What Makes a Toy Educational? The Impact of Educational Toys on Spatial Development in Preschoolers

A thesis submitted by

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In partial fulfillment of the requirements for the degree of

Master of Arts

In

Child Study and Human Development

TUFTS UNIVERSITY

May 2015

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Abstract

This study examines the arbitrary "educational" label assigned to educational toys, and investigates the validity of these toys' marketing claims in a pilot study with two thrusts: 1) a play intervention with preschoolers, in which a group of five 4-year-old preschoolers played with a sample of eight educational toys for six twenty-minute play sessions; and 2) individual interviews with five parents and five educators of preschoolers designed to extract their opinions of educational toys and their marketing claims. The educational toys selected for the sample of toys used in the play intervention were all marketed as improving spatial skills in some way. Children were allowed to play freely with the toys during each session. In order to determine whether or not playing with the selected toys impacted spatial skills, the Test of Spatial Ability (TOSA) was administered to obtain a pre- and post-test measure of participants' spatial ability. Parents of the child participants and educators participated in individual, twenty-minute interviews, in which they were asked their opinions of the efficacy of educational toys in meeting the learning outcomes they advertise; whether or not they provide such toys for children; and what they believed made toys "educational" in general. Only two of the five children participants demonstrated improvements in their performance on the TOSA. Parents and educators presented mixed opinions of the efficacy of educational toys; only two educators and three parents stated that they bought educational toys for children, and all participants expressed that they believed any toy could be educational, contingent on 1) the toy's appeal for the child and the child's subsequent enjoyment from playing with the toy; 2) the way the toy is used by the child; and 3) scaffolding during play from teachers, adults, and peers. This study underscores the need for more research investigating the efficacy of educational toys, the role they play in the way that parents and educators provide learning experiences for children, and how such toys are legitimately marketed.

Acknowledgements

This master's thesis is the culmination of a year-and-a-half of work, and would not be possible without the assistance and support of many, for which I am profoundly grateful. First, I would like to thank my thesis advisor, Dr. Julie Dobrow, for her constant encouragement, wisdom, and unfailing support throughout this process, as well as teaching me the value of interdisplinary, multiple-methods approaches to research. My thesis committee members, Dr. David Henry Feldman and Dr. Holly Taylor, have also been incredible sources of support and knowledge throughout this process. Thank you for contributing your expertise, inspiring me to think critically about every decision I make, and helping me grow as a researcher.

Many thanks to Hanna Gebretensae, director of the Eliot-Pearson Children's School, without whom data collection would not have been possible. Her flexibility, logistical support, generous accommodation made the data collection process a smooth and successful one. Of course, I must thank the parents, educators, and children at EPCS who generously donated their time and participation. Your enthusiasm for this project was so appreciated; thank you for making the data collection process so enjoyable and rewarding. A special thank you also goes to Claudia Mihm '18, my undergraduate research assistant, for her enthusiasm, diligence, and flexibility over the past academic year. Thank you for being a pleasure to work with!

I would also like to thank the following individuals who have helped the formation of this project from its inception: Dr. Kate Camara and the students of the spring 2013 section of CD 142, for guiding this project's growth through thoughtful questions; Dr. Peggy Morris in the Tufts University Occupational Therapy department, for her support and guidance in selecting the sample of educational toys; Dr. Kristina Callina, for her data analysis wisdom; and Dr. Roberta Golinkoff and Dr. Brian Verdine at the University of Delaware, for generously allowing me access to the Test of Spatial Ability, as well as their technical support as I constructed the test stimuli. I would also like to express my gratitude for the Tufts University Graduate Student Research Competition for providing funding for this project.

Finally, I thank my parents, without whom I would not be sitting here writing this acknowledgments section. Words cannot express my gratitude for your constant love and support over the past two years, and always. Thank you, Mom and Dad.

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Chapter One: Introduction and Purpose

Purpose

In today's digital age, where technological advances occur on a daily basis, the field of educational technology has shown considerable growth in recent years. The use of robotics and tools with touch-screen interfaces, such as tablets, are cited as being effective and engaging tools for learning in educational settings (Flannery & Bers, 2013). This trend for technological learning has also extended to toy design, and the benefits of playing with technological toys has been a popular topic of study in recent years (Bergen, Hutchinson, Nolan, & Weber, 2010).

However, much less attention has been paid to the cognitive benefits and learning outcomes that result from playing with physical, manipulative educational toys. Construction toys such as puzzles and blocks have been demonstrated to improve spatial skills and are correlated with later mathematical achievement in elementary school and beyond (Levine, Ratliff, & Huttenlocher, 2012; Wolfgang, Stannard, & Jones, 2009). However, little work has been conducted to investigate the efficacy of toys that are explicitly labelled as "educational," and whether or not these toys are actually accomplishing what they promise to do via marketing: enhance children's cognitive development. Furthermore, the "educational" label is one that is unstandardized, ill-defined, and unregulated; it is applied to a variety of toys without a clear explanation as to what exactly "educational" means. The Campaign for a Commercial-Free Childhood (CCFC) (2007) succeeded in their endeavors to convince the manufacturers of the *Baby Einstein* DVDs to retract their statements that their products, which were explicitly and deceptively labeled as educational, significantly improved infants' learning and cognitive development. In 2013, The CCFC also filed complaints with the Federal Trade Commission due to Fisher Price's claims that their line of apps for babies can successfully teach infants numbers and counting; Fisher Price immediately removed all claims from the products. Other attempts to substantiate the claims of the countless toys on the market that are advertised as being educational have not been conducted.

Currently, there is no standardized observation system for determining the impact of toys on various areas of development (Trawick-Smith, Russell, & Swaminathan, 2011). If toys branded as "educational" do in fact appropriately and effectively further and support a child's cognitive development, parents and educators can make better-informed decisions about the types of the toys to purchase for children in order to meet educational or developmental goals. The existence of a standardized definition of what makes a toy educational may also provide new insight for toy companies that produce educational toys in guiding their design of toys as effective learning tools.

It is clear, however, that children learn from all types of toys, regardless of whether or not they possess an "educational" label. The constructivist theory of learning states that children actively construct meaning through their interactions with objects and their environment (Piaget 1970). These interactions are shaped by their cognitive developmental level (Cobern 1993). Furthermore, what children do during object play directly demonstrates the knowledge that they already have available and, more importantly, indicates how they learn through playing with that particular object (Lifter, Mason, & Barton, 2011). Therefore, if a parent or educator has a learning goal for a child, the child's toys should be appropriately matched with their developmental level and their current knowledge of people, objects, and events in order to achieve the desired learning outcome. In examining how and what children learn through playing with educational toys that are targeted towards certain skills, the proposed study will provide further information on the ways in which different types of toys foster positive cognitive outcomes in preschool-age children.

The "Educational" Label

In examining educational products, the educational benefits of interacting with "educational" technologies and media have been largely examined, but there is a dearth of research on the cognitive benefits of "educational" toys specifically. While the label of "educational" is an ambiguous one, for the purposes of this study, the "educational" label includes toys that are explicitly marketed as meeting a specified learning outcome or improving a cognitive or academic skill. This is in line with the U.S. Consumer Product Safety Commission (CPSC)'s definition of educational toys: "toys designed and marketed specifically for academic gains. The appropriateness of these toys depends on the level of cognitive ability necessary to engage in an intended educational way, and the type of material, size, and number of parts" (Smith 2002).

The present study seeks to deconstruct and examine the label of "educational" toys through 1) aggregating definitions of what make a toy educational from early childhood educators and parents of young children, their respective beliefs in the effectiveness of educational toys in reaching learning goals, and their purchasing habits and provision of such toys for children; and 2) investigating the efficacy of toys that promise to promote spatial development by observing preschoolers' improvement in performance on a spatial task after playing with such toys for six twenty-minute play sessions.

Research Question/ Statement of Hypothesis

Research Question

Do 4-year-old children demonstrate spatial-cognitive gains as a result of playing with "educational" toys that are marketed as doing so? Furthermore, what do parents and educators think makes a toy educational? Do they regard toys that are explicitly marketed or labeled as being "educational" as effective in meeting the learning outcomes they advertise, and do they subsequently provide such toys for children? Why or why not?

Hypothesis

Participants are expected to demonstrate improvement in their scores on the Test of Spatial Ability (Verdine et al., 2013) after playing with a sample of eight educational toys for six twenty-minute play sessions. Additionally, male participants are expected to perform better on both the pre- and post-test measures of spatial ability than female participants due to a male gender advantage in spatial ability (Levine, Huttenlocher, Taylor, & Langrock, 1999). Parents are expected to express higher belief in the efficacy of educational toys and report more frequent buying habits of buying educational toys than educators.

Significance of Study

The efficacy of educational media products have been extensively examined; in 2005, the Kaiser Family Foundation released a report examining the educational claims of infant and toddler DVDs, software, and video games (Garrison & Christakis). After conducting a content analysis of the descriptions and parent reviews of these best-selling products on Amazon.com, as well as interviews with key representatives at several toy companies, they recommended the creation of clearer standards for products marketed as educational, and that more systematic, outcomes-based research be conducted and made available as a resource for educators. Additionally, the educational benefits of playing with different kinds of toys have been thoroughly examined; construction toys, especially blocks and puzzles, are not marketed as being educational, yet the long-term cognitive benefits from playing with such toys are well-established. There remains, however, a distinct lack of research on the cognitive benefits of “educational” toys specifically. While toy companies such as Fisher Price and LeapFrog cite their products as being the result of reputable research (LaPorte, 2012), this research is largely proprietary, unavailable to the academic community and to consumers who wish to make informed decisions about the products they are buying. Furthermore, in 2004, the director of child research at Fisher Price stated in an interview, "There is no proof that this type of [educational] toy helps children become smarter" (Carroll). Very little research has been conducted on the learning outcomes provided by playing with educational toys, especially those that are marketed for a specific educational purpose, including educational toys designed to augment spatial skills. The Toy Industry Association reported educational toys as comprising 20% of all toy sales in 2013 and 2014 (Scheinberg & Harden, 2014). Educational toys are clearly a highly consumed product, and therefore merit study.

Delimitations and Assumptions

The educational toy space is a vast one, and the literature investigating the benefits of educational toys is sparse. These two factors allow for a myriad of ways to conduct research on the efficacy of educational toys. In order to narrow the scope of the study, several delimitations were set:

1) The study focuses only on educational toys that are marketed as improving some aspect of spatial ability or target some spatial skill. Educational toys are often marketed as improving a wide variety of academic and cognitive skills, and individual toys are commonly

advertised as enhancing multiple skills. The toys selected for the play intervention were marketed as predominantly improving spatial skills.

2) The study focuses only on educational toys that were currently sold on the market as of September 2014 and that were available for purchase online. In order to obtain a well-rounded sample of toys, the toys were purchased from large corporations such as Toys 'R' Us, as well as smaller educational toy companies, such as Educational Toys Planet. "Big box" retailers such as Target and Walmart were excluded from the sampling pool due to the vast nature of goods sold in these stores. However, it should be noted that many of the toys sold at Toys 'R' Us are also sold at these major retailers.

3) The literature reviewed focuses predominantly on non-technological, non-digital, manipulative toys. The digital learning space, which includes educational mobile and tablet "apps" and computer games, is much too large to be adequately reviewed in this paper.

4) The Test of Spatial Ability (TOSA) was chosen as a pre- and post-test measure of spatial ability due to its ability to capture a wide array of spatial skills, as well as its target demographic of children aged 3 and 4. Other tests that are classically used to assess spatial ability, such as the Woodcock-Johnson, were unavailable for use. Additionally, only one measure of spatial ability, rather than multiple measures, was used due to time restrictions with the participants.

5) This study is intended to be a pilot study. While every effort was made to include a control group for the play intervention, lack of resources and time constraints made including both a control and intervention group in the analysis impossible. As many participants as possible were recruited.
6) This study was conducted in a small, quiet room (hereafter known as the "therapy room) in order to minimize any existing distractions in the children's own classroom. The researcher realizes that some children may have previously been to the therapy room for other reasons, and referred to the space as the "play room," emphasizing the novel presence of the toys and spatial tasks.

The methodology of this study is also marked by a number of assumptions. The researcher assumes that the preschool participants had been previously exposed to puzzles, construction toys, and other toys that were similar to those included in the educational toy sample; that they could play with such toys on their own or with minimal supervision; and that the parents and educators interviewed were aware of the existence of the educational toy industry, and had seen examples of such toys in person or in advertisements.

Chapter Two: Literature Review

The following literature review will provide a review of the widely-researched educational benefits of various types of toys; an overview of the characteristics of spatial ability and spatial development in early childhood; the intersection of toys, learning, and spatial ability; the spatial benefits of playing with "construction" toys such as blocks and puzzles; the brain-based learning phenomenon; and the existing body of literature on educational toys.

Toys as Learning Tools

The importance of play and its role in children's learning, particularly in early childhood education, is a topic that has been extensively examined in a variety of populations and settings and on a variety of developmental domains. As play is considered one of the most valuable opportunities for learning in early childhood, toys are therefore significantly valuable tools for furthering children's learning (Hirsh-Pasek & Golinkoff, 2003). Play cannot be properly analyzed without assessing the toys used during play (Stagnitti, Rodger, & Clarke, 1997). Furthermore, the ways in which children play with and manipulate toys are often cited as physical demonstrations of a child's developmental level. As a child plays with toys, he or she is actively constructing his or her own knowledge of that toy while building off his or her prior knowledge of the toy. As the child's knowledge increases, the play that the child is capable of becomes more sophisticated (Cobern 1993).

Social interactions. The majority of research in the domain of toys as learning tools investigates the impact of toy play on social development in children. Specifically, the role of toys as “artefacts” (Eagle 2011) in social learning in infancy and early childhood, including the use of picture books and digital technologies during interactions between parent-child dyads, has been extensively examined (Eagle 2011; Wooldridge & Shapka, 2012). More importantly, the type of “artefact” used has been found to have a significant impact on shaping the social interactions within those dyads. Wooldridge and Shapka (2012) found that playing with digital technologies lowered the quality of mother-toddler interactions during joint play, resulting in decreased responsiveness and teaching behaviors from the parents and overall reduced parent-child communication.

Technological toys. The educational benefits of playing with digital or technological toys in both school and home environments has been a subject of increased attention in recent years. Robotics, mobile tablets and other “edutainment” devices with touch-screen interfaces, and educational software are all considered effective educational supplements for children in preschool, kindergarten, and beyond (Flannery & Bers, 2013; Plowman, Stevenson, Stephena, & McPake, 2013). Additionally, the developmental benefits and detriments of the use of interactive electronic media on infants and toddlers has been a subject of wide debate (Wartella, Vandewater, & Rideout, 2005). The American Academy of Pediatrics (2013) recommends that parents severely limit and discourage screen time for children under the age of 2, and no more than two hours of screen time per day for children over the age of 2. While Courage and Setliff (2010) found that too much screen time for infants and toddlers can result in cognitive deficits such as attentional issues and delayed language development, other research suggests that e-books, mobile apps, and similar multimedia learning tools promote cognitive development because of their interactive, multimodal nature that requires the use of multiple symbolic systems in the brain (Neuman, 2009; Underwood & Underwood, 1998, cited in Shamir & Shlafer, 2011). The ways in which such technology is used in the classroom dictates the nature of its impact on young children's development; inappropriate uses of technology in early childhood educational settings may negatively affect children's learning. In a joint report, the Fred Rogers Center for Early Learning and Children's Media and the National Association for the Education of Young Children (NAEYC) stated that technology should not be used as a substitute for play and should not be incorporated into activities that are not "educationally sound, not developmentally appropriate, or not effective" (2012).

Toys, gender roles, and gender preferences. Another major concern of the impact of toys on children's learning is the effects of gender-typed toys on the formation and propagation of gender roles in young children. By preschool age, children are aware of gender roles, and their toy preferences are also gender-specific, preferring toys of their own gender as early as 18 months (Stagnitti et al., 1997). They are also able to identify toys as being gendered, with color palette being the most common characteristic used for gender identification (Cherney & Dempsey, 2010). Characteristics of "girls' toys," such as dolls, stuffed animals, and "educational" toys, include pastel color palettes and soft materials, while "boys' toys," such as manipulative toys, vehicles, weapons, and action figures, include bolder color palettes and are more technological (Stagnitti et al, 1997; Auster & Mansbach, 2012).

Thus, from a very young age, children learn that certain toys are "for boys" only and others are just "for girls" through the gender messages provided by the toys themselves (Francis 2010). In recent years, toy companies have taken note of consumer preferences for gendered toys and have marketed toys accordingly, narrowing consumer options for gender-neutral toys (Francis 2010). Interestingly, toys marketed as "educational" are typically gender-neutral or moderately masculine; they are also rated by parents as most likely to enhance cognitive and physical abilities and scientific thinking (Blakemore & Centers, 2005). While boys and girls show preferences for their own-gendered toys and request those toys most frequently, they are equally as likely to request educational toys. Furthermore, parents spontaneously choose educational toys for their children, and, in general, are more likely to purchase gender-typed toys (Blakemore & Centers, 2005).

An Overview of Spatial Ability

While children's achievements concerning spatial skills are not often lauded by parents in the same way as other cognitive achievements are, like acquiring language or the ability to count (Vasilyeva1 & Lourenco, 2012), spatial skills are a vital part of daily cognitive functioning. They are also related to the functioning of other non-spatial domains, most notably executive functioning (Hegarty & Waller, 2005; cited in Newcombe, Uttal, & Sauter, 2010). Spatial ability is an umbrella term for a variety of spatial skills, and has been defined in numerous ways. Carroll (1993) presented five major clusters of spatial ability: visualization, perceptual speed, flexibility of closure, closure speed, and spatial relations. Others have proposed additional components, including spatial orientation, dynamic spatial ability (judging a moving stimulus), and environmental ability (integrating spatial information about one's surroundings) (Halpern, 2000; Bell and Saucer, 2004; Lohman, 1988, cited in Yilmaz, 2009). Newcombe et al. (2010) divided spatial skills into two realms: between-objects skills, wherein objects are in relation to each other and includes perspective-taking, navigation, and mapping, and within-object representation and manipulation, which includes mental representation and transformation of individual objects. Spatial ability has also been defined as three separate skills: spatial perception, visualization, and mental rotation (Linn & Petersen, 1985). Vasilyeva and Lourenco (2012) suggest that spatial reasoning, which includes location representation, unites spatial cognition as a domain; this skill is comprised of knowledge of distance, direction, and angle, and contributes to success in mathematics and the sciences.

Spatial ability in general is thought to provide the foundation for quantitative reasoning skills, particularly in the mathematics and science domains, and has been found to predict both later success and vocation in these domains (Reilly & Neumann, 2013). Specifically, spatial skills support the processes of representing and analyzing information about the relations between objects that are at the core of mathematics (Clements & Sarama, 2011; cited in Verdine, Irwin, Golinkoff, & Hirsh-Pasek, 2014). Spatial skills are also thought to be related to children's understanding of the number line, which contributes to their number knowledge in general (Gunderson, Ramirez, Beilock, & Levine, 2012; cited in Verdine et al., 2014). Two specific spatial skills, object representation and manipulation, are believed to be related to success in STEM careers, as they are thought to enhance graph-reading abilities and problem-solving skills in kinematics, among other skills that are necessary for succeeding in math and the sciences. They are also the type of spatial skills most often assessed by psychometric tests (Newcombe et al., 2013).

Spatial Development in Early Childhood

Spatial development begins in infancy, most notably in the domain of object representation. In determining the properties of the objects in their surrounding world, infants rely dominantly on spatiotemporal principles (Xu & Carey, 1996; cited in Newcombe, Uttal, & Sauter, 2010). Evidence of early mental rotation ability has been found in infants as young as four months of age (Hespos & Rochat, 1997), but is mostly developed throughout early childhood, spurred by the development of motor representations (Newcombe et al., 2010). By approximately two years of age, children can recognize and generalize objects into geometric shape categories (Smith 2009; cited in Newcombe et al., 2010). Smith (2009) found that this ability to recognize shapes strongly correlated with children's knowledge of the labels assigned to those shapes, i.e. knowing that a rectangle is called a "rectangle." While Piagetian theories suggest that preschoolers view the world egocentrically, or solely in relation to their own bodies, more recent research suggests that egocentrism is transcended by the age of three, and that 3-year-olds are capable of perspective-taking, an ability that was previously thought to develop much later (Newcombe & Huttenlocher, 1992, cited in Newcombe et al., 2010). This suggests that children as young as age three possess central pieces of adult spatial competence (Nardini, Burgess, Breckenridge, Atkinson, 2006; Gersmehl & Gersmehl, 2007).

Spatial development in preschoolers is often assessed through mapping tasks. By 3 years of age, children are able to solve mapping tasks based solely on object correspondence; at four years of age, children begin to use distance cues to solve mapping tasks, and by age 5, children are much less constrained by task features as a whole, a change contributed to developmental changes occurring in the hippocampus during that time (Vasilyeva & Lourenco, 2012). A recently-burgeoning area of research concerns the effect of spatial language on the development of spatial skills. Ankowski, Thom, Sandhofer, & Blaisdell (2012) found that 2-to 6-year-old children who heard either "here" or "next to this one" demonstrated significantly less spatial search behaviors in the middle of a landmark array than children who heard the spatial phrase "in the middle." Loewenstein and Gentner (2005) produced similar findings, and found that 3- and 4-year-old children who heard spatial language had significantly higher performance on a mapping task than children who did not.

Fostering Spatial Ability: Spatial Training in Young Children

Newcombe and Frick (2010) argue for fostering spatial thinking in both preschool classrooms and during play in home settings, citing the importance of spatial thinking as a part of general intelligence, its contribution to verbal thinking, and its connection to success in the fields of science, technology, engineering, and math (STEM). They also recommend that parents take an active role in their children's spatial development by providing them with activities that support spatial growth. Fostering spatial skills has been of recent interest not only to researchers, but also parents and educators, due to the relationship between spatial skills and later success in STEM.

Spatial skills in the classroom. Recently, the implementation of spatial skills in the curriculum of preschool, kindergarten, and first-grade classrooms is supported by research that suggests the brain structures for spatial reasoning are fully developed at an early age; fostering spatial skills in young children thus prepares them for later learning, and adult scaffolding can enhance representational ability (Gersmehl & Gersmehl, 2007). In a meta-analytic review, Baenninger and Newcombe (1989) found that children's spatial thinking improved through a wide variety of spatial training interventions, including practice on spatial tasks, computer games, and academic coursework. Fisher, Hirsh-Pasek, Newcombe, & Golinkoff, 2013 found that children were able to learn mathematical concepts, particularly shape concepts, from structured play-based experiences; however, children did not demonstrate learning shape concepts solely from free play experiences. They found that structured activities led to increased engagement, more directed attention, and a greater sense of the concepts at hand. They thus recommended scaffolding children's mathematics learning during structured math-related play activities as the best method for learning mathematical concepts through play. Verdine et al. (2012) also found there was a positive relationship between children's ability to accurately replicate two-dimensional puzzle and block constructions and later mathematics skills. They attributed this correlation to the conceptual understanding of part-whole relationships children must have when replicating a design; this understanding plays an important role in mathematical problem-solving tasks.

Mental rotation ability, embodied cognition, and spatial training. The meta-analytic review conducted by Baenninger and Newcombe (1989) demonstrates that spatial skills are indeed malleable and can be improved by training. Recent work in the field of embodied cognition suggests that motor processes, including physical manipulations of an object and hand gestures, can influence and improve mental representation abilities, including mental rotation (Frick et al, 2009). Ping et al. (2011) found that both children who practiced physically manipulating objects or practiced gesturing about rotated objects performed significantly better on a mental rotation task than those who did not receive any practice. Frick et al. (2009) found that 5-year-olds and 8-year-olds performed better on a mental rotation task when simultaneously performing manual rotations with their hands than did 11-year-olds and adults. Providing children with any sort of training in mental rotation and encouraging children to embody concepts of rotation appears to improve mental rotation ability.

Toys and Spatial Ability

While the benefits of spatial training on performance on spatial tasks (Frick, Daum, Walser, & Mast, 2009; Ping et al., 2011) have been examined, the use of specific toys as spatial training tools, particularly toys promoted as furthering spatial development, is an area of research that is largely unexplored. However, two toys that have been demonstrated to improve spatial ability are blocks and puzzles. These "construction toys," or toys that consist of smaller components used to build larger objects, require an understanding of the spatial relationships between objects, and a more advanced assembly of these component objects is thought to be linked to advancement in cognitive development (Richardson, Jones, Croker, & Brown, 2010). Richardson et al. (2004, 2006; cited in Richardson et al., 2010) identified four major task variables of construction processes: selection of appropriate components, rotation of the components, positioning of the components, and fastening the components. These task variables are essential for successfully reaching construction goals, such as building a tower or completing a puzzle. Playing with construction toys has been found to improve mathematical thinking skills, including problem-solving strategies, algebraic reasoning, and spatial thinking; these skills are also essential to learning related subjects such as engineering and other sciences (Piccolo & Test, 2010). Block play is also correlated with later academic achievement in middle school and high school, particularly in mathematics and science. Wolfgang, Stannard, and Jones (2003) found that children who performed at a more advanced level on a Lego block play task had higher standardized test scores and report card grades in mathematics in seventh grade and high school, but not in third and fifth grade. Levine, Ratliff, Huttenlocher, and Cannon (2010) found that children who played with puzzles between the ages of 2 and 4 performed better on a two-dimensional mental rotation task than those who did not. Furthermore, higher frequency of puzzle play was a predictor of better performance on the mental rotation task.

Verdine et al. (2013) found that children who came from families of lower socioeconomic statuses performed worse on more difficult construction tasks than did children who came from families of a higher SES, suggesting that children from lower SES families may have less frequent exposure to such toys. The parents of those children also reported using less spatial language, such as “between”, “in front”, and “above.”

In examining the effects of toy play on spatial development in young children, mental rotation ability is the most widely-researched sub-skill of spatial ability, and is the spatial skill that is most often trained. The ability to manipulate the orientation of a mental representation in one’s mind, it is often used to assess spatial ability through a variety of two-dimensional and three-dimensional tasks (Casey et al., 2008). This ability begins to develop in infancy and develops rapidly from ages 3 to 5 during the preschool and kindergarten years, and advances with age (Frick, Daum, Walser, & Mast, 2009). Males exhibit spatial advantages over girls when it comes to mental rotation ability; even at preschool age, boys tend to be better mental rotators than girls. Levine et al. (1999) found that preschool-age boys performed better than girls on a two-dimensional mental rotation task.

Toys, gender preferences, and spatial ability. Miller (1987; cited in Stagnitti et al., 1997) proposed that because boys and girls have different preferences for toys, they develop different skills as a result of playing with those toys. Specifically, boys' toys encourage the development of visual and spatial skills such as manipulation and construction; girls' toys encourage the development of communication skills, particularly as they relate to emotion, care-giving behaviors, nurturance, and domestic skills (Francis 2010). Boys' toys, particularly toys that involve assembly, were also found to provide more opportunities for the transmission of didactic information and "curriculum-related skills," including literacy and constructive abilities (Francis 2010). As males show greater preference for spatial toys (Yilmaz 2009), it can be argued that boys thus have more opportunities to develop spatial skills than girls do. Gender differences in spatial ability have also been interpreted as being a product of not only sociocultural factors but also biological factors; according to this theory, boys are equipped with greater spatial skills that girls at an early age, and thus tend to choose spatial toys and activities, which further augments their spatial ability (Voyer et al., 2000). Nash (1979) proposed a gender-role mediation hypothesis to account for recorded gender differences in spatial ability, suggesting that "masculine identification" fosters mathematical, scientific, and spatial skills, while “feminine identification” cultivates verbal and language abilities. Signorella and Jamison (1986) conducted a meta-analysis that supported Nash’s hypothesis. Recent research supports Nash’s and Signorella and Jamison’s findings; in a recent meta-analysis of studies investigating gender and mental rotation ability, Reilly and Neumann (2013) found that masculine gender roles were significantly related to and predicted the development of spatial ability.

Toy Design

Given the substantial impact of toys on various domains of development, it is reasonable to assume that there are standardized guidelines for general toy design, including both technological and traditional toys. However, no official standards for toy design beyond safety standards currently exist. In 2012, the United States Consumer Product Safety Commission issued guidelines for toys intended for use by children under 14 years of age and that were manufactured on or after June 12, 2012. These guidelines included new limits on and screening procedures for the permitted soluble amount of metals such as arsenic, lead, barium and mercury; updated requirements on use of cords; and the stability of ride-on toys (FAQS: Safety Standard for Children’s Toys). All toys must be laboratory-tested and found to be fully compliant with all relevant sections of the federal toy safety standards before they are released on the market. Other than these safety standards, toy manufacturers are not required to comply with any other design standards.

Hinkse, Langheinrich, and Lampe (2008) suggest that toys should be "'fun,' offer mental challenges, be age appropriate, be reliable, be easy to understand and use, encourage imagination, give immediate feedback, and further extend play, while supporting physical and social interaction" (cited in Bergen, Hutchinson, Nolan, & Weber, 2010). Hirsh-Pasek and Golinkoff (2008) recommend that toys that promote learning should be "accouterments that make everyday interactions more fun and expand the boundaries of children's ordinary experiences." The Universal Design for Play (UDP) Tool developed by Ruffino, Mistrett, Tomita, & Hajare (2006) seeks to provide guidelines for designing toys that will be developmentally beneficial and accessible to all children. This assessment tool identifies seven major principles for evaluating universal toys: "equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance for error, low physical effort, and size and space for approach and use" (Ruffino et al., 2006). The UDP Tool also highlights the importance of having developmentally-appropriate toys in home and early intervention settings for young children with disabilities, and seeks to eliminate ineffective, inaccessible toys by providing design standards that allow for the creation of toys that promote learning opportunities for all children, regardless of developmental level. Currently, no design standards or general curriculum guidelines exist for explicitly "educational" toys.

The Impact of Educational Toys on Cognitive Development

What little research has been conducted investigating the outcomes of playing with educational toys or products is largely outdated and lacks cohesiveness. This research commonly focuses on computer games or board games, rather than manipulative toys. Din and Calao (2001) found that children who played with an educational video game showed significantly greater improvement in reading and spelling, but not math, than a control group. Dirks (1982) found that 10-year-old children who played with a game involving blocks and pattern-matching performed significantly better on the WISC-R Block Design subtest than children who did not. Furthermore, children who were reported as having had experience with the game performed better than children who had never played the game before. However, a five-year review of the recent TIMPANI (Toys that Inspire Mindful Play and Nurture Imagination) study found that educational toys did not inspire “high quality play;” they found most educational toys to be unitary in the ways they could be played with, and thus did not inspire creativity. Instead, open-ended toys, such as wooden blocks and Duplo bricks, resulted in ”high quality play,” and therefore are far more likely to contribute to positive academic outcomes than educational toys (Trawick-Smith, Wolff, Koschel, & Vallarelli, 2014). They thus recommended that parents and educators provide such open-ended toys for children rather than explicitly “educational” toys. However, these are the only recommendations concerning educational toys that exist, and are not readily available; the FTC has not provided any recommendations for consumers of educational toys, nor have they attempted to regulate the advertising or labelling of educational toys.

Educational Toys and Parenting

The brain-based learning phenomenon propagates the notion that parents can develop their children's intelligence through educational products that project only factual information; the propagation of this phenomenon has been fueled by the educational toy industry through its "selling the decontextualized learning of facts" (Hirsh-Pasek & Golinkoff, 2008). The "nurture assumption" states that parents can directly shape the future intellect and personality traits of their child; today, the promises made by educational toy marketing still propagate a widespread cultural understanding that parents, especially mothers, can largely shape the lives of their children in such ways (Trawick-Smith, Wolff, Koschel, & Vallarelli, 2014).

The brain-based phenomenon has not only captured the attention of researchers, but has clearly affected parents as well. Petrogiannis, Papadopoulou, & Papoudi (2013) found that Greek mothers highly valued providing their children with educational opportunities during play experiences, and differentiated play into two categories: educational activities, such as pretend reading; and play activities, namely playing with toys. The researchers noted that their sample was well-educated and that the children attended preschool and daycare centers, two factors that are associated with encouragement of "school-relevant activities," or activities that are designed to prepare children for school, such as playing with educational toys (Tudge et al., 2006). Furthermore, children of well-educated parents are also more likely to engage in school-related activities, including educational toy play (Tudge et al., 2006). Recent research suggests that the nature assumption is flawed, and that an emphasis on educational activities over other play activities may not necessarily lead to definitive cognitive gains. Caplan (2009) stated that “parents today are making large ‘investments’ in their children that are unlikely to pay off.” (Harris, 1998; cited in Wall, 2010).

Summary

In summary, the educational benefits of toys, and their efficacy as significant learning tools in early childhood, have bene extensively examined. Currently, however, no design standards exist for educational toys, beyond safety standards; in general, research investigating the learning outcomes of educational toys is sparse and outdated. In particular, technological toys, as well as construction toys such as blocks, puzzles, and Legos, are of recent interest. Construction toys have been linked to improved spatial skills, and boys have been found to prefer these toys, which are described as masculine-typed toys. This early male preference for such toys, as well a male gender advantage in spatial ability, is supported by Nash’s (1979) gender mediation hypothesis. Investigating the factors that enhance or promote spatial ability has also recently become a topic of interest, as spatial skills are thought to provide the basis for quantitative reasoning skills, and are also linked to later vocation in and success in STEM. The preschool age in particular is a period of great spatial growth, and teachers have begun incorporating spatial skills into classroom curriculum. In general, parents have succumbed to both the "brain-based learning phenomenon" and the "nurture assumption," believing that they can actively shape their child's intellectual development, particularly through educational toys and other products that are marketed as resulting in cognitive gains. However, the validity of the brain-based learning phenomenon has been challenged by researchers, and the efficacy of educational toys in meeting their promised learning outcomes thus merits study.

Chapter Three: Study Design and Methodology

Sample

For both the interview and play intervention phases of the study, parents of preschool children, educators in the Eliot Pearson Children's School preschool classrooms, and 3- and 4-year-old preschool students were recruited via letters distributed to parents and staff at the Children's School. The ages of the children ranged from 4 years 2 months to 4 years 7 months at the beginning of data collection (M = 4 years 4.7 months). Of the five children, four were female, and one was male. Two of the females were Asian American; two were Caucasian; and the male participant was Asian American. The parents interviewed also happened to be the parents of the children who participated in the play intervention; this was not an intentional decision of the researcher, but occurred due to a lack of interest from other parents. Of the five parents, four were female and one was male; of the five educators, four were female and one was male.

Sample of Educational Toys

All of the educational toys selected were all advertised as improving spatial skills in some way, and, concurrently, cognitive skills in general. They were purchased on multiple websites such as educationaltoysplanet.com, Amazon.com, and fatbraintoys.com. The toys also ranged in form and function. Some of the toys, such as Squigz, the Veggie Stacking Game and Pipe Builders, were construction toys intended to build structures. Playful Patterns, Peek-A-Boo

Bunny, and the Shape Sorting Clock were puzzle-like in nature. Goldie Blox and the Spinning Machine has many components, including a story book and a board consisting of many pips, upon which objects can be fastened. See Appendix E for images of each of the toys.

The toys were all advertised in similar ways; namely, they were promoted as improving spatial reasoning skills, problem solving skills, and motor skills. The Veggie Stacking Game promised to develop "thinking skills, manipulative skills, cause & effect, spatial reasoning, healthy eating habits, [and] social skills" through "stacking, thinking, and manipulative fun": (Educational Toys Planet, 2015a). Goldie Blox and the Spinning Machine, a product from a line of engineering toys specifically designed for girls, claimed to "build spatial skills, engineering principles, and confidence in problem-solving" (Goldie Blox, 2014). Squigz allegedly helped children "improve pattern recognition and spatial processing while paying attention to detail" (Marbles the Brain Store, 2015). Pipe Builders promised to "help develop fine motor control, problem-solving skills, spatial reasoning and more" (Amazon.com, 2015a). While playing with Bunny Peek-a-Boo, "children will have fun discovering the world of 3-D spatial perception, an important skill in reading and mathematical reasoning" (Amazon.com, 2015b). The Shape-Sorting Clock "can be used for multiple purposes such as counting, sorting, color/shape recognition, and spatial coordination" (Laddine, 2015). The Filo Mini was advertised as "a great manipulative activity toy" and developing "fine motor skills, creativity, imagination, dexterity, color recognition, [and] spatial reasoning" (Educational

Toys Planet, 2015b). Finally, the makers of Playful Patterns claimed that “logic and spatial thinking will blossom with the 132 wooden geometric shapes and 34 progressively challenging designs” (Discovery Toys, 2013).

Additionally, many of the toys were listed under building and construction or visual/spatial menu categories on many of the educational toy websites. The target age ranges of the toys differed, but all were listed as being developmentally-appropriate for preschoolers; for example, while Bunny-Peek-a-Boo is advertised as being suitable for play by children as young as age 2, Pipe Builders are recommended for four-year-olds and older children Many of the toys included in the sample also have won awards, such as ASTRA Best Toy for Kids Award, ‘Best in Play’ by Parenting Magazine, Toy of the Year Award 2014, and Dr. Toy- Best Vacation Children’s Products, the Tillywig Toy & Media Awards, and Parents’ Choice Awards.

Procedures

Overview

There were two components of data collection: 1) a play intervention with preschoolers, and 2) interviews with parents and educators. Data collection took place in the “therapy room” and small offices in the school building. Interviews with parents and educators were about 20 minutes in length, and participants were asked about their belief in the efficacy of educational toys, as well as their opinion of what makes toys “educational.” Parents of child participants completed an online questionnaire about their children's play behaviors and toy preferences. In order to obtain a pre- and post-test measure of spatial ability, child participants completed the Test of Spatial Ability (TOSA) at the beginning and end of the play intervention. During the course of the play intervention, children played with a sample of eight educational toys that were all marketed as improving spatial skills for 6 twenty-minute free play sessions.

Interviews

All but one of the interviews with educators were conducted in a private office or empty classroom in the Eliot-Pearson Children's School after school hours and were recorded using an audio recorder. One of the educator interviews was conducted over the phone due to the participant's availability; these calls were recorded using the recording service provided by www.freeconferencecalling.com. The interviews with the parents were conducted after dropping off their children at school, or before picking them up at the end of the school day. They were conducted in a small office in the Children's School, and were recorded using an audio recorder. Each interview was conducted individually, and ranged in length from 15-25 minutes, depending on the brevity of the participants' responses. The recordings were transcribed for analysis by an undergraduate research assistant, who was trained by the researcher.

Play Intervention

Parents of child participants completed an online questionnaire asking about their child's toy preferences, playing habits, and participation in spatial activities shortly after the study began. The children took part in a 4-week-long group play intervention, which took place in the therapy room in the Eliot-Pearson Children's School during a "free choice" period built into the classroom's normal schedule. A total of 6 twenty-minute play sessions were conducted, with an average of two sessions occurring in a single week. On average, sessions were 3 days apart; the third and fourth sessions were 6 days apart due to school cancellations because of inclement weather. Participants played with a selection of eight educational toys; the "educational" toys selected were cross-referenced for sale across multiple toy store websites, and their descriptions included such keywords as "spatial reasoning" and "spatial skills." During each play session, the researcher completed an observational scale (see Appendix A) to determine the extent to which participants were actively engaged with the toys during each play session. This engagement time was later coded for reliability by an undergraduate research assistant using the video footage recorded during each play session. Additionally, two other observational scales (see Appendix A) were also completed by the researcher and the research assistant to analyze the types of interactions children had with each other while playing with the toys, and their frequency of play with each individual toy. The researcher completed these two scales using the video footage of each session due to the demands of live coding.

All play sessions were conducted during the late morning. Participants were gathered as a group from their classrooms by a staff member of the Children's School, and were then led to the "therapy room," where the researcher was waiting for them. The staff member said goodbye to the children, and they were immediately allowed to begin playing with the toys, which were arranged randomly on the floor with their respective packaging removed. Each play session was structured as a free play session; at the start of each session, the children were reminded that they could play with any of the toys the researcher brought with her that day, and were encouraged to "play like you do in your classroom during free time." The researcher also reminded them that she was not going to be playing with them, but that she was there in case they had any questions or needed help with something. They were also encouraged to play with a variety of toys during each session. At the start of the first play session, the researcher briefly demonstrated how to play with each toy in order to reduce the frequency of later child-researcher interactions due to their inability to understand how to use a toy. During the course of the play sessions, the researcher briefly intervened only when any of the children announced that they needed help operating a toy, or if there was a disruptive, relational conflict between the children. Towards the end of each play session, the researcher announced when there was five, two, and one minute(s) remaining of the play session in order to make the children's transition from the play session to their classroom as non-disruptive as possible. A staff member returned to the room at the end of the play session, and brought the children back to their classrooms.

In order to obtain a pre- and post-test measurement of spatial ability, the Test of Spatial Ability (TOSA) (Verdine, Golinkoff, Hirsh-Pasek, Newcombe, Filipowicz, & Chang, 2013) was administered to each child independently two days before the first play session and two days after the last play session. The TOSA consists of two separate but similarly-designed spatial tasks, one two-dimensional and one three-dimensional. Children were asked to re-create six three-dimensional structures made of Builder's Blocks and six pictures of two-dimensional shape formations. For the two-dimensional tasks, the children were provided with magnetic shapes and recreated the pictures of shape formations on a whiteboard; for the three-dimensional tasks, the children were provided with Mega Bloks of the same size and color that made up their respective models. See Appendix B for examples of two- and three-dimensional trials. The researcher led each child through practice trials of each task children before introducing the test stimuli. During the practice trial, the researcher produced two incorrect replications of the model, and asked the child to verify whether or not the replication was correct. The researcher then asked the child to reproduce the test model themselves. All participants were able to accurately verify that the researcher's third model was correct and that the researcher's first two replications were incorrect; all participants also accurately replicated the model themselves on the first attempt. The researcher only moved to the test trials when the child verified that the researcher's third and accurate replication "matched" with the model, and when they correctly reproduced the model him or herself.

After the children re-created each model, a photo of their creation was taken from above for later coding purposes.

Instruments

The Test of Spatial Ability. The Test of Spatial Ability (TOSA) was developed to assess the spatial ability of children as young as 3 years of age. It is unique in that it captures a wide range of spatial skills and processes that comprise spatial ability and spatial thinking, including shape composition and decomposition, spatial visualization, and manual construction of two-dimensional and three-dimensional shape forms (Verdine et al., 2013). Rather than adhering to an “all-or-nothing” scoring method that is characteristic of standardized tests, which does not allow children to receive partial credit for their constructions, the TOSA utilizes a multi-dimensional scoring approach. The two-dimensional tasks were scored across the following dimensions: 1) adjacent pieces, which captured whether or not children understood that the model was a unified figure of individual shapes; 2) horizontal and vertical direction, which captured whether or not children understood where each component piece belonged above or below or to the right or left of the designated “base piece” of the model; and 3) relative position, which captured whether or not children understood where each component piece belonged in relation to its neighboring pieces. The three-dimensional tasks were scored across the dimensions of: 1) vertical location, which captured whether children placed pieces correctly above, below, or on the same level as the base piece; 2) rotation, which captured whether children oriented pieces correctly in respect to the base piece; and 3) translation, which captured whether children placed pieces in the correct horizontal position in respect to the base piece. All of the dimensions for the two-dimensional and three-dimensional tasks were scored independently, allowing children to receive partial credit while collapsing across all other dimensions.

Observational protocol. An observational protocol was developed by the researcher for the primary purpose of ascertaining the amount of play exposure to each toy each child received over the course of the six play sessions for later analysis. Other items on the protocol evaluated the children's engagement with the toys, the duration and types of interaction they had with their peers, and their overall distractibility. See Appendix A for the protocol in its entirety.

Parent questionnaire. All parents of the child participants completed an online questionnaire about their child's play habits, behaviors, and preferences. Questions included their child's favorite type of toy; how often they played with various types of toys per day, most notably construction toys; and their participation in activities that have been related to improving spatial skills, such as dance and movement, gymnastics, art, and karate. The spatial activity questions were modified from the spatial activity survey used by Signorella, Jamison, and Krupa (1989), which had been adapted from its original, longer version (Newcombe, Bandura, & Taylor, 1983). See Appendix C for the full parent questionnaire.

Interview questions. Finally, two separate sets of interview questions were developed to aggregate parents' and educators' opinions about educational toys (See Appendix D). All of the questions were aimed at discerning whether or not parents and educators valued educational toys as viable tools for learning, the value they placed on toys as educational materials, and the viability they assigned to the marketing claims of educational toys. See Appendix D for the full set of interview questions.

Reliability and Validity

The TOSA is a recently developed measure, and has only been cited in a small sample of studies that were conducted by the researchers who developed the measure. However, it was found to have good internal reliability, $\alpha = .747$ (Verdine, et al., 2013).

An undergraduate research assistant served as a second coder for the observational protocol, primarily to determine that the researcher was accurately coding each child's engagement with each of the toys. Interrater reliability was fair. Any discrepancies in coding were reviewed by the researcher; if there was a discrepancy of more than two points, the two scores were averaged.

Chapter Four: Findings

Play Intervention

TOSA scores. Each child's raw scores on the TOSA were calculated for both the two-dimensional and three-dimensional portions of the test. Pre-test scores on the two-dimensional portion of the test ranged from 29-33 points out of a possible 35 points, M = 30.8. Pre-test scores on the three-dimensional portion ranged from 28-41 out of a possible 41 points, M = 34.4. Composite pre-test scores, calculated by summing the scores for the two- and three-dimensional portions of the test, ranged from 63-71 points, M = 65.2 Post-test composite scores ranged from 63 to 76 points, of possible 76 points, M = 67.6. Only two participants demonstrated an increase in their composite scores from pre- to post-test; one participant had a 10-point, or 13% increase in her scores, with a pre-test score of 61 and a post-test score of 71. The other participant had a pre-test score of 70 and a post-test score of 76, an 8% increase. One participant scored a total of 63 points on both the pre- and post-test assessments. Two participants demonstrated a decrease in their scores; one participant's scores dropped from 71 to 68, a 4 % decrease, and another participant's scores dropped from 61 to 60 points, a 1% decrease. These percentages were derived by individually calculating the proportion of the pre- and post- test scores over the total possible number of points that could be obtained. These proportions were then converted to decimals, and the difference between these values for pre-and post-test was calculated. This difference was then converted to a percentage. For example, the change percentage for the participant who demonstrated a 10-point increase was calculated as follows:

$$\frac{61}{76} = .80 \qquad \frac{71}{76} = .93$$

$$.93 - .80 = .13 = 13\% \text{ increase}$$

As a group, participants demonstrated a slight decrease in their scores on the two-dimensional portion on the post-test assessment, with scores ranging from 27-35, M = 29.6. Two participants had a 2 point, or 6% decrease. in their two-dimensional scores from pre- to post-test; one participant had a 3 point, or 9% decrease, in his scores, and one participant had a 1 point, or 2% decrease, in her scores. Only one of the participants demonstrated an increase in her scores on the two-dimensional test, from 33 to 35 points, a 6% increase. However, four participants demonstrated an increase in their scores on the three-dimensional portion from pre- to post-test, with scores ranging from 33 to 41 points, M = 38. Two participants demonstrated a 1 point, or 3% increase in their scores, while another participant demonstrated a 4 point, or 10%, increase in her scores. These percentages were derived using the same method to compare changes in the composite scores, as described above. The male participant scored a full 41 points on the three-dimensional portion on both the pre- and post-assessment, and therefore did not demonstrate an increase in his scores. Figure 1 displays each participant’s two-dimensional, three-dimensional, and composite scores on the pre- and post- administrations of the TOSA.

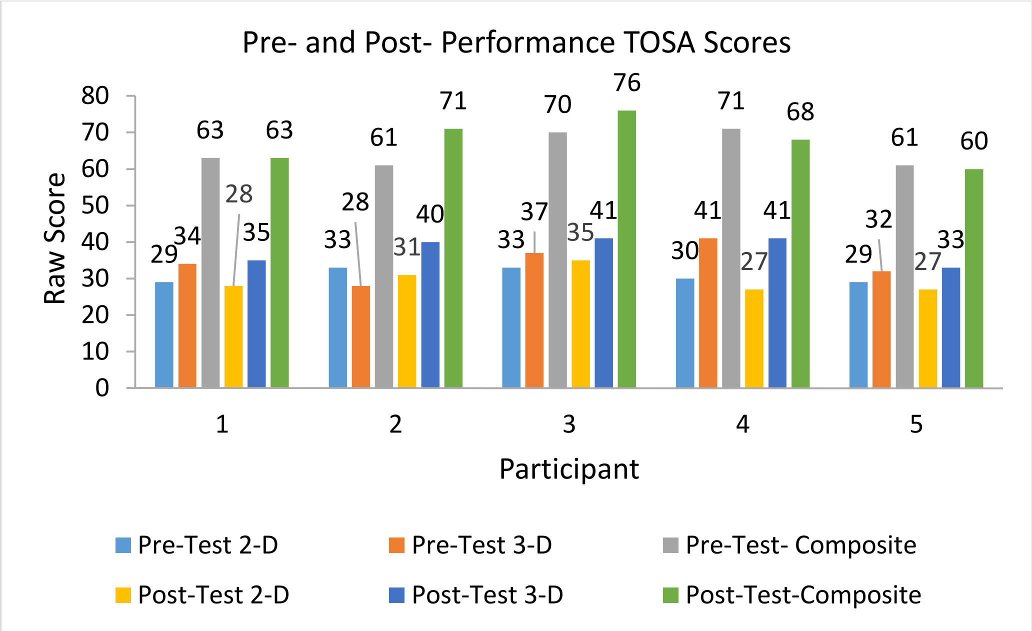


Figure 1. *Breakdown of pre- and post- performance TOSA scores*

Only three of the five participants participated in all six play sessions; one child participated in only three sessions due to illness or absence, and one child participated in four sessions. Thus, the total play time of each child varied, with play time totals of 123.75 (6 sessions), 122.5 (6 sessions), 119 (six sessions), 68 minutes (3 sessions), and 105 (five sessions) (M = 107.65 minutes). It should be noted that some of these totals exceed the expected sum of 120 minutes for six twenty-minute sessions; this is due to interruptions that occurred during two of the sessions by classes or other persons inadvertently entering the therapy room. In those cases, a few additional minutes were allotted to the sessions so that natural activity could resume. Additionally, none of the children spent a full session directly engaged in play; during every session, children spent at least two minutes talking to other children, watching other children play, or being otherwise distracted.

Play behaviors. Children also spent varying amounts of time in collaborative play and parallel or individual play. As a group, participants spent an average of 57.7 minutes in collaborative play, which corresponds to 54.5% of their total play time, and roughly 10 minutes per session. However, there was some variation among children's cumulative amounts of time spent in collaborative play, with cumulative play totals of 77 minutes over 6 sessions, 76.5 minutes over 6 sessions, 84 minutes over 6 sessions, 10 minutes over 3 sessions, and 41 minutes over 5 sessions (M = 57.7 minutes). Respectively, these collaborative play times translate to 62.3%, 64.2%, 68.6%, 14.7%, and 39% of the children's total play time. In contrast, children spent more homogenous amounts of time in parallel play, with respective mean times of 33 minutes (over 6 sessions), 26 minutes (over 6 sessions), 29 minutes (over 6 sessions), 32 minutes (over 3 sessions), and 14.5 minutes (over 5 sessions), M = 26.9 minutes. These times translate to 26.7 %, 21.8%, 23.7%, 47.1%, and 14.2% of the children's total play times. As a group, children spent an average of 26.9 minutes engaged in parallel or solo play, 25 % of their total play time, or roughly 4.5 minutes per session. See Figure 2 for a comparative view of the amount of time each child spent in collaborative versus parallel play.

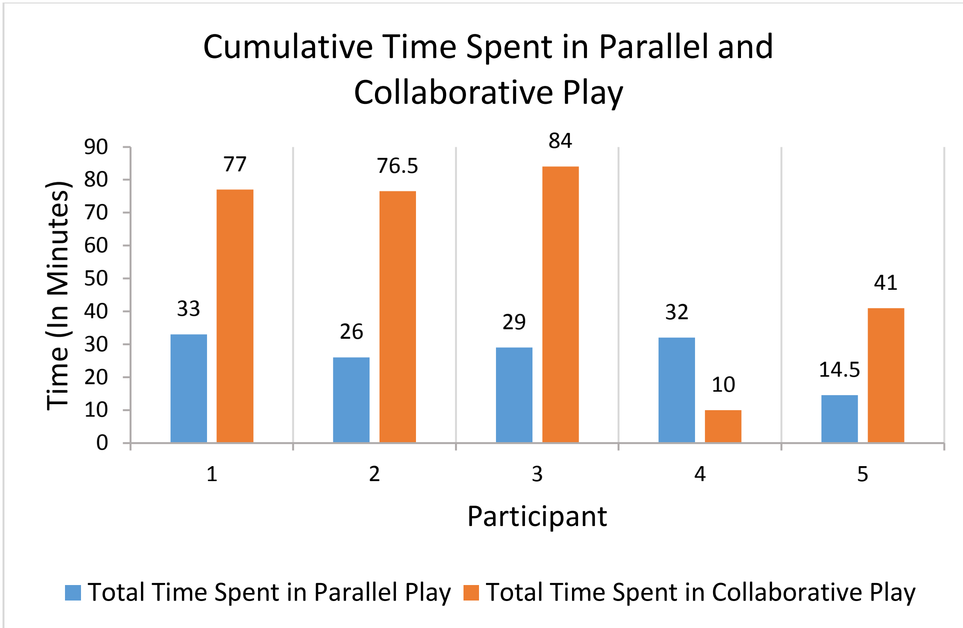


Figure 2. *Cumulative time spent in parallel and collaborative play*

There was also some variation in the total amount of time children spent in conversation about toys: 56 minutes (over 6 sessions), 41 minutes (over 6 sessions), 63 minutes (over 6 sessions), 5 minutes (over 3 sessions), and 37 minutes (over 5 sessions), M = 40.4 minutes. These times correspond to 45. 3%, 33.5%, 53.9%, 7%, and 35.2% of the children's total play time, respectively. Similar discrepancies occurred in how often children discussed sharing toys, ranging from 28 minutes (over 6 sessions), 12 minutes (over 6 sessions), 16 minutes (over 6 sessions), 3 minutes (over 3 sessions), and 12 minutes (over 5 sessions) M = 14.2 minutes, and how many instances each child showed others how a toy worked, ranging from 13 instances (over 6 sessions), 16 instances (over 6 sessions), 12 instances (over 6 sessions), 0 instances (over 3 sessions), and 2 instances (over 5 sessions), M = 8.6. Figure 3 demonstrates the frequencies of these behaviors for each individual participant. These play times should be interpreted in respect to participants' overall play time over the course of the intervention; participant 1 had a total play time of 123.75 minutes, participant 2 had a total play time of 122.5 minutes, participant 3 had a total play time of 119 minutes; participant 4 had a total play time of 68 minutes, and participant 5 had a total play time of 105 minutes.

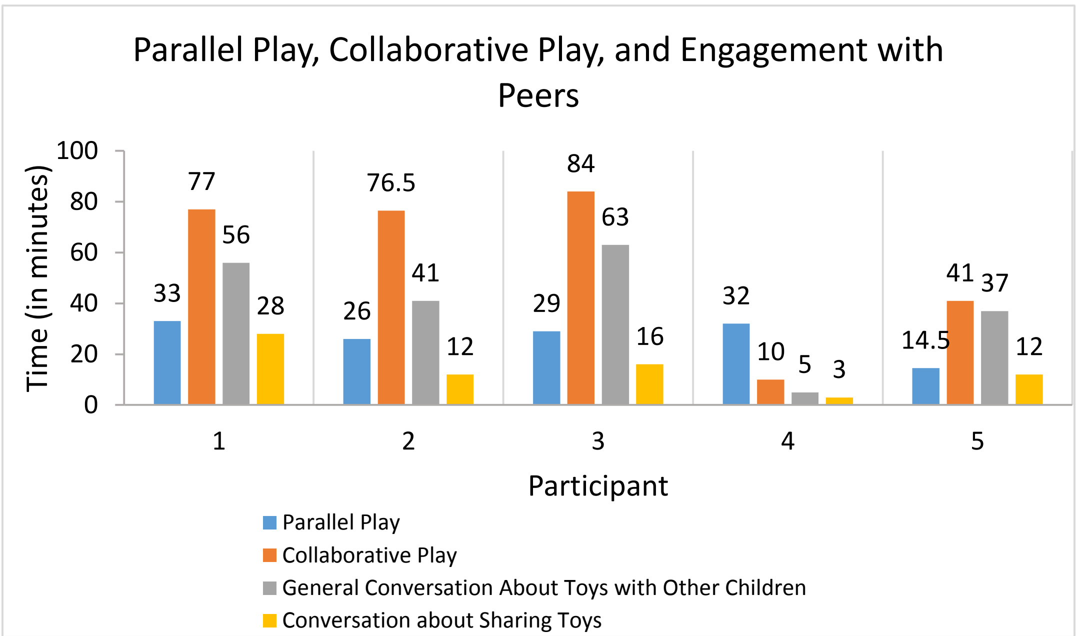


Figure 3. *A comparative view of time spent in parallel and collaborative play and engagement behaviors with peers*

Engagement with toys. While each child's total amount of play time differed, there were distinctive patterns that emerged in how often the children played with each of the toys. Additionally, every child played with more than half of the toys in the sample during at least 4 of the individual play sessions. As a group, participants clearly showed marked preferences for certain toys. Goldie Blox and Pipe Builders were the most popular toys overall, receiving the most play time; the Shape Sorting Clock and Playful Patterns received very little play time from any of the children. All of the children played with the Shape Sorting Clock the least; their play with this toy accounted for less than 2% of their respective cumulative play times. On average, children spent 27.3 minutes playing with Goldie Blox and the Spinning Machine; three of the children played with this toy the most frequently across the six sessions, accounting for 28.2 %, 34.3 %, and 63.9 % of their total play time with the toys. Average play time with the Pipe Builders was 27.1 minutes; two children played with this toy the most frequently, accounting for 24.2 and 48.1% of their total play time. Average play time for the other toys was more homogenous: 12.5 minutes with Peek-a-Boo Bunny, 11.8 minutes with the Veggie Stacking game, 10.75 minutes with Squigz, 8.1 minutes with the Filo Mini, 6.1 minutes with Playful Patterns, and 4 minutes with the Shape Sorting Clock. Figure 4 represents each child's cumulative amount of play time with each toy. Again, these play times should be interpreted in respect to participants' overall play time over the course of the intervention.

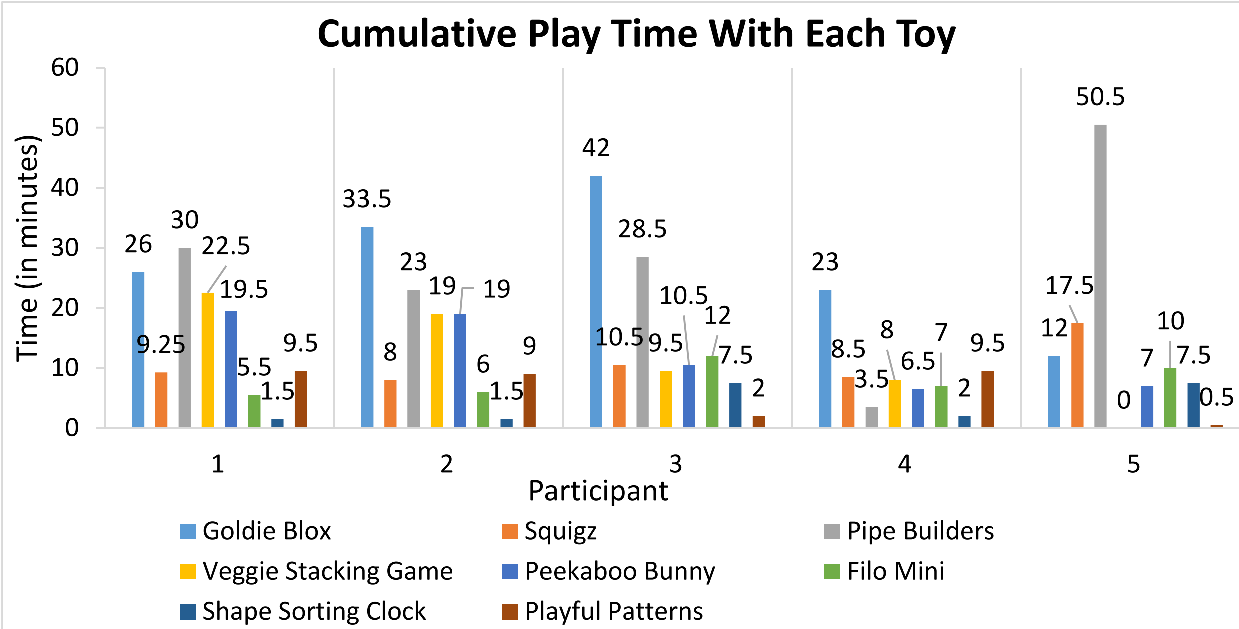


Figure 4. *Cumulative amount of play time with each toy*

Sample demographics and performance on the TOSA. Demographically, the sample of children was not very diverse. All children were between 4 and 5 years of age: one child was 4 years and 4 months old; two were 4 years and 5 months old; one was 4 years and 2 months old, and one was 4 years and 7 months old. There were four female participants and one male participant. The male participant outperformed his peers on both the pre- and post- assessment of the three-dimensional portion of the TOSA, scoring full marks at both time points. However, he scored at or below the mean on the two-dimensional portion of the test. Both of his composite scores were greater than the group mean; his composite score for the pre-test was 71, compared to the group mean score of 65.2, and his composite score for the post-test was 68, compared to the group mean score of 67.6. It should be noted that the male participant was also the oldest participant of the sample at 4 years and 7 months of age. One child, the youngest of the sample at 4 years and 2 months of age, scored a full 76 out of 76 points on the post-test assessment. She also scored one of the highest composite pre-test scores, scoring 70 out of 76 points, surpassed only by the male participant with a score of 71 points. One child, 4 years and 5 months of age, demonstrated the greatest improvements from pre- to post-test, with a 10-point improvement in her composite scores from pre- to post-test, and a full 12-point improvement from pre- to post- test on the three-dimensional portion of the test.

Parent questionnaire. All of the participants' parents indicated that their children enjoyed playing with Legos, blocks, puzzles, and other construction toys. The male participant was indicated as playing with blocks, Legos and puzzles most often per day; his parent indicated that he played with them twice, once, and twice per day, respectively. Other children were indicated as playing with blocks as few as zero times per day, once per week, five times per week, and twice per day. Puzzle play was more frequent, with one child having a reported play frequency of twice per week, and four children having a reported play frequency of once per day. Lego play was the least frequent activity for all participants. Two children were reported as playing with Legos zero times per day, two children were reported as playing with Legos twice per day, and one child was reported as playing with Legos twice per week.

One participant who was reported as playing with puzzles once per day scored the highest on the two-dimensional portion of the pre-test assessment, and scored full marks on the post-test assessment. The male participant was indicated as playing with blocks twice per day and puzzles once per day, and obtained a full score on the three-dimensional portion of the pre-test assessment. The female participant who was reported as playing with blocks twice per day, puzzles once per day, and Legos twice per day scored the lowest of her peers on the two-dimensional pre-test assessment and the second-lowest of her peers on the three-dimensional pre-test assessment. The children who achieved the two highest scores on the two-dimensional pre-test assessment were both reported as playing with puzzles once per day; the two children who scored highest on the three-dimensional pre-test assessment were also both reported as playing with puzzles once per day.

The children were reported as having participated in the following spatial activities: art class/instruction, swimming, gymnastics, dance/movement, and music. All of the children were indicated as having had participated in at least one of these activities regularly for at least once a month or more. The four female children all were reported as having participated in three spatial different activities; the male participant was reported as having had participated in one spatial activity, swimming. All of the female participants had regularly participated in dance/movement; two of the female children had participated in music; three participated in gymnastics; and four of the females participated in swimming. The male participant, who scored full marks on both the pre- and post-three-dimensional assessment, was reported as having regularly participated in swimming only. The female participant who was reported as participating in three spatial activities, music, dance, and swimming, demonstrated the highest two-dimensional pre-test score of 33, but the lowest three-dimensional pre-test score of her peers of 31. She also demonstrated the greatest score change in her composite scores, with a 10 point increase in her composite scores from pre- to post- test. One participant, who was reported as having regularly participated in dance, music, and swimming, tied with another participant for the highest two-dimensional pre-test score. One participant who was reported as participating in music, dance, and swimming, consistently demonstrated the lowest scores of her peers in all pre- and post- test components and composite scores, except for the pre-test three-dimensional portion, where she scored the second-lowest of her peers.

Interviews

All interview data were transcribed for analysis by an undergraduate assistant and were coded into emergent themes, which were organized using a demonstration version of the Atlas.ti software. The data collected from educators and parents were analyzed as two separate units, and the themes that emerged were then compared and contrasted using descriptive analysis techniques outlined by Corbin and Strauss (2008).

Of the five parents interviewed, two were researchers at academic institutions, two were stay-at-home parents, and one was self-employed. All of the parents held at least a Bachelor's degree; two also held master's degrees, and two held doctoral degrees. Of the five parents, four were female, and one was male. The age range of the parents was 34- 47 years of age (M = 39.4 years). While demographic information of the teachers was not collected, years of teaching experience ranged from 3 years to over 20 years of experience in teaching in early childhood classrooms. While all of the teachers interviewed had at least some experience teaching preschool, four were currently preschool teachers, and one was a kindergarten teacher.

Overall, parents and educators expressed varying opinions on the efficacy of educational toys, and reported a range of purchasing behaviors of educational toys; however, their definitions of what makes a toy educational were much more homogenous. While educators reported relatively homogenous opinions on their beliefs in the efficacy of educational toys, the parents' opinions had higher variability. The findings have been summarized in the following summary according to theme, topic, or interview question, below.

What makes a toy educational? All participants expressed that they thought all toys have the potential to be educational; three parents and four educators also went further and expressed that they thought any variety of materials, not just toys, could also be educational. These participants emphasized that it is how the toy is used by the child, or how play with the toy is facilitated by an adult, that results in educational outcomes. One participant noted that some toys were more "self-evident" in terms of being educational, that there were levels of understanding that evolved when children played with toys. She evoked a continuum of educational toys, stating that "some toys are more educational [than others].” This participant defined herself as a “Montessorian,” and stated that, as part of that group, she believed that “no toys are needed” at all for children to learn, and that materials in the environment can lead to same learning outcome as “Magnatiles,” a popular construction toy, can.

Several common themes reoccurred in both parents’ and educators’ descriptions of what makes a toy educational: allows children to explore, inspires creative thinking, and introduces new information. One educator provided the following definition: “A toy is educational when it provides children opportunities to think, use their prior knowledge, and then to consider different ways of doing it.” She also added that the toys must be safe for children to use, and that the “content allows multiple perspectives,” and a “good toy” is “multifaceted,” and “will target all areas of [the children’s] developmental beliefs.” One educator said that she associated the word “educational” with “computerized game[s] [like] LeapFrog.” More broadly, however, she believed that toys that are truly educational are not so “artificial,” but are “things that kids are naturally very interested in, and want to learn about and want to grow in.” Another educator stated that it is “something that children can explore and experiment and learn from, whether it’s inherent or not,” and “something that can introduce a new topic or expand upon something they already know in any domain.” One parent and two educators said that they believed toys were educational when they evoked some sort of understanding in children, and when they “provide children with opportunities to think,” allow children to “experiment,” “can be discovered,” and “introduce a new topic or expand upon something they already know in any domain." The parent who identified herself as "Montessorian" said that toys are educational when they are hands-on, manipulative, and three-dimensional. Two educators and two parents cited toys that spur creative thinking as being educational. One parent, who mentioned that one of her children had worked with an early intervention specialist when he was younger, stated that she had "sort of an informed opinion on this," and that the specialists "trained" her and her husband to look for toys that addressed sensory or motor skills. However, she later stated,

> I don't see a lot of empty toys in that sense. I see toys that don't work as promised, or toys that my kids don't use in the way that the manufacturer intended. I see toys that they're not interested in, I see toys that break really quickly, but again, like I said, I don't see a lot of emptiness, unless it's that they simply aren't interested in the toy or don't really know what to do with it.

Over half of the parents and educators also highlighted the role of scaffolding from adults, as well as the agency of the child, in adding to the educational value of a toy. They all expressed that the roles of the child and educator during play, rather than the toy itself, had the greatest impact on the learning experience. Educators more often emphasized the role of the student, rather than the toy itself or the role of adults, as being primarily responsible for the learning process: "My first thought is that a child is engaged, and it's stretching their thinking in some way. And it can be a block, but if they make that block into something, or they're learning something, that, to me, is educational."

One educator even stated that he tried to make toys less "teacher-directed," and allowed children to play with the toys as they wish. One parent also undermined the role of adults in children's learning through play, stating that it is "up to [the child] to think of different ways to use [toys]; it's up to them to enjoy it or not." One parent and one educator both emphasized that any toy can be educational if it is used properly under the guidance of a "skilled teacher:" "Any toy, any object, any little piece of paper can have the potential to be educational in the hands of the right educator."

Three of the parents, two of whom did report that they purchased educational toys, expressed an awareness of the density of educational marketing claims as a defining characteristic of not only educational toys, but toys in general. One parent noted that "[toy companies] want you to think that everything is educational really," and also expressed an awareness of the gender-typed marketing messages:

> Girls' toys are marketed with less of an emphasis on education, I've noticed. Unless you consider pretend play. Like a lot of the girls' toys are all about pretend play, and dolls, and magical worlds and things like that.

Purchasing behaviors of educational toys. Parents and educators reported a wide variety of purchasing habits when asked if they had ever purchased educational toys; three parents and two educators reported that they purchase educational toys. Many cited marketing as an important factor in deciding whether or not to purchase educational toys. Two of the parents reported that they had never purchased educational toys for their children. When further probed as to why they did not purchase them, one parent said that he “[hadn’t] been exposed much to toys marketed as educational,” citing a limited mental schema of educational toys as being technological, such as LeapFrog products or an iPad. He went on to say that he has “no quarrels” with educational toys, but that the educational aspect isn’t the “deciding factor” when he makes his toy purchases. However, he described the experience of the thought process while purchasing toys for parents in general as being one where the “educational element” of a toy is always in the foreground of their minds: “Okay, Candyland might be educational in some way.” The other parent stated that she “didn’t trust marketing [of educational toys],” and that she “made her own decisions.” She did, however, state that she would be far more likely to purchase a toy if there was a label of “Parent’s Choice Award,” or similar, on the packaging; otherwise, she purchases toys due to recommendations from others, or her own previous positive experience with the toy. One parent expressed her dissatisfaction with the marketing of educational toys in general: “I think that I’d almost prefer for marketing to be geared more towards…like it’s not the age ranges, a lot of toys are marketed for age ranges. But it’s really the developmental ranges, that would be way more helpful.”

For the three parents who reported that they did purchase educational toys, skill-building or introduction to new concepts were the most-commonly cited reasons. One parent explained,

> As a parent, we want to do what’s best for our child, provide the most nurturing environment possible to give him all the toys that will help his

> development and give him the love, the attention, even teach the discipline, everything that he needs to help him grow and give him the best shot in life. And so we shower him with things that we think will help him, toys included.

However, she added,

> I know there are some parents that I've seen, peers that buy Einstein's Workshop stuff for their kids. And really push the studying, make them memorize. I try to stay away from that, just because that's not necessarily education. Anything that helps their brain to grow and learn about the world is my idea of education.

All of the parents who said that they purchased educational toys said they did so because they were looking to "build certain skills," "challenge [their] kids," or "expose [their children] to certain concepts." One parent explained that she felt that she couldn't provide "that kind of instruction" for her child herself in their home setting, and that educational toys could provide a learning experience for her child that she, as a parent, could not. Another parent emphasized that she sought educational toys that were "appropriate [for her child's] skill level" and that were "conceptually interesting." Interestingly, two of the parents also expressed that they were aware that educational toys were marketed as improving skills: "I think the way that they're marketed, educational toys have specific skills they're trying to teach children, and tend to be more academic skills, like numbers, letters, sounds, words." All of these parents also cited the toy's appeal for their child or the entertainment value of the toy as a major reason for purchasing educational toys.

One parent who reported that she did buy educational toys also stated that she and her husband tried to be “judicious” and “selective” and “give [their children] toys that allow them to do multiple things with the toy.” She added,

> And you never know, the return on investment in these things is a complete mystery to us. Some things, the really inexpensive things are big wins, and sometimes the really expensive ones are, and you just never know, because they each get something different out of them.

She also stated that her son “seems to do better with toys that are marketed towards having a purpose”: “For example, the snap circuits, like he has to figure out different ways to put them together, look at the diagram and translate it, and put it together...And so, in that sense, toys that are marketed as educational work really well for him.”

However, the three parents who reported that they did purchase educational toys emphasized that they often did not explicitly seek out educational toys because the toys were labelled as educational. One parent mentioned that she never explicitly set out to buy educational toys; she never “watched a television commercial and thought, ‘I’m going to get that [toy],” nor had she ever “wander[ed] around and [saw] an educational toy and [thought], ‘that’s going to be it.’” In fact, many parents reported that they usually did not enter toy stores with preconceived notions of what they wanted to buy their children.

Two educators reported that they do purchase educational toys for their classroom. When asked if she buys toys that are marketed or labelled as being educational for her classroom, one educator responded, “Of course, yes, I do, because some of them are really good. I mean some of them I think are fun.” She also said that introduced what she called “brain toys” into her classroom at the beginning of the academic year, explaining that they were sensory toys that “[gave] children the sensory input they need.” Another educator also referred to educational toys as “fun,” and stated that he did purchase educational toys for his classroom, but he “usually use[d] them differently than what they’re supposed to be for,” disregarding the instructions and denoted purpose for the toy and transforming it into a “freer” or “more kid-friendly” toy. Three educators said that they never bought educational toys; one of them negatively described educational toys as “something that was so targeted towards a skill.” One educator, like one of the parent participants, also expressed a pre-existing mental schema of educational toys: “When I hear the term ‘educational toys,’ I think of like the Fischer-Price commercials, and the Baby Einstein.” She reported that she had never purchased any educational toys.

The two educators who reported that they purchased educational toys were also parents, and they both said that they bought or had bought educational toys for their children when they were younger. They both responded that they did notice learning benefits from their children playing with the toys, but did not cite any specific examples.

Three educators reported that they did not purchase educational toys for their classrooms. One educator stated that she did not purchase educational toys because she did not believe the educational label: "I also think sometimes when things are marketed as educational; I think it's questionable almost. Because I feel like, the way I think about toys or different materials in the classroom, I think anything can be educational. So for one specific material to be labeled educational, I don't really believe that, because I think you can turn anything into an educational opportunity." Another educator stated that her primary reasons for purchasing toys—which did not include educational toys— were because she thought they would appeal to her students, or because she herself enjoyed playing with them as a child.

Are educational toys effective? When asked their opinions about the effectiveness of educational toys in meeting the learning goals as advertised on the packaging, participants provided mixed responses. Parents did not express overwhelming support for the educational validity of educational toys; they cited a variety of reasons for a toy being educational in general, but not specific characteristics or qualities of educational toys themselves. One parent expressed no support for the efficacy of educational toys at all; she stated that she did not purchase educational toys and, when asked if she would encourage her children to play with educational toys over non-educational toys, answered, "Absolutely not. Whatever their interest is." She was unable to provide any examples of effective or ineffective educational toys. While the educators generally did not provide such support for the efficacy of educational toys, one educator expressed strong support for such products. She stated that she had observed many benefits and learning outcomes from her students playing with educational toys, particularly in terms of social development: "…they learn to interact with one another and pay attention to each other." She described the experience of children playing with educational toys: "You see them getting excited, but not out of control, so their voices may get louder or become high-pitched…so there's an interaction, so they are engaged." She also noted that children often intensely focused on educational toys, and that children tended to play with the toys over and over again. One educator, while he was unable to provide substantial anecdotal evidence of positive learning outcomes, noted that he thought educational toys have been "tested a lot, so the quality of the item is better."

Effective/ineffective educational and conventional toys. Overall, parents and educators were able to cite examples of effective educational toys more often than examples of ineffective educational toys. However, parents were able to supply specific names of educational toys more often than the educators were. Educators tended to use the process of playing with the toys as descriptors, and were often unable to remember the names of the toys. Both groups also provided more examples of learning outcomes children displayed through playing with non-educational toys rather than educational toys. Furthermore, many of the participants were either unable to provide specific examples of effective educational toys, or expressed uncertainty that toys met the goals claimed on the back of the box. One parent explained, “I can’t think of any toys where I’ve felt like I’ve bought that to teach her something, and it worked exactly how the plan said it would.” Two educators were unable to provide any examples of both effective and ineffective educational toys, both stating that they supported open-ended toys rather than educational toys, which they defined as having only one purpose or goal. One parent, however, was able to provide many examples of educational toys: snap circuits, which she reported taught her children about electricity; magnetic blocks, which taught “the process of building;” and a toy from the Goldie Blox line, which taught engineering skills.

Two parents described examples of ineffective educational toys, both of which involved track sets. One parent explained,

> We bought this awful mistake of a toy that’s a marble run that can only be put together a certain way, and it came with an 80 page instructional manual. Biggest mistake ever, and I think we will definitely be giving it away. He got very bored very quickly, so definitely non-educational.

The other parent cited a similar toy called Click Clack Track, stating that she noticed her children “didn’t have either the interest level or the patience to play with [the toy] like it was supposed to be played with.” Because of that, she stated that she “[didn’t] really know if my kids got out of it what was on the box.” She also mentioned a toddler toy that “was supposed to be used as a sensory toy, or a cause-and-effect toy, like hit the plunger and the balls come out,” and that her son did not reap the benefits advertised on the box, because “what he got out of it was a completely different cause-and-effect experience, which was 'Hey, what can you stick down there that gets stuck?'"

One educator cited many examples of educational toys that he described as meeting their respective advertised learning goals: tube-like water toys that taught engineering skills and the laws of physics; a toy designed to build counting skills; Legos and Duplos; Magnatiles; and a cash register toy that taught counting skills. The majority of the educators, however, cited only ineffective examples of educational toys. One example was a sling-shot toy that was "nice and flashy," but "the rate of success [was] very limited." The educator said that she didn't think the toy was meeting its advertised goal of fine motor skill development, so she removed it from her classroom. Another educator expressed her frustration with a toy that was designed to promoting reading but resulted in children simply memorizing words: "That was frustrating to me. That it was being marketed that kids would learn how to read, but they kind of skipped a step, they weren't reading with understanding." Another educator also cited toys that are "marketed towards parents about literacy development and math skills" as being inappropriate for the target age group, and that while it may appear that the child is gaining those benefits, "those marketers don't provide that information for parents." Another educator cited infant-toddler toys are being ineffective due to the lack of open-endedness of the toy; she said that these toys are often designed to teach only factual information like colors and numbers, and that children, who are "naturally curious," easily get bored with these toys.

Across both groups, board games were the most commonly-cited example of effective educational toys. One parent mentioned an educational game called Blokus, and stated that she saw great improvements in her son's ability to strategize as a result of playing with the game over a three-month time period. One educator also cited a board game that was marketed to promote collaborative play and social development, and reported that the game did "meet expectations." Another parent also referred to an educational board game called Feed the Woozle, which also promised to promote collaborative play. One educator cited an educational board game called Sneaky Snack Squirrel; however, while she explained that while from her own observations, the game enhanced addition and subtraction and fine motor skills in the moment, she could not definitively say that those learning outcomes were fully met. She also stated that these were likely not the educational claims advertised on the box. Two educators also cited social learning as a result of educational toy play.

Delineating "educational" and "non-educational" toys. Many parents and educators grappled with providing specific examples of effective educational toys because they weren't sure if certain toys were classified as "educational" or not. Around half of the participants seemed to have a clear grasp of what delineated "educational toys" from "non-educational toys," while others asked the researcher to clarify or express her own definition of educational toys as it pertained to the study. One parent, after some deliberation, defined puzzles as an "educational toy," particularly as a learning tool for geography and the alphabet. Another parent struggled with categorizing Duplos as an educational or non-educational toy, but ultimately categorized them as educational. She stated that her son had an "'aha' moment" while playing with Duplos in realizing that he could build things to create "a representation of a physical object." One parent switched between identifying puzzles and blocks as educational or conventional toys, at times referring to them as educational, but at others, referring to them as non-educational.

Learning outcomes of non-educational toys. Parents were readily able to supply examples of conventional toys that caused changes in their child's thinking, learning, or knowledge; furthermore, many often added that they realized these toys weren't "explicitly educational," but they definitely were able to discern the educational value of these toys. Board games were often cited by parents as effective learning tools, particularly in numeracy and social cooperation: "So I guess none of those are explicitly educational, but definitely I think she's extracted some education from them." One parent also mentioned that she observed that board games often promoted her child's numeracy and counting skills, although she did not define them as explicitly "educational." Puzzles, blocks, Legos, and construction toys were also commonly referred to by educators and parents as improving skills related to construction, engineering, and physics. One educator cited train sets as improving engineering skills. Magnatiles was also a popular example of effective non-educational toys mentioned by parents; educators also cited Magnatiles, but more commonly labelled them as "educational," rather than "non-educational," toys. The self-identified "Montessorian" parent, while she expressed her appreciation for toys, particularly construction toys, stated that she didn't think toys were "necessary" for learning, and thus did not cite any examples of effective conventional toys.

All of the educators were able to provide many examples of learning outcomes resulting from conventional toys, most notably puzzles and blocks. The educators who cited these toys also expressed that they were aware that these toys could be "marginally marketed as educational," echoing the blurred distinction of educational and non-educational toys that parents expressed when trying to cite examples of effective educational toys. One educator, however, did not explicitly reference specific conventional toys, and instead stated that "it's all up to how you present it and how they look at it." Another expressed that she believed that play with toys itself taught skills, particularly executive functioning skills such as self-regulation, planning, and organizing ideas. One educator explained that she observed children learning spatial concepts such as shape composition and decomposition and one-to-one correspondence from playing with the open-ended Magnatiles and unit blocks, rather than strictly "academic skills."

Only one parent mentioned an example of an ineffective conventional toy: a remote-controlled carriage. She stated that she and her husband "saw it as helping [their daughter] learn to use a controller, the fine-motor of working her thumbs and her fingers separately…I guess that's part of spatial development." However, she said the toy itself didn't work that well, and her daughter wasn't very interested in the toy.

Encouragement for playing with educational toys. Most of the parents reported that while they supported their children playing with educational toys, they did not often explicitly encourage that they play with educational toys over non-educational, conventional toys, unless a specific opportunity for learning arose. One parent explained, "Yes, I encourage it, but I don't encourage it. I don't explicitly say 'you should play with some blocks because it's good for you.'" Two parents said that they do not encourage their children to play with such toys "at all;" but also mentioned that they intervene during play when they think there's an "educational moment." One parent stated, "My children can play with anything they want to, because toys are for exploring and most of it at this age is all about pretend." Another parent said that she sometimes did encourage her child to play with the educational board game called Feed the Woozle. She then stated that she doesn't feel that encouraging her child to play with educational toys is "as necessary at this [preschool] age," but said that she could foresee herself encouraging her child to play with educational toys as she got older to "fill in gaps in her knowledge that she's not getting addressed in school." One parent stated that she didn't "necessarily" encourage her child to play with educational toys, and she tried to "keep a good balance of educational and non-educational toys [in the home]." However, she did say that she had tried to encourage her child to play with educational toys in the past, but had "given up on that": "I think the more I push, the more he tends to resist."

Learning through play: open-ended toys. One theme that saturated both the parents' and the educators' responses throughout the entirety of the interviews was the notion that "open-ended" play provided the most valuable, highest-quality learning experiences. When asked of their opinions about the educational nature of both conventional and educational toys, both groups reiterated that they supported open-ended play as being the most beneficial educational experience for children, regardless of what type of materials were used. The educators expressed that they purposefully included open-ended toys in their classroom, and that these toys made up the majority of the toys in their classroom. Furthermore, they supported children playing with toys in various ways that may not be the "intended" use of the toy.

All of the parents stated that they allowed their children to play freely and open-endedly with the toys of their choosing. One parent explained, "I love the ability for a child to think out of the box, I don't like toys where you can only do one thing with it and that's it." One parent repeatedly expressed that she sought toys that inspired her children's creativity or allowed them to express themselves, noting that the true benefits came from the processes of exploring the toy:

> But mostly what I see is that they play out the little scientist thing. They have an idea of how it's going to work, and they try it, and either it does or it doesn't. And then they might try something different, or they might try the same thing again to see if they can get it right.

One parent felt this open-ended characteristic enriched the toy by making it multi-dimensional: "So I felt like it worked on two levels…it also lent itself to open-ended play as well. So I thought that was fairly effective." Furthermore, some parents and educators expressed that they thought non-effective toys were ones that were narrow in scope, as these toys are too "repetitive" and quickly become "boring" for children. They thus reported that they preferred buying open-ended toys, particularly toys that were “math materials” and “lend [themselves] to building.”

Construction toys. Parents in particular discussed the educational benefits of blocks and puzzles; all of them stated that they encouraged their children to play with construction toys, and would often play alongside their child. They also expressed that their children really enjoyed playing with these toys, particularly Magnatiles and Duplos. While the “Montessorian” parent stated that she did not encourage her children to play with construction toys, she “made sure they’re available,” especially because her child is a female, and “often toys are elicited and marketed to females very differently than males.” Educators were also in favor of construction toys, and all of them reported that they had such toys in their classroom, and that they were some of the most-favored toys among their students.

Chapter Five: Discussion

Play Intervention

Overall, the hypothesis that participants would demonstrate substantial improvements in their scores on the TOSA after participating in the play intervention was not met; only two participants demonstrated improvements on the assessment, while two participants' scores decreased, and one participant's scores remained constant from pre- to post- test. However, the two participants who demonstrated a decrease in their scores only decreased by 1 and 3 points, relatively small declines. As the sample size does not allow for significance testing, it is unable to be determined whether or not these improvements and declines in performance are significant. Furthermore, several factors other than the play intervention may have affected participant's performance on the post-assessment tasks: practice effects, maturation effects, increased comfort with the researcher, and increased confidence with three-dimensional tasks. The two participants who displayed improvements on the TOSA may have only achieved higher scores due to familiarity with the stimuli from having taken the test a few weeks prior to the post-assessment, or simply developmental maturation of their spatial skills during that time period independent of the intervention. As there were less than 4 weeks between the pre- and post-assessment, however, it is unlikely that participants underwent significant spatial-cognitive maturation, although it is possible, as the ages of 4 and 5 are a time of great spatial growth in children. The participants who displayed decreased scores and the participant who showed no improvement may have done so due to an increased level of comfort with the researcher; they may have performed better on the pre-assessment due to a desire to do well to “please” the researcher, a teacher-like stranger. Additionally, the six sessions of interacting with the toys, three-dimensional objects, may have increased their confidence with and ability to do well with the three-dimensional tasks; a lack of emphasis on two-dimensional spatial skills during the intervention may have played a role in the trend of decreased post-test two-dimensional scores.

Another factor that may have influenced children’s spatial gains, or lack thereof, was the exposure they had to each of the toys. The children as a group displayed marked preferences for the toys; certain toys, such as Playful Patterns and the Shape Sorting Clock, received much less play time than Goldie Blox and the Spinning Machine and Pipe Builders. It is impossible at this time to say if any of the toys are more spatially advantageous than others, or if they individually meet their respective marketing claims; however, it is possible that the toys that received less play time result in qualitatively different spatial gains than the toys that were played with more often. Because the children favored certain toys over others, it is possible that they did not fully reap the possible spatial benefits of the toys that were largely ignored. However, Goldie Blox was the toy of the sample where spatial skills, particularly as they relate to engineering, were at the forefront of the marketing. This toy was extremely popular with all of the children, and may have contributed to high three-dimensional scores on the post-assessment. Conversely, Playful Patterns and the Shape Sorting Clock, both of which had flat shape pieces, were similar in design to the two-dimensional task of the TOSA, and were played with the least by participants. The two participants who had the highest post-test composite scores both played with Pipe Builders more frequently than other of the toys, and the male participant, with the highest three-dimensional score, played with Pipe Builders much more frequently than any of the other toys. Again, while it is not possible to conduct correlation tests due to the small sample size, the data trends towards Pipe Builders as possibly being a spatially-beneficial toy. Nevertheless, this has important implications for parents and educators who may be looking to enhance the skills advertised on the back of the box, not only in potentially informing the characteristics of engaging and entertaining educational toys, but also in guiding their purchasing decisions. If these toys do not in fact meet the learning goals as advertised, then there exists a great need for parents and educators to make even more discerning decisions when purchasing educational toys.

Interestingly, the male participant exhibited toy preferences that were slightly different from his female peers. While he played with Goldie Blox the most frequently, Playful Patterns received the second-highest amount of play time from this participant. Pipe Builders, on the other hand, received the second-lowest amount of play time. While the preferences of a lone male participant can certainly not be generalized to the entire population of male four-year-olds, these findings indicate that Playful Patterns was a more attractive toy for this participant than his fellow female participants. These preferences may have played a role in the male participant’s exceptionally high scores on the three-dimensional portion of the TOSA; again, however, attributing causality from a single participant is impossible. Furthermore, as boys tend to show higher preferences for spatial toys than girls, it is possible that Playful Patterns was more "spatially-typed" than some of the other toys, which could also account for the male participant's engagement with the toy, and female participants' lack of engagement.

It is also possible that the toys in the sample enhanced spatial skills that are not assessed by the TOSA. For example, some of the toys, such as Peek-a-Boo Bunny, could have promoted between-objects skills, while the TOSA, like many other assessments of spatial ability (Newcombe et al., 2013), largely assesses within-objects skills. If the toys in the sample enhanced spatial skills not assessed by the TOSA, then participants would likely not demonstrate improved performance. At this time, it is not possible to confirm the skills that each toy actually does or does not enhance, particularly in accordance or in conflict with marketing claims on the packaging.

It is also important to note that *how* children play with the toys is equally, if not more, important than *how much* they play with the toys. For example, during two of the play sessions, three of the children spent about half of the session time playing with the Veggie Stacking Game. However, rather than building towers of the veggies, as demonstrated by the researcher in the first session, they simply played fantasy games instead, which likely did not result in the same spatial gains as would playing with the game in the way it is intended. Additionally, while all of the toys were labelled as being appropriate for children two years of age and older, it seems that the children would have benefitted even more by playing with some of the toys with an adult's assistance. Goldie Blox and the Spinning Machine comes with a storybook; while one child was able to read the book and successfully complete the tasks as outlined, the other children were not able to do so, and therefore only used the pictorial instructions to aid their play. The Filo Mini also proved to be a difficult toy for many of the children in terms of motor skills; on several occasions, the children asked the researcher for help, simply abandoned the toy after less than one minute of play time, or used the toy as a dramatic play tool.

Social and cooperative play, as captured by the observational protocol, played a major role in how the children engaged with toys, and with what toys they played with during the sessions. Playing collaboratively with other children also arguably may have resulted in different cognitive benefits than if children had played with the toys by themselves. Participants who were less outspoken about toys and did not show other children how toys worked also spent less time overall in collaborative play; for example, the male participant did not once show other children how a toy worked, and spent the least overall amount of time in collaborative play. However, this participant also only attended 3 play sessions, and may not have been fully comfortable with the other children; if he had attended all 6 play sessions, he may have interacted with his peers more often. Despite his lack of engagement with the other children, he did demonstrate the highest pre- and post-test scores on the three-dimensional portion of the TOSA. Spatial training research performed in laboratory settings demonstrates that spatial skills certainly can be augmented on an individual basis (Baenninger & Newcombe, 1989), and the benefits of play on social development are numerous

(Eagle 2011); however, it is unclear if there are any benefits in children experiencing spatial tools individually as opposed to experiencing them collaboratively with peers.

As there was only one male in the sample, and a lack of variation in the ages of participants, gender and age are two factors that cannot be correlated with performance at this time. However, the youngest child of the group did achieve a full score on the post-assessment, and was one of the two participants who demonstrated improvement on the TOSA over the course of the intervention. The male participant achieved the highest scores of his peers on the pre- and post- three-dimensional assessments of the TOSA. Again, whether or not these improvements in performance were due to chance is not determinable, but these trends are noteworthy for future research. It is also important to note that the Test of Spatial Ability was developed for use with three- and four-year-old preschoolers; as the children were all around four-and-a-half years of age and at the top of the age range of the TOSA, it is possible that ceiling effects may have occurred. This is particularly salient for the male participant, who was the oldest child in the group at 4 years and 7 months of age, and scored a full 41 points on both the pre- and post- three-dimensional measure of the TOSA.

It is also not possible to determine if participation in spatial activities was correlated to higher performance on the TOSA, as almost all of the participants regularly participated in at least three spatial activities. However, the male participant, who only participated in one spatial activity, swimming, had the highest performance on both pre- and post- three-dimensional portions of the

TOSA; he was also reported as playing with blocks, puzzles, and Legos more frequently than his fellow participants. Three female participants participated in swimming as well; two of them both scored the highest two-dimensional pre-test score of 33 out of a possible 35 points. As three participants who participated regularly in swimming achieved some of the highest scores on the pre- test components of the TOSA, it is possible that swimming may result in spatial advantages as they pertain to the skills assessed by the TOSA. While all of the female participants all participated in three spatial activities, most notably dance and movement, there was no distinct pattern in the data that would suggest that participation in a greater number of spatial activities aided performance on the TOSA. However, these spatial activities may augment spatial skills, such as spatial orientation and environmental ability (Yilmaz, 2009), that are not assessed by the TOSA, and therefore may not have provided participants a spatial advantage on the test. Furthermore, selection effects may have played a role in the types of activities participants engaged in; as the children of parents who all chose to enroll their children in a laboratory school, they may have also enrolled them in the same types of extra-curricular activities.

It is important to note that, according to the researcher's anecdotal observations and the results of the engagement measures of the observational protocol, the children did enjoy playing with the toys provided for them during the play sessions. They were actively engaged with the toys for almost all of the time during every play session, and often expressed disappointment when the play session ended. This factor alone is sufficient to suggest that some form of learning occurred, even if it was not the learning that was promised by the packaging of the toys or assessed by the TOSA. Although an overall increase in spatial-cognitive skills was not seen for all participants, all of the children did gain experience and exposure with toys that were likely novel to them, which is a valuable play experience itself. Given that children showed marked preferences for certain toys over others, it can be concluded that if toys are not enjoyable for children, children will not want to play with them, and will not gain the educational benefits that those toys might offer. This echoes the TIMPANI study's recommendations for using toys to foster educational experiences (Trawick-Smith et al., 2014), and may be of use to toy companies and marketers in terms of toy design.

Furthermore, these findings underscore the inherent ambiguity of the "educational" label. Taking into account not only the mixed results of the TOSA, that only two children demonstrated improvements in their scores due to the intervention, but also children's enjoyment with the toys and that they played with the toys in multiple ways, particularly in fantasy play, it can be concluded that the "educational" label is not one that is proprietary only to toys that result in measurable learning outcomes. The play process itself is a rich learning experience, and "educational" gains are not necessarily quantifiable skills or easily assessed. This expanded view of the "educational" concept has important implications for toy companies, parents, and educators in the ways in which these groups provide educational experiences for children. First, it indicates a reduced need for toys that teach explicit concepts and skills—toys that currently saturate the toy market—and a greater need for toys that inspire creativity and imagination, which may also result in educational gains. Second, given the uncertainty that still surrounds the efficacy of educational toys in meeting their advertised learning goals, parents and educators should not become subsumed by efforts to develop specific skills, but should encourage children to play freely, with toys that engage them in active, diverse play.

Interviews

The hypothesis that parents would purchase toys more often than educators was met; only two educators reported that they purchased educational toys, while three of the parents reported that they did purchase educational toys. However, those parents also did not express strong support for educational toys as learning tools; none of them expressed that they preferred buying educational toys over conventional toys, and several expressed that they did not consciously purchase toys because they had an "educational label." While two parents expressed that they did not purchase educational toys and did not support them as efficacious learning tools, the parents that did express that they buy educational toys did not report being driven by marketing claims to do so, but rather their own agenda to introduce concepts to their children, or to provide their children with a toy they desired. These motivations for providing educational opportunities for their children, along with the parents' strong educational backgrounds, is in line with previous research that children of well-educated parents are more likely to have educational experiences provided for them (Tudge et al., 2006). However, many parents expressed that they "had never really thought about" why they do or not purchase educational toys, and, furthermore, exactly makes a toy educational. The "educational" label, then, is clearly not one that they make a priority when purchasing new toys for their children, regardless of whether or not they are seeking to "build certain skills or introduce concepts." Regardless, many parents expressed learning outcomes of and motivations for purchasing toys in terms of improving quantifiable skills or gaining knowledge, suggesting that they may be partially influenced by the "decontextualized learning of facts" (Hirsh-Pasek & Golinkoff, 2008) that is cleverly advertised not just by educational toys, but toys in general.

Furthermore, educators expressed more support for educational toys than was expected; two educators expressed enthusiastic support for educational toys. Similar to the ways the children played with the toys in the play intervention, however, the educators often utilized toys in different ways than the packaging instructed, or modified the toys to meet their students' needs. Nevertheless, those educators did see the value in educational toys as learning tools, but not as more valuable than conventional toys. The educators who reported purchasing educational toys were also parents. It is therefore possible that educators assigned more value to educational toys than did the educators who were not parents due to greater exposure to the educational toy industry as a parent consumer of toys, and positive personal experiences with those toys outside of the classroom. Overall, however, educators were not able to cite specific examples of educational toys as were parents; it seems that educators highly valued the overall learning experience of play, rather than the specific experiences afforded by individual toys.

One theme that was pervasive throughout many of the interviews with both parents and educators was a difficultly of being unable to distinguish “educational” toys from toys that have educational benefits. These “blurred lines” speak to nature of the marketing of the toy industry, and the saturation of the market with toys that are touted as having educational benefits. However, parents and educators were still able to identify educational benefits of conventional toys, reinforcing that they don’t separate toys into two dichotomous categories of “educational” and “non-educational.” Furthermore, for all participants, the “educational” label did not lead to marked assumptions that the toy would in fact lead to educational gains.

Several parents also commented that “everything” is marketed as being educational. However, this heightened awareness of marketing claims did not consistently play a role in all parents’ decision-making processes in purchasing toys; ultimately, all parents purchased toys for their child’s enjoyment. One parent cited the unpredictable “return on investment” of educational toys, calling it a “mystery;” one educator called educational toys “really good,” while another spoke of the high-quality craftsmanship. Other parents and educators, however, did not cite expense or quality as a salient characteristic of educational toys; rather, they only spoke of their children’s enjoyment and engagement with the toy. The lack of acknowledgment that educational toys are expensive or of different quality than other toys may have been due to the nature of the sample, who were all highly educated professionals. Overall, parents and educators assigned worth to toys based on their learning outcomes and children's enjoyment, rather than the design or quality of the toys themselves. Only one parent, however, expressed that revised marketing standards, namely the inclusion of developmental ranges on the packaging, would be beneficial. While parents and educators expressed an awareness of the overbearing marketing claims of educational toys, many did not express a desire for revising the marketing of these toys, again suggesting that they value their own judgment over commercial advertising. While the sentiments expressed by the parents and educators in these interviews do not represent the population at large, they certainly have implications for the toy industry as a whole; for this group of parents and educators, toy marketing was not particularly influential, and they were aware that the marketing claims made by toy companies were not always rooted in fact. The lack of influence of marketing on these parents' and educators' toy purchasing habits suggests that the marketing strategies used by toy companies are not as effective as such companies would desire. Furthermore, while parents and educators express a strong investment in providing educational experiences for children, they do not exclusively utilize or turn to educational toys to provide these experiences. If educational toys do not meet the learning goals as proclaimed on the back of the box, as did toys utilized in the play intervention, then there is a clear need for the implementation of marketing standards for educational toys, as well as need for greater research in this area, in order to truthfully guide the toy purchasing behaviors of parents and educators.

Puzzles, blocks, Legos, and Magnatiles were common examples of "effective" toys cited by both parents and educators. However, these toys were categorized as both "educational" and "conventional" toys, but were regarded as highly beneficial, educational toys regardless of how they were categorized. Four of the parents said that they encouraged their children to play with these toys, and one educator discussed the spatial benefits of puzzles as outlined in the literature. Participants thus demonstrated an enthusiastic awareness of the benefits of construction toys, citing anecdotal evidence, marketing claims, or even research. As with educational toys, however, it seems that the label or categorization of toys is second to the learning outcomes that participants perceive the toys accomplish. An "educational" label is not necessary for parents and educators to perceive educational value.

Clearly, the educational benefits of these toys are important to parents and educators, particularly in learning about physics, engineering, mathematical concepts. Toy companies could benefit from this knowledge, not only in the types of educational toys they create, but also in how they advertise toys to meet these skills. Again, although parents and educators did not express a preference for purchasing educational toys, this desire to provide STEM-related experiences has important implications for educators who may be seeking to incorporate supplementary activities or materials into their classroom to build these skills. It also has important implications for parents who are looking to fill gaps in their children's knowledge, particularly as they continue to be introduced to more situations that require quantitative reasoning and problem-solving skills.

Limitations

The present study is limited in scope by a significant number of uncontrollable factors that, due to the natural constraints, limitations, and lack of resources that are common in master's thesis work, could not be avoided. Most notably, these include the nature of the sampling pool of participants; the instruments utilized, and time constraints. First, the sample recruited was predominately middle or upper class Caucasian American educators, parents, and preschoolers. The researcher was not able to control for demographic characteristics during the recruitment process, and realizes that such a population may differ significantly than others in their exposure to and experience with educational toys, particularly from populations of lower socioeconomic status. The sample size of child participants, parents, and educators is quite small, due to the already small population of preschool students and early childhood educators at the Eliot-Pearson Children's School. As many participants as possible were recruited. In aggregate, these factors make it impossible to generalize any findings, particularly in terms of gender.

Every effort was made to use standardized or research-based instruments; however, the observational protocol used to code the play intervention videos was developed by the researcher, due to the lack of availability of an appropriate measure. While the TOSA is a fairly comprehensive measure of spatial ability, other, more standardized measures may have captured changes in different aspects of spatial ability in isolate, such as mental rotation ability. Additionally, the self-report nature of the questionnaires administered to parents may have resulted in skewed or biased data about the children's toy play behaviors.

This study was designed to assess the short-term learning outcomes of playing with educational toys. The duration of the intervention and the individual play sessions were designed as a short-term intervention due to time constraints and the availability of the participants. While participants did not demonstrate improvement in spatial ability from playing with the sample of educational toys for 6 twenty-minute play session, which took place over the course of four weeks, they may have demonstrated greater improvement if there had been a greater quantity of play sessions, if the sessions had been longer, or if the intervention itself took place over a long-term time period.

Directions for Future Research

The findings and limitations of this pilot study beget several direction for research going forward. First, a larger sample size of children in the play intervention group, as well as a matched-sample control group, is key in further determining the potential, statistically-significant learning outcomes that may result from playing with the selected educational toys. Furthermore, a more even distribution of gender in future samples would be beneficial, as the present study's sample was skewed towards females. Given that the literature trends towards males having an advantage spatially over females, a future study that examines the effect of the play intervention on a group of females versus a control group of females could shed more light on whether or not this type of spatial training results in cognitive benefits for females in particular.

The sample of parents and educators for interviews were also quite small; moving forward, data collection with a larger sample of both groups will result in a richer, fuller analysis. As a laboratory school in the suburbs of Boston, it is reasonable to suggest that the Eliot-Pearson Children's School possesses a different demographic of students and families and educational philosophy than public, charter, or magnet schools in urban or rural areas. Future research will include recruitment from a more diverse sample of schools. A larger, more diverse sample of schools, and therefore parents and educators, will contribute to more robust conclusions about the opinions parents and educators have of educational toys.

The play intervention was purposefully designed as a free-play experience in order to mimic the children's natural toy play experiences. The toys selected were also chosen as a representative sample of the educational toys that are advertised as promoting spatial skills that are available on the market. However, this design does not allow for direct conclusions about the benefits or lack thereof from playing with individual toys. The design of future research will allow for such conclusions to be made.

Another potential area of study would be in comparing the learning outcomes of functionally-similar physically manipulative educational toys and electronic educational toys. As reviewed in the literature, technological educational toys have been studied far more than physically-manipulative educational toys; such research may greater inform the role of the design of educational toys plays in learning, and the significance of how the toys are teaching children and the way information is imparted, rather than simply the content of what is being taught.

Finally, future research will include multiple assessments of spatial ability. While the TOSA does capture a wide range of spatial skills, it is possible that participants did have other spatial gains that were not assessed by the TOSA, or reaped other cognitive benefits entirely. The toys themselves were marketed as improving motor control, numeracy, and problem-solving skills, among various other skills. Possible assessments for future research include the Block Design subtest of the WISC-IV, the Woodcock-Johnson, or other measures that assess executive functioning or mathematical abilities.

Conclusions

Overall, a spatial training intervention using educational toys marketed as improving spatial skills did not contribute to improved spatial ability in a group of 5 four-year-olds. Only two participants demonstrated improvements from pre- to post-test; due to a small sample, it is unclear if these improvements were statistically significant. It is also unclear if children's interaction with this sample of educational toys would result in spatial-cognitive gains in the long-term, or if the toys in the sample resulted in cognitive gains other than the skills that were assessed on the TOSA. Furthermore, conclusions about the efficacy of individual toys in meeting their respective marketing claims is also indeterminable at this time. Future research will include a larger, more diverse sample size, additional assessments, and a design that will allow of study of individual toys in isolate.

The findings of this study also demonstrate the importance of appropriately matching toys to children's developmental levels. Some of the toys proved frustrating or boring to children during the play sessions, and thus did not receive much play time. In such cases, scaffolding from adults—or even peers—can potentially enrich the learning experience for the child. As parents and educators expressed, while a toy may be marketed as educational, the way the toy is played with, either individually or as a social artifact largely determines the quality of the play experience. The data from the play intervention confirms this.

As demonstrated by the interview data, parents and educators highly value provide opportunities for children's learning, and often strive to provide quality educational opportunities, but not necessarily through toys that are labelled as educational. While several were concerned with skill building and fostering children's creativity, enjoyment, entertainment, and freedom in play were their top priorities when making toy purchases. They also presented mixed opinions about the efficacy of educational toys. Some referenced the overwhelming amount of educational claims that are often present on toy packaging in general, although as a whole, both parents and educators ultimately valued their own sense of judgment in how the toy would be beneficial and enjoyable for their respective children, rather than external marketing claims, in guiding their purchasing decisions.

This pilot study was intended as initial step in fulfilling the great need for systematic research investigating the efficacy of educational toys. Ambiguity still surrounds the issue of whether or not educational toys do in fact achieve the learning goals advertised on the back of the box. As demonstrated by parents and educators' awareness of and dissatisfaction with the marketing claims of the toy industry, and the preschoolers' mixed performances on the TOSA at the end of the play intervention, this study reinforces the need for the implementation of design standards for educational toys. As the Kaiser Family Foundation (2005) found in investigating educational media, outcomes-based research such as the play intervention in this study only shows part of the picture, necessitates controlling a large number of factors, and works best as a longitudinal randomized control trial. Additionally, while some educational product companies conduct internal evaluation of their products, such research is often not standardized, and involves a combination of outcomes research and feedback from consumers to guide product development. Clearly, the need for a greater quantity of methodologically-sound research investigating educational toys still exists. Such research will not only inform parents and educators as they navigate the educational product space to provide learning opportunities for children, but also inform the design of educational toys, which will ultimately impact the educational experiences children can gain from playing with educational toys.

Appendices

List of Appendices

Play Session Observational Protocol

TOY ENGAGEMENT/DISTRACTIBILITY MEASURE

Play Behavior	Frequency (# of times)	Duration (Approximate # of minutes)
Interacts with other children (joint play)		
Interacts with other children (conversation only)		
Switches between toys		
Plays with only one or two toys (less than half the toys available)		
Plays with a variety of toys (more than half the toys available)		
Interacts with researcher (toy-related)		
Interacts with researcher (non-toy-related)		

INTERACTIONAL PLAY BEHAVIOR MEASURE

How often did the child…..	Frequency (# of times)	Duration (approximate # of minutes)

Engage in parallel play with other children?		
Discuss strategies for playing with a toy with other children?		
Collaboratively play with other children?		
Discuss sharing a toy with other children?		
Showed other children how a toy worked?		

PLAY ACTIVITY BY TOY MEASURE

How often did the child play with:	Frequency (# of times)	Duration (approximate # of minutes)
Goldie Blox and the Spinning Machine		
Squigz		
Pipe Builders		
Veggie Stacking Game		
Peek a Boo Bunny		
Filo Mini		
Shape Sorting Clock		

Playful Patterns		

Additional Notes:

____

____

____

____

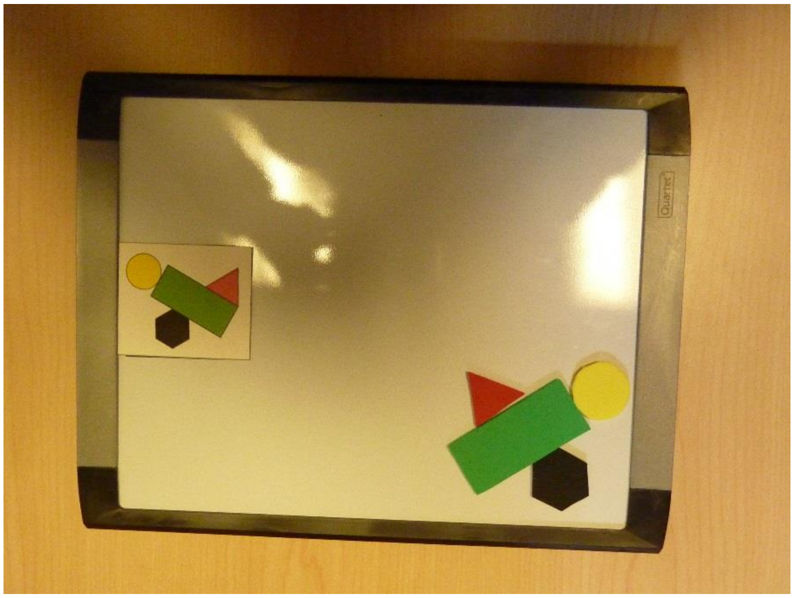
____

____

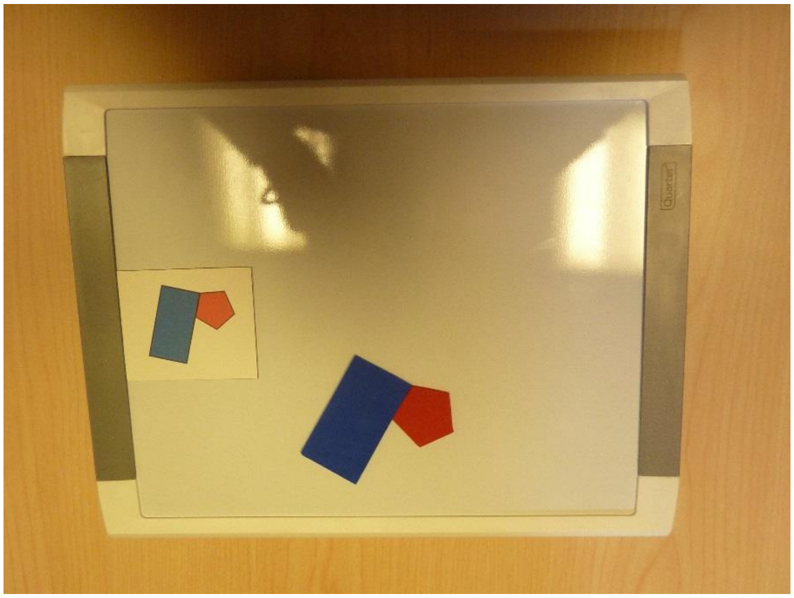
Examples of the Two-Dimensional and Three-Dimensional TOSA Trials

Two-Dimensional:

Model (Left) and Correct Copy (Right):

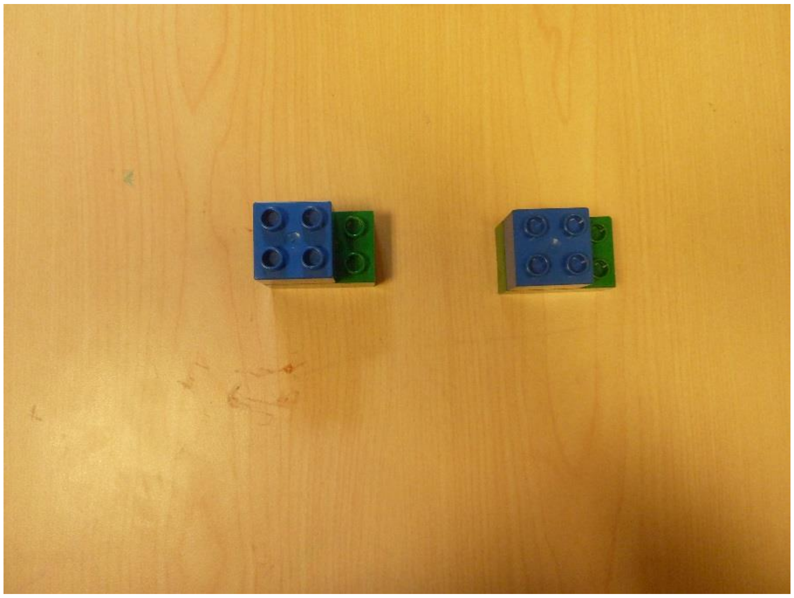


Model (Left) and Incorrect Copy (Right):

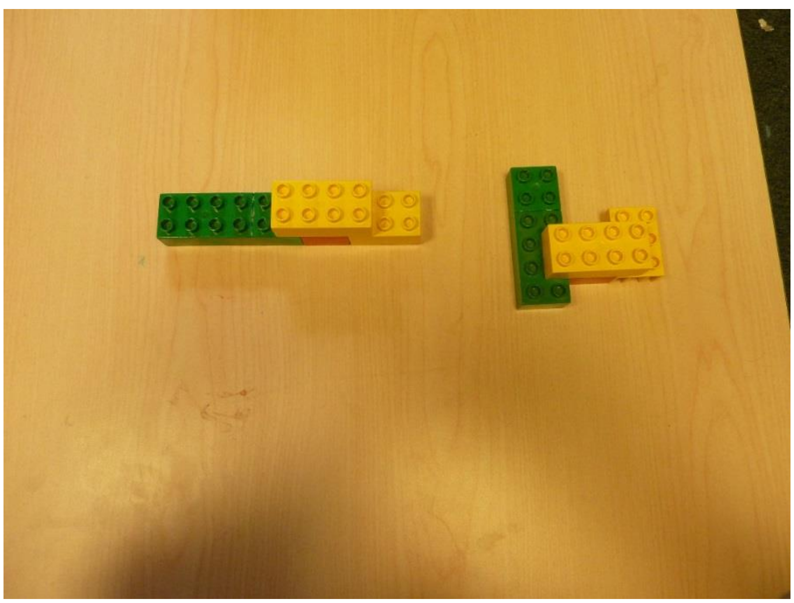


Three-Dimensional:

Model (Right) and Correct Copy (Left):



Model (Right) and Incorrect Copy (Left):



Parent Questionnaire

TOY PLAY SURVEY

NOTE: Your responses to this survey will be kept completely confidential and only the researcher will have access to this information. If there are any questions you prefer not to answer, you may leave the question blank.

Today's Date (Please answer in MM/DD/YY format.): ________

Your gender: ___Male ___ Female

Your age: _____

Occupation: ________________

What is your highest level of education? (Please check one.)

___ High school graduate or equivalent
___ Technical/hospital school or certification
___ Some college but no degree
___ Associate degree
___ Bachelor of Arts or Bachelor of Science
___ Master of Arts or Master of Science
___ PhD/EdD
___ MD
___ JD

How do you describe your race/ethnicity?

___ American Indian or Alaska Native
___ Native Hawaiian or Pacific Islander
___ Asian
___ Caucasian/White
___ Black or African American
___ Hispanic

___ Biracial/Multiracial
___ Other (please describe): ___________

What is the gender of your child participating in this study? ___ Male ___ Female

What is his/her date of birth? (Please answer in MM/DD/YY format.)

____

How many children, including stepchildren, do you have? _________

How many children are currently living in your household?

____

What are the ages of your children, if any, that are not participating in today's study?

____

____

On average, how many times per day does your child play with:

Blocks? ________

Puzzles? ________

Legos?__________

Dolls/action figures?_________

Stuffed animals? ________

Electronic gaming systems (Wii, Play Station, X Box, etc.)? ________

Mobile and tablet devices (iPads, Kindles, mobile phones, etc.)? _______

Computer? ________

Other (Please describe: ________): ________

What type of toys does your child like to play with most? (i.e. trucks, dolls/action figures, electronic gaming systems, mobile tablets, etc.

____

Specifically, what is your child's favorite toy?

____

Why do you think this is your child's favorite toy?

____

____

____

____

Does your child enjoy playing with blocks, puzzles, Legos, or similar toys?

____Yes ____No

On average, how often do you buy new toys for your child?

____

How many times have you bought a new toy for your child in the past month?

____

What kinds of toys did you buy? ____

How often has your child participated in the following organized activities?

Please circle one.

	1 Never participated	2 Participated less than four times	3 Participated from five to fifteen times	4 Participated about once a month	5 Participated about once a week	6 Participated more than once a week
T-ball	1	2	3	4	5	6
Soccer	1	2	3	4	5	6
Basketball	1	2	3	4	5	6
Music	1	2	3	4	5	6

Dance/Movement	1	2	3	4	5	6
Gymnastics	1	2	3	4	5	6
Karate/Martial Arts	1	2	3	4	5	6
Swimming	1	2	3	4	5	6
Art Class/Instruction	1	2	3	4	5	6
Other: __________	1	2	3	4	5	6

Do you have any additional comments about your child's play habits and behaviors or toy preferences?

Interview Questions

Educators

1) First, I'd like to learn a little bit more about each of you/you. What is your educational background?
2) How long have you been teaching for?
3) What ages of children have you taught?
4) How long have you been teaching preschool?
5) Can you share with me any knowledge you may have of physical/motor development in early childhood?
6) Can you share with me any knowledge of cognitive development in early childhood?
    a. Of spatial development in early childhood?
7) What kinds of toys are currently in your classroom?
8) What kinds of toys do you most often buy for your classroom?
9) From your observation, what kinds of toys do your students generally enjoy playing with the most? What toys do they play with most often?
    a. Are there differences between what girls play with and what boys play with?
10) Do you/have you ever bought toys marketed or labeled as being educational for your classroom?
    a. Why or why not?
11) What, in your opinion, makes a toy educational?

12) Have you noticed any learning outcomes or benefits from your students playing with explicitly educational toys?
    a. If yes, can you explain in greater detail?
    b. What learning outcomes or benefits from your students playing with non-educational, conventional toys?
13) Can you provide any examples of effective/ineffective educational toys—that is, toys that do or do not meet some educational goal as promised on the back of the box?
14) Do you have children?
    a. If so, do you buy them educational toys?
        i. Why or why not?
    b. What kinds?
    c. Have you noticed any learning outcomes/benefits?

<u>Parents</u>

1) First, I'd like to learn a little bit more about each of you/you. What do you do? What is your educational background?
2) What, in your opinion, makes a toy educational?
3) Have you ever bought a toy for your child because it was marketed as being educational?
    a. Why or why not?
    b. If you have other children, have you bought them educational toys? Why or why not?

4) Do you prefer buying toys marketed as being educational over toys that are not for your child?
    a. Why or why not?
5) Have you noticed any difference in your child's learning, thinking, or knowledge as a result of playing with educational toys?
    a. If yes, can you explain in greater detail?
    b. Have you noticed any difference in your child's learning, thinking, or knowledge as a result of playing with non-educational, conventional toys?
6) Can you provide any examples of effective/ineffective educational toys—that is, toys that do or do not meet some educational goal as promised on the back of the box?
7) If you have educational toys in your home, do you encourage your child to play with them over non-educational toys?
    a. Why or why not?
8) Do you encourage your child to play with Legos, puzzles, blocks, or similar "construction toys?"
    a. Why or why not?

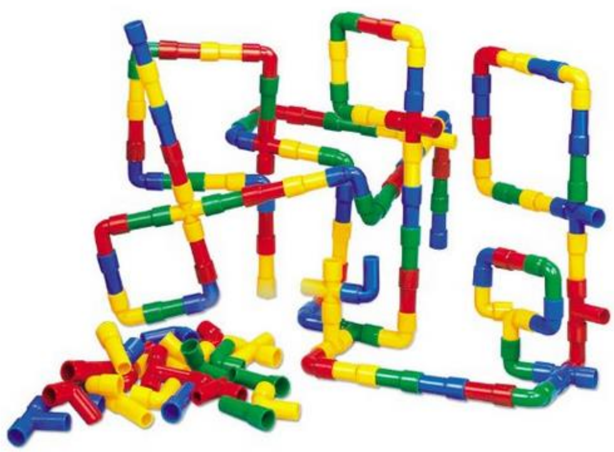
Sample of Educational Toys

Stacking Veggie Game (Educational Toys Planet, 2015a):

Goldie Blox and the Spinning Machine (Goldie Blox, 2014):

Squigz (Marbles the Brain Store, 2015):

Pipe Builders (Amazon.com, 2015a):



Peek-A-Boo Bunny (Amazon.com, 2015b):

Shape-Sorting Clock (Laddine, 2015):

Filo Mini (Educational Toys Planet, 2015a):

Playful Patterns (Discovery Toys, 2013):

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