands (Bjorklund, 2005). What remains a challenge is the toddler's judicious and thoughtful application of the strategy at the right time and in the right place. That is, the toddler learns when a particular strategy is best used, and this thinking continues throughout one's life. This is clear in Jake's case where in the early session he showed a tendency toward the means-ends analysis but in later sessions, he showed a stronger use of the trial and error strategy. This point is illustrated in the excerpt from one of the latter sessions:

> Jake started with tower building using blocks using a muffin pan as a base. He did not continue with this activity. He left the tower building and picked up a bandana from the floor and put it in a box. He picked up more bandanas and put them in the same box. As he was trying to grab more bandanas, another toddler was interested in playing with bandanas as well. The two engaged in a bit of a conflict over who is going to take more bandanas. Jake seemed determined to move on with his ambitious grab for more bandanas which he placed in a bigger box, and then moved them to a bigger box yet. Not content with the bandanas in the biggest box, Jake moved them to the first box they were in and tried to place a lid on the box but it did not fit. This was Jake's last action in this session which continues to show Jake's dominant trial and error approach to problems he encounters.

Furthermore, one of the characteristics of a solid understanding of the means-ends analysis is the ability to transfer it to another context. That is, the toddler remembers the steps that he/she used previously and follows the process to solve new problems. Transfer as a skill, however, has not been consistent. For example Jake did not try to press down the bandanas in this situation when he pressed down the objects in a container earlier in session 2 in order to fit the lid on the container. At any rate, the following excerpt from Session 10 provides an example of a transfer or application of strategy to another context:

> This session began by Jake stepping on top of a muffin pan and while he was doing that, one of his mates needed help putting a bracelet on, so he gave him a hand with it. After helping his classmate, Jake continued to step on the muffin pan. He moved on to doing something he attempted in the earlier session which was flipping one of the containers. He was successful in doing that. He emptied all the items off the container and sat inside the container. This action can be seen as a means-end strategy where Jake set out to use the container as a place to sit and explore what is around him through the transparent walls of the container. Jake repeated the same action with another container.

Toddler 3: Session 1

The third and last toddler in this study is Mark (21 months). The session started with Mark standing in front of the two big containers filled with contents such as muffin pans, balls, bowls, bracelets, blocks, canisters and cups. He started walking towards the containers, leaned over and stared at the containers for a while. All of a sudden, Mark looked away in a direction that the camera did not capture. He was distracted for a short while by what seemed to be another classmate doing something that fascinated him. Not too long after, Mark put his hands on his eyes and repeated the action that he did at the beginning of the session, which is looking at the containers. He leaned over again and grabbed a container and held it in one hand, and picked up a mini bean bag with the other. He put the two items down, and then grabbed a big canister, held it for a few seconds and then moved it closer to his eyes so he could see what was inside it. He put the big canister on the floor. He first twisted the cover to the right but it did not work, then he figured out the solution by twisting it to the other side. Then he held the canister cover in one hand and started filling it with balls and bracelets. Afterwards, he put the cover back and closed it. He started looking again at the big container and thinking about

grabbing another item. He picked a medium canister with one hand, and used his other hand to open a bigger canister. He let go of the big canister and used both of his hands to open the medium canister. Again, Mark is exhibiting strategic problem solving as he realized that he cannot achieve his goal while holding the big canister. After many attempts at taking the cover off, he decided to quit. This is an example of repetition as well as of employing the trial and error problem-solving strategy. He kept holding the medium canister in his hand, and was momentarily distracted by the other kids who were playing in the same area. Then he went back to the container and searched for more items to play and experiment with. This time he grabbed a small canister and did same thing with it as he did with the big and medium canisters. He opened and put it on the floor right beside the big canister. He went back and opened the big canister and emptied its contents into the small canister. This is an indication of Mark's thinking about which of the containers has more holding capacity. With the canisters full of other items, Mark put the covers back on both canisters.

Mark moved to the second big container that had items similar to those in the first one. He stared at the items around him and was seemingly deciding what item to grab next. He grabbed two muffin pans of different sizes. One of them had 12 small holes, and the other one had six big holes. He put both of them on the floor and went back to grab a third one which he placed right beside the other two. The third muffin pan was much larger as it had 24 small holes. He then started taking balls out of the container and was placing them where they fit in the muffin pans. He successfully filled one pan that

had 12 holes that fit balls. Mark looked at the container again and searched for balls that would fit perfectly in the other two muffin pans. He grabbed a small canister and took its lid off. Mark grabbed a ball and tried to fit it into the canister, but it did not fit. He put the canister down on the floor, and put the ball on the muffin pan that had 12 holes. He filled the pan with two other balls. He also picked three muffin pans that were not same size, put them down and went to the container that he was playing with earlier. After this, Mark was looking for something else to play with.

Out of the container, Mark grabbed a bandana, looked at it for a few seconds and then put it back in the container. He took three balls from the container and placed them in a muffin pan for a short while before taking them back to the container. He grabbed a bean bag, held it in his hands for a few seconds and then put it back in the container. He picked a water pitcher, filled it with balls then started shaking it which caused the ball to fall out of the pitcher. Mark stood for a few seconds and then started shaking the pitcher. His solution was to put a cover on the pitcher. He first tried a small cover but it did not fit. He looked again for a right cover, but did not find it, so he decided to use a new strategy. He grabbed a box, took its lid off, and tried to use the lid to cover the pitcher, but it did not fit. Unable to find the right size cover for the pitcher, Mark decided to put the ball into the pitcher and shook it again to see if the ball would fall. There was no cover on the pitcher. His strategy worked—the ball did not fall out this time. Next, Mark emptied the balls out of one of the muffin pans and pretended he was pouring cake mix into muffin cups.

Afterwards, Mark went back to the container and grabbed another box. He took the lid off and put it on the floor, walked toward the muffin pan, and moved balls from the muffin pan and pitcher to the box. After many trials, he successfully put the cover back on the box as he forgot the right way to place the cover back on the box. After that, he shook the box vigorously, he then took the lid off and moved the balls from the box to the muffin pan and the pitcher. He repeated the same action several times, but this time he used the bigger balls which he took out of a different muffin tin. He repeated this experience for a third time. He paused and repeated the same action two additional times using one ball only.

Mark moved balls from the muffin pans to a big box. Mark looked at the floor for a moment in search for more balls. He found one which he quickly threw into the big box. He held the box in his hands, shook it, and emptied the balls into a bowl. He moved the balls again from a bowl to the box, and shook it and later put it on his lap. He put his hand inside of the box and shook the balls. Then he moved the balls to the bowl, shook the empty box, and moved the balls from the bowl to the box again. Mark started shaking the box again, and then poured the balls from the box into the bowl. He repeated the same action again.

Mark grabbed a tall plastic item from the big container, and pretended that he was pouring some type of mixture into the muffin cups. He then put the lid back on the box he was playing with a bit earlier and put it on the floor. A bit later, he moved balls from the muffin pan to the big box. He shook the big box and moved the balls twice from one

box to the other. Each time, Mark shook the box as he placed the balls in it. Then, he grabbed a pitcher from the floor and held it in his hands.

Afterwards, Mark stacked two boxes and moved balls from one to the other. He picked up a bowl, shook it, and grabbed a bottle which he was able to open after trying a few times. He pretended as if he were pouring something on the balls by using the bottle. He then quickly put the lid back on the bottle. Mark repeated the same action several times. He twisted the bottle's cover and took it off. He filled the bottle with balls, and put the cover back on it and started shaking it. After shaking the bottle, Mark pretended that he was pouring some mixture on the balls.

Later, Mark picked a bandana from the floor, looked at it for a while, and then put it down where he found it. He turned his attention to a small box and started to put a ball in it and then covered with a lid. He also put some balls in a bowl. Mark emptied the balls from the bowl to the big box, and then again from the box to the bowl. He repeated the same action, but this time he grabbed a medium box, took its lid off and proceeded to empty the balls from the big box to the medium-sized one. His next action was to cover the medium box but he could not because the lid he chose was not the right size. Mark's action suggests that perhaps he was planning strategically of how to deal with the problem. His solution was to take out some of the balls so the cover would fit perfectly on the box. This is in line with means-and-ends problem solving strategy.

Since his strategy worked and the lid fit on the box, Mark took the lid off and moved the balls out and put them into the muffin tin. As he did before, Mark took the

balls out of the muffin pan, placed them into the medium box, and put the lid back on the box. This perhaps shows Mark's way of testing whether the lid would still fit on the box if he had a different arrangement of balls, or whether he would have the same result when he took the balls out and back in the box.

Toward the end of this session, Mark started a different exploration—stacking. He put the medium box into the big box and then he tried to separate them. After many trials, he figured out how to separate the two boxes. He flipped the boxes and was able to easily take the boxes apart. This is an example of Mark using the trial and error strategy as he was repeating an action many times without an apparent systematic approach to separate the boxes. He was not displaying hill climbing either as he did not exhibit a difficult move that an easier one would accomplish more easily.

Seeing that the medium size box had a lid on, he wanted to take it off. Apparently the lid was snug and could not be taken off easily. Mark tried his best and in different ways to take the lid off the medium box. Among the strategies he used was to pull the cover from different edges of the box which helped him to finally open it. Mark repeated what he did earlier at least three times; he moved the balls to the big boxes and again to the medium boxes. Similar to what Mark did before, he did not display for a difficult approach to solve the problem as all the steps he took seemed to be a variation on the previous ones but not too markedly different.

Mark picked up a muffin pan and put it on his lap and put it down after a few seconds. He got up, walked to the boxes, and started moving the balls from the boxes to

the muffin pan that he placed on his lap a few minutes earlier. He was selective on what size balls he picked as he only took the medium size balls as he knew that large size balls would not fit into the spaces in the muffin pan. The fact that Mark was picky on what size ball to put in the muffin pan shows his ability to transfer the means-ends strategy to this situation. Mark knew that the strategy worked for him before and that he could apply it in this context without any problems.

Mark carried the muffin pan and walked to other side of the room and placed it on the floor. He repeated an action but with slight variation. He moved balls from a canister to the muffin pan he used before. He grabbed another muffin pan and strategically started looking for balls that would fit into the pan, but he could not find any. Mark transferred the balls that were in the muffin pan to the bigger muffin pan that he was holding in his hands. Since the spaces in the first muffin pan were fewer than the ones in the pan he was holding, Mark had to get more balls from a nearby bowl to fill the empty cups in the larger pan.

At the end of this session, Mark moved one ball to a small box and then immediately tried to take it out. When he could not get the ball out, he did not persist and quit. He went back to an empty muffin pan that was on the floor and picked it up. He held the pan in his hands for a few seconds and then put it down. A departure from what he was doing, at the end of the session Mark saw a box full of bandanas and started taking them out of the box one at a time.

Summary of Session 1

In this session, Mark exhibited intentional behavior and use of problem-solving strategies. Although he used the trial and error a few times, Mark used the means-ends strategy more often and implemented it correctly and skillfully. Compared to Sara and Jake who exhibited use of the means-ends strategy in the eighth session and second session, respectively, Mark demonstrated the thinking and actions of the means-ends strategy right away in session 1.

Toddler 3: Session 2

In this session, Mark started by walking toward one of the big containers and took out his favorite objects: muffin pans and balls. He soon started putting the balls into the muffin pans. Spotting a pitcher in the container, Mark took it out and also started putting balls into it until it was full. Mark very quickly discovered that the pitcher can hold only two big balls. He tried to put a third ball in the pitcher, but there was no space for it. This is an example of learning by discovery—learning the holding capacity of the pitcher for the size balls he was using.

Mark took one ball out of the pitcher, and with one ball remaining in the pitcher, he started shaking it as he did at the beginning of the first session. The difference this time is in Mark's using balls of different sizes and colors to shake one at a time in the pitcher. This experimentation is rather creative and reveals Mark's thoughtful and systematic approach to experimentation. He experimented with the big ball, followed by the medium size, and the smallest ball last. Mark picked four small balls to see if they fit

in the pitcher that only accommodated two big balls earlier. The four small balls fit nicely into the pitcher which he then started to shake. Next, he took out the balls and put them in a small box and started shaking it. Mark is exhibiting active but plan-full experimentation by carrying out the same action on multiple materials.

Mark moved on to play with a small box which he picked up from the floor and soon put it down as he seemed to be distracted by a canister that was on the floor. He took the lid off the canister and shook the canister; then, he put the lid on and shook the canister again. He repeated this shaking action with the lid and off several times. Afterwards, he grabbed two cups and put one on top of the other, and then pretended as if he was pouring some liquid out of one into the other. Seeing his teacher sitting close by, he jumped into her lap and continued on with his pouring action with one of the cups he was playing with. He jumped off his teacher's lap and picked up two small cups from the floor, put one down, and left one in his hand and was repeating the pouring action he displayed earlier. He soon trained his eyes on a bandana that was lying on the floor. He first placed the cup that was in his hand on the bandana and then grabbed a bowl and also placed it on the bandana. He then removed both the cup and bowl off the bandana and stood on the bandana with the cup in his hand and lifting it periodically to his mouth as if he were drinking something.

Mark noticed a ball on the floor and picked it up and was rolling it in his hands and suddenly threw it on the floor. He bent down and pretended as if he were taking

something that came out of the ball and placed it inside the canister. He then covered the canister with a bandana.

The pretending and experimentation continued. Now, Mark held a bowl in his hands and then placed it over his head as if it were a hat. He picked up the balls again and started squeezing one of them as if he were squeezing a lemon and put the liquid into the canister. Satisfied with the amount of whatever liquid he was squeezing into the canister, he started pouring the imaginary liquid into a bowl. The empty canister became the holding space for balls, bandanas, which he covered with a box. He took some bracelets from the container and stuffed them into the canister and placed a lid on it. He put the cover on and took it off six times. He then removed the cover, emptied the canister into the container. He would again fill the canister and pour it back into the container. He also repeated this action several times.

Summary of Session 2

Mark continued to exhibit his usual active exploration and experimentation with some of the objects that he played with before. In this session, Mark exhibited the now established means-ends problem solving thinking and doing. In his play, it is obvious Mark behaves like a naive scientist seemingly testing hypotheses about how things work and what kind of results some of his actions are likely to produce.

Toddler 3: Session 3

In this session, Mark started by looking in the container and grabbing a box out of it. He also grabbed two bracelets which he placed inside the box. Another toddler came

and took one of the bracelets while Mark was looking for more items in the other container. He picked up one small and one big ball and placed them inside the box, and wanted to cover the box so he started looking for the right size cover. He was engaged in a trial and error process by placing one cover after another on top of the box until he found the right one. Mark, however, noticed that the cover stuck out a bit. He was trying to figure out how to make the lid cover the box perfectly. As soon as he took the lid off, he noticed that the big ball was sticking out of the box, and once he took that ball out, the lid covered the box perfectly. With this challenge solved, Mark held another box in one hand and put its cover in his other hand. He then placed both box and its cover on the floor and grabbed a bowl from the container and put it into the box. Mark suddenly quit this activity and moved on to play with other items--only to quickly return to do what he was doing before.

Mark took out a ball from the container and put it in a box and covered the box with a lid and started shaking it like a rattle. He continued with experimenting with the rattling sound by opening the box, taking two balls from it and placing them into a bowl. He moved more balls until he had a total of four balls in the box which he then shook as he did before but for a longer period this time. He then took out all the balls from the box and placed them into another bowl. As quickly he took out the balls, Mark put them back into the box and placed the lid on the box and shook the box some more. He suddenly quit what he was doing and started watching his peers play.

In the next episode of interactions with items from the container, Mark engaged in a series of repetitive actions like he did before such as opening and closing boxes, filling boxes with balls, shaking boxes with items inside them, pretending to eat balls as it they were fruits, and filling boxes with items such as balls and trying to fit the lid perfectly on boxes. Mark started by opening a box and taking out balls and pretending to eat them, then he closed the box and started shaking it with the balls inside it. He repeated this action seven times. He would take a break to watch what his peers were doing around him. Quickly, Mark returned to play with the boxes. He put a box on his lap, placed a bandana on the floor, and then covered the bandana with the box. He repeated the same action with a bit of variation. He put the box on his lap and sat on the bandana. He opened the box and again started pretending to eat the balls as if he were eating an orange or an apple. He did this for a short while and then put the box on the floor and placed a bandana on top of it. He then opened the box and took some balls out and pretended to be eating them. As he did before, he closed the box and covered it with a bandana.

Next, Mark put a big box full of balls on his lap and then placed it on the floor because it was seemingly easier to open and take balls out of it. He then opened and closed a small box and tried to put balls in the box. He was taking balls in and out of the small and big box meanwhile he was trying to cover the boxes. He added one more ball to the big box but it did not fit. He tried to place it on top of the other balls but there was no room for it, and when it stopped rolling, he could not keep the lid on the box without the ball falling out of it. Mark solved this problem by simply leaving the ball out and

covering the box--a signal of his acknowledging that there is no space for the ball in the box.

Mark's repetitive play and experimentation continued. Mark opened the box full of balls and moved the balls out and placed them into a bowl, and quickly returned them to the box. He methodically and carefully closed the box and started shaking it for a few minutes. And, as he did before, Mark put the box down on the floor, opened it, and took some balls out and closed it again. Mark did this several times. What is curious about this experimentation is Mark's increasing and decreasing the number of balls in the box as if to find out what difference in rattling sound they make. The fact that Mark kept opening and closing the box and putting in and taking out balls reflects his active experimentation and is also indicative of means-ends problem solving.

Toward the end of this session, Mark turned his focus on muffin pans. He took one out of the container and put it on the floor and started filling it with balls. Then he grabbed his favorite box and filled it with balls. His aim apparently was to see what happens when he stands up and drops the box on the floor. He repeated this action a few times with a small box and a big box. Mark's actions show his active experimentation and means-ends analysis. That is, Mark was experimenting with different permutations such as size of box, number of balls, rattling the box while standing, rattling the box while sitting, and dropping the box on the floor. Controlling these variables and examining their impact is indicative of Mark's mini-scientist's mind.

Summary of Session 3

Very much like in the previous session, the mini scientist Mark was active in his experimentation. Manipulating variables and looking at the different possible outcomes seemed to be almost a hallmark of Mark's thinking. That is, Mark's hypothesis testing is almost predictable as he engages with the experimental contents of the container: different size boxes, placing balls in and outside of the boxes, experimenting with rattling sounds with objects in a box while standing and while sitting.

Toddler 3: Session 4

Stacking, nesting, and putting things in and outside of other containers seem to be Mark's dominant actions in this session. At the beginning of the session, Mark first picked up a bowl and a canister and then started taking balls and bandanas from one of the big containers and putting them into the canister. Mark engaged in pretend play by taking the bowl he picked up earlier and put it on his head and by putting a bracelet on his mouth. Mark oriented his focus to putting things in a box. He opened a small box and tried to fit a ball in it, and then closed the box when he could not fit the ball in the box. He tried again by taking a ball from the container and placing it into a small box. The ball fit, and Mark was able to close the box. He repeated this action six times. He was methodical in the way he took the ball out: by turning the box upside down. He would put the ball back in it and cover the box.

Mark repeated the same action but with some variation because the ball was stuck in the box and he could not take the ball out. He tried to flip the box in different ways

and still the ball did not come out. Feeling as if he exhausted all possibilities and ways to get the ball out of the box, Mark asked some of his peers to help him take the ball out of the box. Together, they were able to get the ball out by some holding the box tightly and some wiggling the ball out of the box. This action showed Mark's resourcefulness as he enlisted his playmates' help only after he tried several times to get the ball out of the box by himself.

Afterwards, Mark turned to pretend play. He put a ball under his shirt to make his belly look bigger. He was smiling and laughing as he was doing this. Perhaps he did this to show off and to attract the attention of his peers.

A few minutes later, Mark went back to playing with boxes. He started by grabbing a box lid and then looking for the box it fit. This was a new action as he always grabbed a box first and then looked for the right size lid for it. Mark placed a ball in the box, put the lid on it, and began to shake the box. He then opened the box, took the ball and placed it in a bowl and put the lid back on the box. Mark repeated the same action but with two balls this time and without using the box lid. He took out the two balls into a small bowl, and then moved them to a bigger bowl.

Mark went back to pretend play and doing something he did earlier but with some variation. He tucked a ball under his shirt acting to make his belly look big and then added another ball to make his belly look even bigger. He then grabbed a small bowl and put a ball into it and shook it in a circular fashion and all the while smilingly observing the movement and the light bouncing off the ball. This was also Mark's first trial of

shaking the bowl and the box without a lid or cover. At first, the ball kept falling when he shook the bowl, but later he managed to shake the bowl without the balling falling out. This action shows Mark's use of the means-ends strategy. He deliberately kept the lid off as he shook the ball and was shaking in a circular fashion instead of up and down. Controlling two variables (keeping the lid off and circular motion) made it possible for Mark to keep on shaking the bowl with the ball in it without the ball falling out.

Mark moved the ball from the bowl to a box and added more balls to it. He covered the box and shook it. The fact that Mark covered the box when he had more than one ball in it shows that Mark probably knew that shaking the box without a lid when it has more than one ball is likely to result in balls bouncing out of the box. Mark returned the big box to the container and grabbed a smaller box. He put one ball into it and then covered it. Soon though, Mark grabbed the big box and nested the small box into it. He took the big box away and kept holding the small one and put the cover on and off four times. Mark walked to the large container holding all the material and grabbed a ball and put it in the small box. The session ended by Mark lifting the box and turning it upside down and watching how the ball fell out of it.

Summary of Session 4

Throughout this session, it seemed that Mark was experimenting to see how fast the ball would fall out, how the ball looks as it falls, and perhaps what kind of noise and how loud it is as it hits the floor. All of these actions are manifestations of an active

experimenter whose thinking is intentional. In other words, Mark was employing the means-ends strategy accurately and successfully.

Toddler 3: Session 5

Mark was absent during this session, so there was no observation to be analyzed.

Toddler 3: Session 6

This was a relatively short session in which Mark displayed actions similar to ones he displayed in earlier sessions. The session began with Mark taking out a pitcher, a box, and a bracelet from the container. With these three items, Mark first placed the bracelet into the pitcher and then emptied the pitcher into the box. He successfully searched for and found the right lid to cover the box. He grabbed another bracelet and put it into the box, put the lid securely on the box, and shook the box. A few minutes later, Mark emptied the small box into a bigger box, and tried very hard to put the lid on it but it did not fit. He put the box down, and took out the items inside it and placed them in the small one. He knew the lid he had for the small box was the right size, so he covered the box. But seconds later, Mark opened and closed the small box many times. When the lid was on, Mark shook the box to listen to or experiment with the rattling sound of the items inside the box. The session ended with Mark putting the box down on the floor and walking away.

Summary of Session 6

In this session, as in earlier sessions, Mark exhibited curiosity by experimenting with nesting boxes, placing items inside one box and transferring the contents to another,

shaking the small box and shaking the bigger box. Perhaps Mark was trying to discover the difference in sound when items were shaken inside a small box versus the big box. The repetitive nature of his active exploration suggests that he was thoughtfully and deliberately manipulating variables to see what new outcomes they would produce.

Toddler 3: Session 7

As he did numerous times in previous sessions, Mark started this session by putting a ball into a small box and covering the box with the right lid. He then opened the box and took the ball out and placed the lid back on the box. No sooner had Mark closed the box than he opened it again to put the ball back in the box. He then took the ball out of the box and put it into a bowl, and upon noticing more balls on the floor, he gathered them and added them to the one that is already in the bowl. Afterwards, Mark stacked two boxes and quickly put them back into the container. He picked up two boxes that were inside a big box and attempted to stack them, but he could not. Since stacking did not work for him, he started filling one of the boxes with two balls, which he immediately moved out of the box and back to the container where he got them. He took out a water pitcher and pretended as if he were pouring water from it into the box. He repeated this action three times.

With the pitcher still in his hands, Mark reached out for a block that was on the floor and placed it on top of the pitcher as a cover. Moments later, Mark held the pitcher in one hand and grabbed a mini box and threw it into the pitcher. He kept putting the small box in and taking it out of the pitcher for a few minutes. Mark suddenly lay down

on his stomach apparently to observe the pitcher from the bottom side while he was taking the small box out and letting it fall.

Mark momentarily switched activity. He grabbed a box cover from the container to see if it would fit one of the boxes he took out, but the lid did not fit it. He went back and forth to the container trying one lid after the other on the box. None of them was the right size. He started strategizing by grabbing a large and a small-size lid, but neither one fit the box. Since the big and small lids did not work, Mark grabbed a medium-sized lid which turned out to be the right size for the box he had. By process of elimination, Mark found out the right size cover for the box.

Repetitive actions like the one above continued. Mark grabbed a block from the small box and put it into the pitcher and then he put it back in the small box. He put the lid back on the small box for just a second before taking the block out of it and placing it into the big box. The block sat in the big box for a few seconds before Mark took it out of it. Seemingly wanting more than one block in the box, Mark grabbed different size blocks, put them in the big box, and put the lid on. Mark walked to the container and looked for something. He grabbed a box out of the container, and then proceeded to empty the box that had blocks into a smaller one, but the blocks did not all fit in it. Since the small box did not accommodate all the blocks, Mark emptied the blocks out of it on the floor. Mark did the same thing to a big bowl that had some items in it. With the bowl now empty, Mark picked the blocks that he emptied out of the box and put them into the bowl. Even though the box was empty, Mark put the lid on it.

Mark took out another block from a canister and put it into the bowl. He opened the small box and then pretended as if he filled it with something from a small bowl, and then put the lid back on the box. He made sure that the cover was securely fastened to the box before he started shaking the empty box. Mark now was going to shake the box with some items inside it. He opened the box and filled it with bracelets, put the lid back and shook the box vigorously. He repeated this action several times before moving the bracelets from the box and into the canister which he closed with right size lid.

In the final minutes of this session, Mark grabbed a box from the floor and emptied the three bracelets into the canister. With the box on his head as a big hat, he took the canister in his right hand and emptied the bracelets on the floor. As he was pouring the bracelets down from the canister, Mark noticed a red bandana on the floor and decided to pick it up and to place it on top of one of bracelets he dropped on the floor earlier. He reached for the bandana again only to use it this time to grab three bracelets and a lid. With the bracelets, lid, and bandana in his hands, Mark walked toward a box and put them inside it and put the lid back on the box. He also placed a bandana on the lid of the box. He then put the bandana on the floor and sat on it for a few seconds. He stood up and went and opened the box. He took all the bracelets out of it, and placed the box in his lap as he did in an earlier session. Mark remembered how he used the items from the container and sometimes repeated what he did before, and at other times, he improvised and devised new ways of using some of the contents of the containers.

Summary of Session7

Building on skills he acquired through interactions with the experimental contents, especially his favorites (balls and boxes), Mark displayed an ability to connect new functions or uses of objects with ones that he discovered before thereby creating new and novel ways. This was most evident in Mark's actions with the bracelets, box lid, and bandanas toward the end of this session.

Toddler 3: Session 8

As this brief session began, Mark was trying to take a canister's lid off, but he could not. The lid seemed to be too tight for him to open. Mark momentarily left the canister, and instead, he grabbed two balls from the floor. Then, he went back to the canister and tried to open it again apparently using a different twisting way and he was able to open it. He filled the open canister with two balls and put the lid back. He took the lid off and filled it with more balls and then put the lid back. He shook the canister and listened to the rattling sound the balls made.

Mark took the lid off and moved the balls to a big box, and then decided to put the balls back into the canister. He repeated this experiment many times. The session ended with Mark transferring the balls from the canister to the big box and putting the lid on it.

Summary of Session 8

This was a brief session in which Mark demonstrated a feature of successful problem-solving—perseverance. Mark tried different ways to take the canister's lid off, and when he could not, he took a short break and did something else. No sooner had he

left the canister than he returned back to it to give it another try and to use yet another strategy to twist the lid off.

Toddler 3: Session 9

This session was even shorter than the previous one. Mark grabbed two bandanas; held them in his hands, then threw them on the floor. He then walked toward a box lid which he picked up and put on his face like a mask. A few seconds later, Mark went to the container and took a bracelet out of it and put it around his wrist. Mark seemed to be looking for a particular item in the container which he could not find readily. Mark flipped the container upside down and took out a box full of blocks which he emptied into the container. In this session, Mark exhibited pretend behavior as well as active manipulation of some of the contents of the container.

Summary of Session 9

Session 9 was also brief. The main action observed was that Mark was intent on finding a particular object. As he searched for it, he emptied containers and looked through the contents to see if he would locate it there. Mark was intentional in his behavior; he was goal directed, and seemingly had a plan which he was following to locate the item he was looking for. Goal-directed behavior is a salient feature of problem solving.

Toddler 3: Session 10

The tenth and final session began with Mark taking a bandana out of the container and putting it on his head. He also grabbed a big bowl and put it on his head and then on

his face. The bowl fell down from his head to the floor. Seemingly wanting the bowl back on his head, Mark reached for it and put it on his head again.

Summary of Session 10

The brief description of Session 10 above summarizes itself as it is reminiscent of actions Mark displayed in earlier sessions.

Table 6

Toddler 3 Summary

	Events	Coding Events	Problem-solving Strategy
1	Closing Opening Filling	Exploration (E1c) Experimentation (E2) Repetition (R) Solution (S)	Means-ends Analysis Trial and Error
2	Stacking Filling Emptying	Exploration (E1a, E12, E1c) Experimentation (E2) Repetition (R) Solution (S)	Means-ends Analysis
3	Nesting Filling Emptying	Exploring (E1a, E1b, E1c) Experimenting (E2) Repetition (R) Solution (S)	Means-ends Analysis
4	Stacking Opening Closing Filling	Exploration (E1b, E1c) Experimentation (E2) Repetition (R) Solution (S)	Means-ends Analysis

(Table continues)

5	None	None	None
6	Opening Closing Emptying	Exploration (E1b, E1c) Repetition (R) Experimentation (E2) Solution (S)	Means-ends Analysis
7	Nesting Filling Stacking	Exploration (E1b, E1c) Repetition (R) Experimentation (E2) Solution (S)	Means-ends Analysis
8	Opening Closing	Exploration (E1b, E1c) Experimentation (E2) Repetition (R) Solution (S)	Means-ends Analysis
9	Filling Emptying	Exploration (E1b, E1c) Experimentation (E2) Repetition (R) Solution (S)	Means-ends Analysis
10	Emptying	Exploration (E1b) Experimentation (E2) Repetition (R) Solution (S)	Means-ends Analysis

Table 7

Problem-Solving Type: Toddler 3

Strategy	Se 1	Se 2	Se 3	Se 4	Se 5	Se 6	Se 7	Se 8	Se 9	Se 10
T/E	X				----					
MEA	X	X	X	X	----	X	X	X	X	X

T/E: Trial and Error, MEA: Means-Ends Analysis, Se: Session

Research Question 2a for Toddler 3: What Intrapersonal Differences, if any, Do Toddlers Display in Their Problem-solving Approaches with Contents and Containers Materials over the Ten-session Period?

The individual tables as well as the integrative one (Table 8) in the next section all show that Mark was actively involved in exploring the alternatives that he narrowed down as means to solving the problem he was dealing with. His experimentation followed a few repetitions of options he was likely entertaining as an avenue toward a solution. His actions seemed to imply an envisioned end in mind and a decided course of action that would likely achieve that end. A specific example from one of the sessions illustrates this point:

> Mark picked a bandana from the floor, looked at it for a while, and then put it down where he found it. He turned his attention to a small box and started to put a ball in it and then covered with a lid. He also put some balls in a bowl. Mark emptied the balls from the bowl to the big box, and then again from the box to the bowl. He repeated the same action, but this time he grabbed a medium box, took its lid off and proceeded to empty the balls from the big box to the medium-sized one. His next action was to cover the medium box but he could not. Mark's action suggests that perhaps he was planning strategically how to deal with the problem. His solution was to take out some of the balls so the cover would fit perfectly on the box.

Purposeful experimentation (toward a clear goal) is a hallmark of the means-ends strategy. As Mark experiments, he becomes more imaginative and inventive, and his flexible thinking is still guided by the end result that he is seeking. In the next example, Mark is creating a shaking action with different size balls using a pitcher and later using a box:

> Mark took one ball out of the pitcher, and with one ball remaining in the pitcher, he started shaking it as he did at the beginning of the first session. The difference this time is in Mark's using balls of different sizes and colors to shake one at a

> time in the pitcher. This experimentation is rather creative and reveals Mark's thoughtful and systematic approach to experimentation. He experimented with the big ball, followed by the medium size, and the smallest ball last. Mark picked four small balls to see if they fit in the pitcher that only accommodated two big balls earlier. The four small balls fit nicely into the pitcher which he then started to shake. He did not get the shaking effect he was hoping for, so he took out the balls and put them in a small box which enabled him to shake it. Mark is exhibiting active but plan-full experimentation by carrying out the same action on multiple materials.

As the descriptions of all the sessions show, the dynamics of problem solving encompass exploration, repetition, experimentation, solution, or no solutions at times, as well as the desire to pursue a goal or to follow one's curiosity to find out a solution to a problem, to stay on task, and to seek the thrill of a challenge of a problem-solving situation. As the number of minutes suggest, Mark (and for that matter Sara and Jake) seem to spend more time on exploration (type E1c) and active experimentation. There is less of the haphazard exploration (type E1). With less aimless repetitions, the chances seem to increase for choosing and using a means-ends strategy. Here is a final excerpt from one of Mark's sessions that illustrates the transition from trial and error to a means-ends analysis. It shows Mark's persistence, especially toward the end of the excerpt, to tackle the challenge that was facing him:

> He was engaged in a trial and error process by placing one cover after another on top of the box until he found the right one. Mark, however, noticed that the cover stuck out a bit. He was trying to figure out how to make the lid cover the box perfectly. As soon as he took the lid off, he noticed that the big ball was sticking out of the box, and once he took that ball out, the lid covered the box perfectly. With this challenge solved, Mark held another box in one hand and put its cover in his other hand. He then placed both box and its cover on the floor and grabbed a bowl from the container and put it into the box. Mark suddenly quit this activity and moved on to play with other items--only to quickly return to do what he was doing before.

The above were the data related to Research Question 1 (What behaviors do toddlers exhibit as they begin their exploration with Contents and Containers) and the first part of Research Question 2 (2a What intrapersonal differences, if any, do the three toddlers display in their problem-solving approaches with contents and containers materials over the ten-session period?). Below are the data related to Research Question 2b regarding individual differences among the three toddlers.

Research Question 2b: What Interpersonal Differences, if any, Do the Three Toddlers Display in their Problem-Solving Approaches with Contents and Containers Materials over the Ten-Session Period?

The aggregated problem-solving strategies recorded for the three participants are depicted in Table 8. This section will lay out the differences between the approaches used by the toddlers. As was pointed out in the Definition of Terms in Chapter 1, Micsinai's (2011) operational definition of trial and error, hill climbing, and means-ends analysis was used. A single attempt resulting in a solution was considered as Means-Ends, two to three attempts resulting in a solution were considered as reflective of Hill-Climbing, and a strategy is considered trial and error if a toddler makes three or more attempts.

Table 8

Integrative Problem-Solving Type for the Three Toddlers

Sara										
Strategy	Se 1	Se 2	Se 3	Se 4	Se 5	Se 6	Se 7	Se 8	Se 9	Se10
T/E	X	X	------	X	X	X	------			X
MEA			------				------	X	X	
Jake										
Strategy	Se 1	Se 2	Se 3	Se 4	Se 5	Se 6	Se 7	Se 8	Se 9	Se10
T/E	X	X	X		X		X	-----	X	X
MEA		X		X		X		------		
Mark										
Strategy	Se 1	Se 2	Se 3	Se 4	Se 5	Se 6	Se 7	Se 8	Se 9	Se10
T/E	X				------					
MEA	X	X	X	X	------	X	X	X	X	X

T/E: Trial and Error, MEA: Means-Ends Analysis, Se: Session

The reader should note that Table 8 clearly demonstrates that the researcher found no instances of hill-climbing strategies being used among the three toddlers selected as participants. Given that recordings of the toddlers using materials occurred twice each week for five weeks, while the toddlers actually used the materials up to 10 times each of those weeks, instances of hill-climbing may have occurred when the cameras were not in

operation. Hill-climbing simply was not evident in the recordings analyzed for this research study.

The similarities that were observed within the limitation of the experimental environment of the study include: active exploration and engagement with the experimental contents, deliberate efforts to solve problems in the context of play, pretend behaviors that manifest different facets of toddler thinking and reasoning. More specifically, the three toddlers exhibited similar behaviors such as opening and closing boxes; filling and emptying boxes, canisters, muffin pans, and pitchers; stacking small and big boxes as well as muffin pans; and nesting of different size boxes and bowls.

Each toddler, however, approached challenges and solved problems in unique and different ways. The first toddler, Sara, solved problems primarily through trial and error. It was a consistent approach throughout the 10 sessions. It was not until toward the latter sessions, that toddler one began to exhibit aspects of the means-ends strategy. It is quite possible that repetition has taught this toddler that trial and error yields the same result and the same result was not enough to solve the problem. This fact shows that use of strategy requires both time and opportunity (Goffin & Tull, 1985).

Toddler one used the trial-error more so than Toddlers two and three did. Toddler three used the means-ends strategy the most, and did so more consistently and systematically. This begs the question as to why there are differences among the three toddlers' problem-solving approaches. Is the difference engendered by the nature of the experimental contents? Is it related to the toddlers' home setting and lack or availability

of a rich stimulating environment? Are the differences related to manifestation to what Piaget referred to as horizontal decalage, individual differences among children in the same developmental stage (Piaget, 1964)? Is there a genetic factor that is entirely or partially responsible for the difference? Or, could it simply be personality differences. These questions about interpersonal differences is simply stated here as a recommendation for a future study since the experimental conditions of this study did not allow the investigator to collect data about these individual differences.

The individual differences among toddlers show how human beings adapt to the environment in unique ways. Some adapt in a self-enhancing way and build upon the skills they gain. Others adapt in a haphazard way or inconsistently thoughtful and systematic way at the beginning or even throughout one's developmental stage (Bjorklund, 2005).

The other possible explanation for the individual differences among the three toddlers may be related to knowledge and skills a toddler acquires through mimicking playmates' behavior. That is, if a toddler plays with a friend who displays a more advanced problem-solving strategy, it is likely that he or she would, over time, emulate that behavior.

Moreover, the concept of functional fixedness perhaps sheds light on the differences observed among the three toddlers. Functional fixedness refers to the tendency of some toddlers to view problems only in their customary manner. This tendency could prevent toddlers from fully seeing all of the different options that might

be available to find a solution to the problem they are trying to solve. Related to functional fixedness is the possibility of toddlers focusing on irrelevant and misleading information when trying to solve a problem. Sometimes it is difficult for a toddler to distinguish between information that is relevant to the issue and irrelevant data that can lead to faulty solutions. When a problem is very complex, it is more likely for a toddler to focus on misleading or irrelevant information thereby choosing an ineffective problem-solving strategy. In deciding on what information to use, toddlers often make assumptions about the constraints and obstacles that prevent certain solutions (Seigler et al., 2014). This also is a possible explanation for individual differences. Finally, the three toddlers in this study may have used only solutions that have worked for them in the past. This mental set factor is an obstacle that may enhance or impede problem solving for individuals and helps explain variation among toddlers.

There were also themes that emerged from this study about problem solving namely, intentionality, competence, curiosity, perseverance, and reciprocal interaction between play and skills.

Emerging Themes from the Study

What behaviors do toddlers exhibit as they begin their exploration with Contents and Containers? Based on careful reflection on the findings of the study, a number of themes related to problem solving emerged including intentionality, competence, curiosity, perseverance, and reciprocal interaction between play and skills. By themes, the researcher adopted Ryan's and Bernard's (2003) description of what they are. That

description is, “themes are abstract (and often fuzzy) constructs that link not only expressions found in texts but also expressions found in images, sounds, and objects” (p.87). The investigator generated the themes by reviewing the literature and more particularly the characteristics of problem solving displayed by the three toddlers in the study. More specifically, the researcher looked for unifying and broad characteristics that undergirded key behaviors and how often they were repeated or manifested by the three toddlers. The following is an elaboration of each one.

Intentionality

Intentionality is the first major theme that emerged in this study. According to the Webster’s II New College Dictionary, intentionality is defined as, “Acting with intention on a course of action or an aim that one intends to follow; a plan to achieve; setting a goal” (Webster, 1995, p. 1386). When children displayed intentionality during play, they seem to be cognitively busy deliberating and thinking before they take any action (Schiller, 2009). More particularly, when the toddlers in this study acted intentionally, they appeared to consider their choices of actions or next steps before taking them. That is, they seem to follow a plan that will help them achieve their goals. In the means-ends strategy, the toddler sets a goal, develops a strategy, and takes deliberate action to accomplish the goal. All three toddlers displayed intentionality. For example, Toddler number 3, Mark, showed and displayed intentionality numerous times throughout the 10 sessions. In session number 3, intentional behavior is reflected in the following episode

as Mark opened boxes and filled them with balls and started taking them out in an apparent attempt to see what changes can be made in rattling sound. Here is the excerpt:

> Mark opened the box full of balls and moved the balls out and placed them into a bowl, and quickly returned them to the box. He methodically and carefully closed the box and started shaking it for a few minutes. And, as he did before, Mark put the box down on the floor, opened it, and took some balls out and closed it again. Mark did this several times. What is curious about this experimentation is Mark's increasing and decreasing the number of balls in the box as if to find out what difference in rattling sound they make. The fact that Mark kept opening and closing the box and putting in and taking out balls reflects his active and systematic experimentation and also indicative of means-ends problem solving.

This episode shows that Mark knew what his aim was and had a strategy developed to achieve it. He apparently knew what he wanted and followed a plan to achieve it. Mark's actions point out that an observer cannot read what is going on Mark's mind, but the intentionality shows in the behaviors or steps of actions being observed. Also, Mark's active and deliberate experimentation demonstrated in opening boxes and putting balls in and out of the boxes to see what rattling sounds are produced as he changes a variable indicate a sense of intentionality. Mark seemed confident in the choices of actions he manifested, did not waiver, and moved forward confidently to accomplish his goal. Mark's intentionality and purpose as demonstrated in this episode guided his decision making toward goal achievement.

In conclusion, Mark's intentional actions were reflected in the thoughtful choices he made, the alternatives he considered, seeming understanding of the differences between thoughts and actions, carrying through his plan or strategy to achieve his goal, the persistence and determination he demonstrated, and the confidence with which he

acted. Intentional children, like Mark, are competent and effective. Thus, it is to the theme of competence that we turn next.

Competence

Toddlers gain many of their skills through play as was demonstrated by the three toddlers in this study, Sara, Jake, and Mark, throughout the 10 sessions. The skills they gain, in turn, expand the world of play for them. In this way, play can be viewed as both a process that toddlers engage in as well as a product. It is a product as toddlers gain more autonomy and competence which are core concern for a developing child (Erikson, 1993). Competence and confidence have been defined in the literature as having adequate and appropriate actions to meet the demands of events children encounter in their environment (Baumrind & Black, 1967). Feelings of competence propel children to meet challenges with an attitude and air of confidence of overcoming them. The child displays a degree of optimism and persistence in the face of difficulties or problem-solving situations.

Each of the three toddlers in this study displayed a degree of competence through the positive and realistic perceptions of themselves and their abilities in the different videotaped sessions of the study. Also, the toddlers manifested their sense of competence in their ability to identify problems and seeking solutions to them regardless of the strategy they ended up using. Since the toddlers in the study interacted with the experimental objects freely and independently without approval or disapproval from caretakers, teachers, or other adults in their environment, their actions reveal their natural

competence about their abilities. The following excerpt from session 7 of Jake, the second toddler, illustrates Jake's feelings of competence, namely perseverance and independent decision making, as he accomplishes his goal of turning some of the experimental contents into his imaginary objects while engaged in pretend play:

> Jake placed a bowl in a small box and covered them with a lid. The bowl nested within the box was then used by Jake as a hat which he put on his lap and later put into a bigger box. Then, he grabbed two boxes from the canister and put them on the floor and left. He then grabbed a block from the container and used it as a stick to beat on the muffin pan. The pan turned into a drum in Jake's playful and imaginative mind. Again, Jake repeated this action as he did before with novel actions or ones that interested him. While he was using the muffin pan as a drum and beating on it as a drum, he placed a bowl or a box on his head as a hat. This action seems to be mimicking the role of a musician playing his/her instruments.

In the video sessions, Jake appeared happy and smiley toward the end of the session perhaps due to feelings of confidence arising from his ability to tackle the delightful yet challenging pretend situations. Jake, much like Sara and Mark, the other two toddlers in the study, interacted with the play materials in a supportive but non-intrusive environment. Thus, the toddlers, as in the case of Jake, seemed to have learned a lot more by trying on his own though it took longer because of the active and continuous experimentation. A related theme to competence is an intense desire to know. The next section discusses curiosity as one of the major themes that emerged in this study.

Curiosity

In all the sessions of the three toddlers show their natural disposition to investigate, to explore, to discover, and to add to their knowledge and adaptation to the

world around them. Sara, Jake and Mark displayed their curiosity by demonstrating interest in their environment, exploring new materials, identifying problems and seeking solutions, and exhibiting persistence and determination. Without curiosity, the three toddlers in the study would not have exhibited the range of behaviors and actions they did including pretend a pan is a hat, seeing if a box would accommodate more items than its capacity allows, discovering the function of an object and adding to its repertoire of uses. To the three toddlers, the experimental materials afforded them a seemingly infinite range of possibilities which delighted their insatiable curiosity. They explored, questioned their constructions, experimented, and solved problems such as closing a box or finding the right size of a cover for a box. They also seemed to remember strategies when they later engaged in similar problem-solving situations.

The actions displayed by Sara, Jake, and Mark are in line with what Perry (2001) asserted about the role of curiosity in that it propels exploration and leads to discovery. What the toddler discovers in turn leads to pleasure and repetition. All three toddlers repeated some actions many times such. Here is an example for each of the three toddlers in this study.

In session 8 of the third toddler, Mark took the lid off and moved some balls to a big box, and then decided to put the balls back into the canister. He repeated this experiment many times. Similarly, in session 10 for the second toddler, Jake emptied all the items off the container and sat inside the container. This action can be seen as a means-ends strategy where Jake set out to use the container as a place to sit and explore

what is around him through the transparent walls of the container. Jake repeated the same action with another container. A third example from session 8 of the first toddler, Sara emptied a pan by stepping on the edge of the pan which made balls that were in it fall out of it. She repeated the action of collecting the balls and putting them in the pan and then emptying the balls and throwing the pan on the floor a couple of times.

Table 9 below depicts the ten components of Perry's Cycle of Learning. According to Perry (2001), repetition produces a sense of mastery and confidence in toddlers which in turn feeds their desire to continue exploring their environment. Perry contends that the cycle whose catalyst is curiosity is the foundation of learning.

Table 9

Cycle of Learning

Curiosity	Results in	Exploration
Exploration	Results in	Discovery
Discovery	Results in	Pleasure
Pleasure	Results in	Repetition
Repetition	Results in	Mastery
Mastery	Results in	New Skills
New Skills	Results in	Confidence
Confidence	Results in	Self-esteem
Self-esteem	Exploration	Sense of Security
Security	Results in	More Exploration

Perry (2001) Adapted from Schiller (2009, p.38).

Perseverance

Perseverance is another major theme derived from the data of this study. It is related to how a toddler carries out a task, action, or a plan that he or she believes will produce a desirable result or solution. Polya's (2004) model of problem solving described in the literature review (Chapter 2) included perseverance as step three in his four-step model. The four steps in Polya's model are: understanding the problem,

making a plan, carrying out the plan, and reviewing, reflecting, and extending what one has learned to another context. Perseverance is tied to the carrying out of the plan, Step three. Throughout the 10 sessions of each toddler, whether the problem solving strategy used is trial and error or means-ends, perseverance was manifested by Sara, Jake, and Mark as they encountered situations that needed solving. The toddlers stayed on task and tried different ways to tackle the issue at hand. They tried different ways to address the challenge until they found a solution for it. There were times when one of the toddlers for whatever reason left the activity, but came back to it later seemingly with renewed determination to solve the problem.

The following are examples of perseverance in problem solving for each of the three toddlers. The first is taken from session 2 and for the first toddler, Sara. In this session, Sara tried tirelessly to place boxes inside other big ones or stuff as many items as she could in a box. The prevailing feature in this excerpt is that Sara sticks to the task and shows dogged resolve and intentionality to achieve her goal. The excerpt goes as follows:

> The toddler began her exploration by grabbing a medium-size box and a ball from one of the two containers and put them on the floor. Sara then walked to the second container and took out a bandana from it and on her way back to the spot on the floor where she put the other two items, she grabbed a plastic bowl and a small box that were lying on the floor and put them with the other items. As if these items were not enough, Sara went back again to one of the containers and took out a bowl and put blocks and balls in it. She reached for a medium-size box and put two small boxes in it and started shaking the box making a rattling sound. She put the box down and reached for a bandana and a small box from the container and then tried to put the box in one of the spaces of the muffin pan but Sara found out that the box did not fit in any of the spaces in the pan. Since she did not have any success fitting the box in the muffin pan, Sara moved on to

> experiment with balls and small lids to see if they would fit in the muffin pan slots, and placed them in the pan. Intrigued by putting items in the muffin pan or in boxes, Sara now grabbed a big box from the container and put a bowl and balls in it. She left the box alone and once again tried to fit the small-size box into the cavities of the muffin pan.

The second excerpt is from session 9 for Toddler number 2, Jake. Throughout the session, Jake demonstrates an intense focus on the task of using containers as other objects by putting them on his head and covering himself with them. The excerpt goes as follows:

> This session began with Jake putting a box cover into the big container. He then took out two covers from the container and put his foot in the container. He kept his foot in the container and sat on the edge of the container. Slowly, Jake put his whole body into the container and quickly went out. He turned the container upside down and covered himself with it. Perhaps this action reveals Jake's curiosity regarding what happens to items when they go into the container. He had to get a taste of what it feels like to be inside the big container. He extended his experimentation by covering himself with the container to probably, again, see how it feels to have the container be on him instead of him being inside it. At any rate, Jake is actively exploring and experimenting.
>
> As slowly as Jake got himself into the container, he got himself out of it. As soon as he did, Jake put the container upside down and covered himself with it for a short while and then put it down. He then walked toward the other big container and tried it to flip it but could not because it was too heavy due to the many items that were inside it. When he could not, Jake walked back to the first container, sat down, and turned it over and then put it over his head and shoulders. The container seemed to cover most of his body except his feet. Jake stood up and took the container off, and engaged in an interesting experiment. He flipped the two containers sideways so the bottom or opening of each was placed on the other. It seemed like Jake was trying to see what putting the two boxes together would look like. This lasted for approximately two minutes, after which Jake took one of the two containers to the spot that it was in originally. Still exploring and experimenting with the containers, not their content, Jake took one of them and emptied its contents, and while he was sitting, he put the container over himself.

The third example related to perseverance in problem solving is from session 3 of the third toddler, Mark. This part of the session shows Mark experimenting with balls and boxes. He was trying to fit as many balls as he could in the box, a task that took him several trials to achieve. He persevered and eventually solved the problem he was dealing with. Here is the segment from session 3 that illustrates Mark's stick-to-it-iveness:

> Mark started by opening a box and taking out balls and pretending to eat them, then he closed the box and started shaking it with the balls inside it. He repeated this action seven times. He would take a break to watch what his peers were doing around him. Quickly, Mark returns to play with the boxes. He put a box on his lap, placed a bandana on the floor, and then covered the bandana with the box. He repeated the same action with a bit of variation. He put the box on his lap and sat on the bandana. He opened the box and again started pretending to eat the balls as if he were eating an orange or an apple. He did this for a short while and then put the box on the floor and placed a bandana on top of it. He then opened the box and took some balls out and pretended to be eating them. As he did before, he closed the box and covered it with a bandana.
>
> Next, Mark put a big box full of balls on his lap and then placed it on the floor because it was seemingly easier to open and take balls out of it. He then opened and closed a small box and tried to put balls in the box. He was taking balls in and out of the small and big box meanwhile he was trying to cover the boxes. He added one more ball to the big box but it did not fit. He tried to place it on top of the other balls but there was no room for it, and when it stopped rolling, he could not keep the lid on the box without the ball falling out of it. Mark solved this problem by simply leaving the ball out and covering the box--a signal of his acknowledging that there is no space for the ball in the box.

All of these three excerpts underscore the importance of perseverance in problem solving.

Reciprocal Interaction of Play and Skills

Another theme that emerged from this study is the intimate relationship between play and cognitive skills, namely problem solving. The experimental materials used in

this study were helpful in tapping toddlers' approaches to problem solving as the objects in the containers offered myriad possibilities for problem solving. The types of problems toddlers encountered can be described as divergent problems as they potentially have multiple solutions. The three toddlers in the study, Sara, Jake, and Mark, demonstrated divergent problem solving. They were free to solve issues in any way they wished without interference from adults in the room. The fact that the toddlers felt completely free to go about their problem solving encouraged them to explore and experiment until they reached solutions that were satisfactory to them. These observations are in line with research findings comparing divergent and convergent play. In one study, Pepler and Ross (1981), preschoolers were presented with two types of play materials. Some toddlers were given materials for convergent play (i.e., puzzle pieces). Other toddlers were given materials for divergent play (blocks). The toddlers were given time to play and then were tested on their ability to solve problems. The researchers found that toddlers who were given divergent play materials performed better on divergent problems. The toddlers also showed more creativity in their attempts to solve the problems.

Similarly, Wyver and Spence (1999) conducted an experimental study that showed a causal connection between pretend play and divergent problem-solving ability. The toddlers in the study who were given training in pretend play showed an increased ability to solve divergent problems, while the toddlers who were trained to solve divergent problems showed increased rates of pretend play.

Samples of divergent problem solving were provided to the reader. These examples were given in the form of trial and error as well as means-ends strategies used by the three participants in this study as reported in the early part of this section.

Summary

In summary, Sara, Jake, and Mark primarily displayed problem solving strategy use. Each showed it in a different setting given the particular demands of the context of the problem they were dealing with. Sara displayed primarily the trial and error problem solving strategy, and used means-and-ends analysis only toward the end of the experimental period. Jake also showed trial and error solving strategy but displayed means-and-ends analysis half way through the study. Mark showed the more advanced problem-solving strategy of means-ends analysis much earlier than both Sara and Jake. He displayed it in the second session of the experiment. Again, the task demands of the problem, the toddler's cognitive level as well as his or her prior experiences may have dictated which strategy a toddler would use.

The data of this study suggest that children exhibit problem-solving thinking and behavior very early in life, and that toddlers vary in their approaches to problem solving. Being aware of the fact that toddlers gain and build upon their problem-solving skills especially during play should make parents, daycare providers, child-care centers, and preschool settings should provide play activities and opportunities that nurture toddlers' problem-solving skills. The implications and limitations of this study as well as directions for future studies are discussed in the next and final chapter.

CHAPTER 5

IMPLICATIONS, LIMITATIONS AND FUTURE DIRECTIONS

The results and their discussion covered in the previous chapter provide a number of suggestions about toddlers' thinking and behavior as well as offer implications for practice. The thinking and actions of the toddlers observed in this study, although ungeneralizable to all humans, shed light on two phenomena: active agency and goal-directedness.

Toddlers actively seek information and operate on objects in their surroundings. It was evident from the 10 sessions of each of the three toddlers that each came in to the experimental condition and environment with prior knowledge, skills, beliefs, and concepts about what objects are or should be, what objects do, should do, and could do. These in turn influence what and how toddlers notice about their environment and how they organize and interpret it. Given that this study only focused on three toddlers, generalizing the results to others is not possible.

The toddlers in this study were definitely active learners, and the differences noted in their interactions with the contents and containers show that each brings a point of view and a way of interacting to their setting. They experimented and attended to certain types of information: physical properties, functionality, and the movement of inanimate objects. In short, the toddlers were constructing new knowledge and understanding of the contents and containers based on what they already knew and

believed about them as well as their experiences with the materials in this study. The observations made in this study are in line with the contemporary and constructivist view of learning (Cobb, 1994; Piaget, 1936/1952; Vygotsky, 1978). The implications of the study are discussed next.

Implications

In a constructivist preschool or child-development center, teachers need to pay attention to the limitless supply of curiosity and love of exploration and experimentation, imagination, incomplete understandings, the false beliefs, and the naive renditions of concepts and strategies toddlers bring with them to a given situation or subject and use to solve problems in their surroundings. Teachers would need to understand each toddler's background and build on what toddlers already know in ways that will help each toddler develop and grow and achieve a more complete understanding of problems they encounter. If toddlers' initial ideas and beliefs are ignored, the understandings that they develop can be very different from what the teacher may have as learning goals for them.

Based on the themes discussed in Chapter 4, daycare providers can promote problem-solving habits and skills by allowing toddlers opportunities to discover in an atmosphere that is both fun and inviting. As toddlers engage in problem solving, adults need to support and encourage the child's need for new experiences and for mastery. As much as possible, adults, be they parents, early-childhood educators, daycare providers, need to help toddlers to create and achieve their goals by providing an environment and opportunity for exploration, experimentation and problem solving. Teachers must avoid

solving problems for toddlers because doing so will rob them of the opportunity to develop the skill, desire, the perseverance, and confidence to tackle problems they face in their daily life.

As the limited data are reviewed and the different episodes of each toddler are reflected upon, one can attribute the difference to an amalgam of factors. Environmental, genetic, and personal factors all play a role in making the toddlers who they are and what they are capable of doing. The environmental and personal factors, however, seem to play the most influence on toddlers' behavior. It would be worthwhile investigating the potential impact a home environment that encourages independent exploration, experimentation, and problem-solving has on a toddler's problem solving thinking and actions. As was stated before, a future study could focus on the hypothesis that "The more experience one has with figuring out and sorting out problems, the more advanced and sophisticated one becomes at problem solving."

Moreover, it is possible the experimental contents used in this study influenced the toddlers' approach to problem-solving. Although the contents afforded myriad possibilities for experimentation and problem-solving, it is possible that one or more of the three toddlers could have exhibited a different problem-solving strategy if different play items were used. This can only be ascertained through a future study that uses the same contents used in this study in addition to new experimental contents or items.

In the context of this study, there was no focus on the toddlers' interactions with other classmates, so this aspect could be explored in a future study to find out the extent

that one toddler's behavior can be influenced by the actions and behaviors of their playmates. Also, a future study could explore developmental differences in problem solving from toddlerhood to adulthood.

Limitations of the Study

As with all studies, this study had a few limitations. To begin with, the videographers who videotaped the study sessions were skilled in the topic of problem solving and focused on active toddlers of interest. Thus some toddlers were not recorded if the videographer happened to be focused on another toddler. A second limitation is related to the fact that the age range of the toddlers (18-23) prevents us from applying the study to children who are either older or younger. A third limitation is related to absence of data on what the toddlers' prior experiences may have been either in the center or at home.

Future Directions

The following are a few recommendations for future research studies:

1. Future studies could replicate this study with toddlers who solve problems arising from interactions with the Contents and Containers and compare them with toddlers who solve problems while playing with objects already available in their center or school. This is recommended because in this study, the materials were only the ones in the Contents and Containers.
2. The experimental condition of the study can also be changed in a future study where teachers can interject and direct toddler's behaviors. That is, a study could investigate

problem solving in toddlers with guided help from their teachers. This is recommended because in this study, teachers were instructed not to interfere or help toddlers as they interacted with the materials in the contents and containers.

3. Another future research direction could look at the effect on problem-solving behavior and thinking of toddlers when seeing a model solve a problem. This is recommended because it was not a focus in this study. It would be useful to know whether a model could accelerate a toddler's use of a particular strategy.
4. Additionally, future studies could focus on problem-solving behavior of the same children over time. That is, a longitudinal study could look more closely at the mechanisms of change in problem solving over time. Such a study could examine the role of development and environmental factors in the context of problem solving. This is recommended as the data gathered could illuminate how problem-solving behavior changes over time.
5. Another future direction that can be pursued relates to similarities and differences in problem solving among toddlers. This is recommended as a separate direction or combined with recommendation four.
6. A follow-up study using different items could assess how consistent Mark (the third toddler in this study) has become in the use of means-ends strategy. This is recommended because Mark exhibited more use of means-ends analysis. A future study could look at whether this pattern continues as well as how it changes as Mark gains more experiences.

Summary

This study investigated problem-solving strategy use of three toddlers ranging in age from 18 to 23 months by thoroughly observing and describing toddlers' interactions with contents and containers during free play. It was found that the three toddlers used the trial and error strategy the most especially in the early sessions. The third toddler, however, exhibited more use of the means-ends analysis more consistently especially in the latter sessions. The findings of the study show that toddlers engage in problem-solving thinking and behavior very early in life, and that the more opportunities they have in problem solving the more skilled they are likely to be. Parents, daycare providers, and teachers can therefore foster and promote problem solving by providing both ill-defined and well-defined problem-solving opportunities. Problem solving teaches and promotes competence and a sense of self-efficacy in children. One of the main long-term aims of early childhood education, according to Piaget, should be to "create individuals who are capable of doing new things, not simply repeating what generations have done" (Duckworth, 1964, p.172).

This study focused on strategy use among toddlers using undefined problem solving. Most of the studies reviewed in Chapter 2 were done with defined problem solving. That is, the adults invented the problems and handed them to the toddlers to solve. The Indicators of Individual Growth and Development for Infants and Toddlers (IGDI) testing is sometimes carried out with materials and activities that children are not interested. This practice unfortunately goes on in schools, through things like worksheets

and skill drills. Then later in school (middle/high school) educators change strategy and want students to do project- based learning where they have to first figure out what the problem is. The work of engineers, for example, is around undefined problems where they have to find the problem before they can solve it.

The themes that emerged in this study were the result of the undefined nature of the problem solving. Toddlers were more curious, persevered longer, developed confidence as they developed competence, were intentional about their explorations and experimentation, and developed skills through their play. The toddlers gained all of these because they had been handed the power to determine their own problems to solve.

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APPENDIX A

CODING INSTRUMENT

Events

Nesting: 3 objects or more.

Filling: one by one or pouring into.

Emptying: dumping, taking out one by one, or un-nesting.

Body as a content.

Body as a container.

Stacking: 3 or more objects.

Opening: lids, latches (flip, snap or unscrewing).

Closing: lids, latches (flip, snap or screwing).

Coding

E1: exploration: (child is acting on objects with no apparent goal in mind).

E1a: variety of actions on a variety objects.

E1b**:** variety of actions on one class/type of object (for example, a variety of actions using multiple bowls or similar containers).

E1c: one action on different types of materials (for example, putting a bean bag into a muffin tin, a bowl, box, etc.).

R=Repetition: (child repeats action 3 or more times without changing anything about the action; repeating same action on same object).

E2= experimentation: (child varies the actions in some way but keeps one object constant).

Variety of actions on ONE object (the same object); action varies by degree/intensity

One action with one object (becomes R when action is repeated 3 or more times).

To be E2, at least one object must remain constant (Child tries large lid on medium bowl; tries small lid on medium bowl: medium bowl is constant).

S= Solution: (child stops experimenting when materials do what he/she was trying to accomplish).

NS= No Solution: (child abandons the problem before finding a solution--could be the result of outside elements).

APPENDIX B

LIST OF MATERIALS

Tub 1 Contents:

Mini muffin pan, standard muffin pan, large muffin pan, large strainer, clear rubber-maid container with red lid, colorful plastic balls, small Frisbee disc, Measuring cup, ½ cup silicon bowl, Rubbermaid bottle, small rectangular sterilite container, three small round Glad containers ½ cup, 4 cup Glad round container, 1.5 oz. Glad container, Rubbermaid square 2.1 cup container, Glad large square container 13 cups, salsa bowls, and a canister set which includes: (1) one large 5 liter container, (2) one medium 2.8 liter container, (3) one small 1.4 liter container, (4) one smaller 1.8 liter container. The Tub also includes clear graduated beakers: 10 ml, 250 ml, 400 ml, and 100 ml; soft balls, oval 3-tiered plastic container, and a plastic pitcher.

Tub 2 Contents:

Colored Scarves, hard plastic balls, small 2” water bomb soft balls, 2 sets of Links, 3” synthetic leather bean bags, large white plastic bowl, medium white plastic bowl, small white plastic bowl, one large rectangle wooden block, 2 small rectangular wooden blocks, large square wooden block, assorted wooden blocks, long skinny rectangle wooden block, plastic strainer with handle, clear plastic container with handle and cap, and different sizes see-thru jars : 4, 8, 16, and 32 oz.