## Title

Science, Media, and Efficacy: Social Cognitive Theory, Educational Media, and Science Self-Efficacy During Early Childhood



## Author

Schlesinger, Molly

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# Science, Media, and Efficacy: Social Cognitive Theory, Educational Media, and Science Self-Efficacy During Early Childhood

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Molly Schlesinger

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Dissertation Committee:
Dr. Rebekah A. Richert (Chairperson)
Dr. Elizabeth Davis
Dr. Mary Gauvain

The Dissertation of Molly Schlesinger is approved:

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_____

Committee Chairperson

University of California, Riverside

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ABSTRACT OF THE DISSERTATION

Science, Media, and Efficacy: Social Cognitive Theory, Educational Media, and Science Self-Efficacy During Early Childhood

by

Molly Schlesinger

Doctor of Philosophy, Graduate Program in Psychology
University of California, Riverside, June 2017
Dr. Rebekah Richert, Chairperson

This dissertation examined the relations of self-efficacy, vicarious perceptions, and learning outcomes during early childhood. In two studies, 3- to 6–year-old children watched videos of characters solving physical science problems, and following, were asked to solve analogically similar problems. Participants who applied the solution from the videos to the novel problems were acknowledged as having displayed analogical transfer and learned the intended content from the videos. Participants were interviewed about their self-efficacy for solving problems and their vicarious perceptions of the characters in the videos. Study 1 indicated strong positive relations between children's vicarious perceptions and mastery experiences with self-efficacy during early childhood. Study 2 revealed key differences in children's self-efficacy and vicarious perceptions by whether they displayed convergent or divergent learning from the video stimuli. Overall, this dissertation supports that self-efficacy can be studied during early childhood, and that both self-efficacy and vicarious perceptions are important for children's learning from media.

Table of Contents


Title Page i
Signature Page iii
Acknowledgements iv
Abstract v
List of Tables vii
List of Figures vii

Chapter
1. Literature Review 1

Theoretical Framework 4
Self-Efficacy 5
Observational Learning Subprocesses 15
Analogical Transfer 17
Educational Media 22
Fantasy 25
Selective Trust 26

2. Study 1 29

Methods 30
Results 45
Discussion 54

3. Study 2 65

Methods 68
Results 76
Discussion 89

4. General Discussion 106

Context 108
Diversity 116
Guiding Research Questions 115
Limitations 120
Future Directions 121
Conclusions 122

References 124

Appendix A 134

Lists of Tables

Table 1: Study 1 Correlation Matrix 47

Table 2: Hierarchical multiple regression predicting self-efficacy from mastery experience and vicarious perceptions 51

Table 3: Hierarchical multiple regression predicting transfer from self-efficacy after controlling for vicarious perceptions. 53

Table 4: Study 2 Correlation Matrix 77

Table 5: Means (SD) by research site, and *t*-tests 79

Table 6: Means (SD) by condition, and *t*-tests 80

Table 7: Means (SD) by recall group, and *t*-tests 85

Table 8: Study 2 Means (SD) by transfer group, and *F*-tests 87

Lists of Figures

Figure 1: Bandura's Self-efficacy model 49

# Chapter 1: Introduction

There is a lack of gender, racial, and ethnic diversity in science fields (National Science Foundation, 2014); with respect to socioeconomic inequality interacting with institutionalized discrimination, a primary contribution to the lack of diversity may be related to the contributions of science self-efficacy for children (Bandura, Barbaranelli, Caprara, & Pastorelli, 2001). Self-efficacy is a culmination of personal judgments of self-capacity, or people's beliefs they can accomplish specific tasks, achieve future goals, solve problems, or attain success in certain domains, and are based on self-evaluation (Bandura, 1997; Usher & Pajares, 2008). Self-efficacy is domain specific, dynamic, and constantly reevaluated based on new information, and therefore impacts motivation, affect, achievement and perseverance throughout development (Bandura, 1997; Schunk, 1985). In an academic context, self-efficacy motivates efficacious people to take on challenging tasks and persist when faced with difficulty, and conversely, contributes to inefficacious people avoiding tasks they believe they may fail at (Schunk, 1985).

Self-efficacy is specific personal perceptions about abilities to perform specific tasks, or what people believe they are capable of doing (Bandura, 1986; Jinks & Lorsbach, 2003). Conceptually, self-efficacy is a capacity judgment, encompassing judgments about both current capabilities and future abilities; therefore, beliefs about capacity for success impact actual performance (Bandura, 1997; 2006; Putnum, 2005). Self-efficacy is a term distinctive from efficacy, that is, self-efficacy is beliefs about abilities, whereas efficacy is actual ability; to alleviate confusion, only the term self-efficacy will be used in this dissertation, and the term efficacy will be replaced by

relevant measures of learning outcomes, mastery, or performance when appropriate. Empirical work has indicated strong self-efficacy promotes efficacious behaviors, such as persistence, effort, and achievement (Bandura, 1997; Putnam, 2005; Linnenbrink & Pintrich, 2002; Pintrich & De Groot, 1990**;** Schunk, 1999). Specific self-efficacy judgments develop through personal experiences (mastery experiences) with, experiences observing others (vicarious perceptions) engage in, feedback from others (social persuasion) about, and physiological feedback (emotional and psychological states) during relevant tasks (Bandura, 1997; Usher & Pajares, 2008). Self-efficacy develops in response to engagement in challenging but achievable tasks, under circumstances when people are able to interpret their actions and the results of their actions (Jinks & Lorsbach, 2003**;** Pintrich & De Groot, 1990; Putnam, 2005; Schunk, 2003**;** Schunk & Rice, 1993). Because of the dynamic relations between self-efficacy and achievement (e.g., efficacious beliefs promote achievement, achievement promotes efficacious beliefs), it is relevant to examine how self-efficacy can be promoted throughout development, especially before entering grade school. Research focusing on self-efficacy before elementary school is rare, as most children have yet to receive explicit feedback about their academic performance.

Empirical work has indicated adolescents' and adults' self-efficacy influence their career choices, delineating a series of factors (e.g., stereotype threat, expectancy effects) that impact self-efficacy, and describing how self-efficacy impacts career choices (Aschbacher, Li, Roth, 2010; Bandura et al., 2001; Britner, 2008; Gillen-O'Neel, Ruble, & Fuligni, 2011; Buck, Cook, Quigley, Eastwood, & Lucas, 2009; Riegle-Crumb, Moore,

& Ramos-Wada, 2010; Usher & Pajares, 2008; Usher & Pajares, 2009; Yazilitas, Svensson, de Vries, & Saharso, 2013). Much past research has focused on the cycle of highly positive self-efficacy promoting achievement, and inefficacious beliefs relating to underachievement (Wigfield & Eccles, 2002). The evidence that inefficacious beliefs during adolescences and socioeconomic factors relate to career choice highlights the need to examine children's self-efficacy beliefs (Aschbacher et al., 2010; Bandura, 2001). If the lack of diversity in science fields is truly related to inefficacious beliefs (rather than a third variable such as socioeconomic status), promoting science self-efficacy for children prior to grade school is a necessary factor for substantially increasing diversity in science fields.

A variety of social education campaigns have attempted to bring awareness to the lack of diversity in science and promote girls' interest in science in recent years (e.g., Girls Do Science, 2015; Girls Who Code, 2012), however, these campaigns are limited in reach. Educational television programs targeted at young children are easily accessible, at minimal cost to viewers (e.g., PBS, web-based viewing), promote skill and concept development (e.g., school readiness), and include diverse characters and role models. For this dissertation, the observational learning context will concentrate on educational television programs and the observational learning models will be characters featured in educational television programs for young children who attempt to teach science (e.g., *Sesame Street*'s Super Grover 2.0 and novel puppets). The goal of this dissertation is to examine the relations between young children's science self-efficacy, beliefs about educational media characters, and learning from educational media characters.

## Theoretical Framework: Social Cognitive Theory

The foundation of modern self-efficacy conceptualizations is found in Bandura's social cognitive theory (Bandura, 1977; 1986; 1997). Social cognitive theory is a model of learning, arguing for triadic reciprocal relations (or interactions) of personal factors, behavioral factors, and environmental factors (other theoretical literature considers environmental factors to be social factors; see Schunk, 1999). This theoretical construct suggests personal factors (e.g., cognitions, biology, affect, and self-efficacy) impact behaviors and environments (e.g., feedback, stimulation), and in turn behavior and environment impact personal factors (Bandura, 1986; 1997; Schunk & Pajares, 2002).

Personal factors filter how one enters an environment or chooses to engage in behaviors (Bandura, 1986; 1997; 2006; Usher & Pajares, 2009). Having positive affect will contribute to perceiving the environment positively and frame feedback from the environment as encouraging, as well as contribute to motivation to engage in efficacious behaviors. Conversely, negative affect will lead to interpreting arousal as anxiety and a focus on environmental feedback as undesirable, dissuading motivation for efficacious behaviors. For example, a high school student entering a chemistry classroom may interpret high arousal as lack of ability and may respond by disengaging with the teacher and lesson (Usher & Pajares, 2008; 2009). Cognitive abilities filter attention to the environment, interpretation of observations and feedback from the environment, symbolic transformation of the information from the environment into long-term memory, and behavioral responses to the environment. Biological immaturity limits attention to, cognitive awareness of, and behavioral responses to the environment. The

social environment impacts personal factors and behavior through vicarious and personal consequences of behavior, and affords opportunities for observational learning and attributes success and failure to internal (e.g. personal ability) or external factors (e.g. outside guidance), impacting personal and behavioral factors. Children's efficacy judgments of the social environment contribute to the triadic reciprocal relations, following a similar theoretical construct as self-efficacy (Bandura, 2006). If a child believes the environment can provide or teach new skills or information, the child may have increased motivation to learn, greater interest in opportunities offered by the environment, be more likely to persist in the face of failure, and continue engaging in observational learning opportunities after failure. However, if the child believes the environment is inefficacious and unable to provide useful information or learning opportunities, the child will likely have less motivation and interest to learn from observational learning opportunities in the environment (Bandura, 2006). In understanding how self-efficacy impacts other aspects of development, it is necessary to review what constitutes the construct of self-efficacy.

## Self-Efficacy

Self-efficacy is the culmination of capacity judgments and continuously changes with environmental input through different experiences; as children receive feedback from the environment, they reevaluate their domain-specific self-efficacy (Bandura, 1981; 1982; Schunk, 1985; Schunk, 1999). There are multiple experiences through which feedback is processed: mastery experiences, vicarious experiences, social persuasion, and affective states.

**Mastery Experiences.** Mastery experience, or previous personal experiences with similar tasks or activities in similar domains, has been argued by Bandura (1981; 1982; 1997; Schunk, 1985) to be the most "valid" source of self-efficacy (e.g., the best way to determine capacities for future experiences is previous experience). Empirical research has found mastery experiences to be the strongest statistical predictor of students' self-efficacy, likely due to the nature of self-evaluation (Britner & Pajares, 2006; Usher & Pajares, 2008). Previous experience being successful or failing to solve a difficult problem is a better measure of likely success or failure than any other factor. A group of primarily white middle school students with higher science achievement than other schools in their district took the Sources of Science Self-Efficacy Scale (Britner & Pajares, 2006), with four subscales measuring mastery experiences, vicarious experiences, social persuasions, and physiological states, separately (Britner & Pajares, 2006; Lent, Lopez, Brown, & Gore, 1996), science grade self-efficacy (Bandura, 1997), and science achievement (e.g., grades). Britner and Pajares (2006) found mastery experiences significantly predicted science self-efficacy for the full sample, and contributed the largest percentage of unique variance with respect to measures of vicarious experiences, social persuasions, and physiological states. Within social cognitive theory, success or failure in mastery experiences will result in both reevaluated self-efficacy as well as learning new skills (Bandura, 1997). Although vicarious experiences, social persuasions, and physiological states did not significantly predict self-efficacy for their sample, these factors were significantly correlated with self-efficacy,

meaning they may be antecedents of children's self-efficacy and could contribute to initial mastery experiences (Britner & Pajares, 2006).

Aschbacher et al. (2010) conducted a longitudinal qualitative survey to examine high school students' decisions to pursue science majors in college. Aschbacher et al. (2010) measured children's science identity, not self-efficacy specifically; however, the qualitative responses from their sample overlap with the construct of science self-efficacy (Britner & Pajares, 2006). Many students who did not major in science in college had low grades or AP scores (mastery experience), had counselors who recommended not taking science courses or authoritarian teachers who refused to provide extra help (social persuasion), believed they were worse students than their high achieving counterparts (vicarious experiences/social comparison), and did not have a family member with a career in science (vicarious experiences/modeling). Overall, Aschbacher et al. (2010) argued that having two or more risk factors for low self-efficacy predicted students not pursuing science in college. Only students who had two of the following risk factors were far less likely to major in science during college compared to students with one or no risk factors for low self-efficacy: low grades or AP scores (mastery experience), were persuaded by counselors not to register for science courses (social persuasion), refused help by teachers (social persuasion), believed their peers were better students (social comparison), or did not have a family member with a science career (modeling) did not pursue science in college. Although this research was qualitative, and did not measure self-efficacy using validated scales, it described how mastery experience is the dominate factor contributing to self-efficacy and efficacious behaviors, and that mastery, vicarious,

social persuasive, and emotional experiences are interrelated, dynamic, and contribute to self-efficacy and efficacious behavior as a packaged variable (Aschbacher et al., 2010).

**Verbal and Social Persuasion.** Verbal and social persuasions from others impact self-efficacy through encouragement from adults and peers when children trust those adults and peers (Usher & Pajares, 2008). When children are unable to make accurate self-evaluations, they may rely on others for feedback. Although encouragement can contribute to self-efficacy (e.g., increasing motivation and perseverance in the face of obstacles) the impacts of social persuasion are limited (Usher & Pajares, 2008). Social persuasions are more likely to contribute to inefficacy than inflated self-efficacy, such as interpreting discouragement from others as lacking capability (Aschbacher et al., 2010).

**Emotional and physiological states.** Emotional and physiological states inform self-efficacy as children learn to interpret their physiological arousal and affect in relation to experiences (Usher & Pajares, 2008). Emotional and physiological states are bidirectionally related to self-efficacy; for example, judging self-efficacy in a positive mood will lead to more positive self-efficacy judgments, but high anxiety leads to mistaking arousal for incompetence, and therefore leading to inefficacious judgments (Bandura, 1997; Usher & Pajares, 2008; 2009).

**Vicarious experiences.** Vicarious experiences impact self-efficacy through observations of others rather than personal experiences. Simply, observations of a model engaging in a particular behavior provides feedback to the observer similar to mastery experiences, but includes the additional cognitive process of assimilating the model's behaviors and traits into self-efficacy (Bandura, 1997; Usher & Pajares, 2008; 2009).

Similar to mastery experiences, if children observe the model failing to complete a task, they will likely believe the task is less possible, lowering their self-efficacy for that task as if they failed to successfully accomplish it themselves. If children see a model struggle to complete a task, but are eventually successful, this observation will likely raise children's self-efficacy because they know success is likely, just as if they persisted to accomplish the challenging task. However, to integrate observations into self-efficacy, observers must also undergo a process of social comparison to the model. Although theoretical and empirical work has argued mastery experiences have the greatest contribution to self-efficacy, for young children who lack personal experiences for practical reasons, vicarious experiences may be more important in young children's self-efficacy judgments than mastery experiences (Bandura, 1977).

***Model Performance.*** Aligned with social cognitive theory (Bandura, 1977), perceptions of the model's abilities and accomplishments for the observed task will contribute how the model impacts self-efficacy, because interpretations of the model's success are determined by the observation of the model (e.g., persistence, success, or failure of the model). For example, a model's successful accomplishment of a task will be integrated differently into self-efficacy than if a model fails at a task. Whether a model accomplishes a specific task will be a greater determinant in how it impacts self-efficacy beyond all other model factors (e.g., similarity). Additionally, judging the model by physical appearance, such as perception of gender during early childhood, may lead to perceiving the model as inept. Even if the model displays a behavior, if the behavior is

done by accident or without replicability, the usefulness of the model's observed behavior may be discounted (Bandura, 1997).

***Model Perceptions.*** Similarity to the model regulates the integration of aspects of the model into self-efficacy. If the model is a peer, the observer will likely believe she has similar abilities to the model (Bandura, 1997; Schunk & Pajares, 2002), and therefore perceive the model's performance and therefore abilities as reflective of her own, and integrate the model's performance into her self-efficacy (e.g., if she can do it, then so can I). If the model is an extraordinary peer to whom the observer feels inadequate (e.g. dissimilar), perceptions of the model may be inversely integrated to the observer's self-efficacy (e.g., if she can do it, then I cannot). However, if the model is a role model to whom the observer desires to be similar, the performance of the model may be positively integrated into self-efficacy with the caveat that mastery of the observed task may not be accomplished until the future, providing motivation for achievement (e.g., if she can do it, I will be able to in the future if I work towards that goal).

Paralleling general similarity, belief that the model has similar human-like attributes or has the ability to engage in realistic circumstances will impact self-efficacy. Particularly for circumstances in which the model is not a real life person, belief that the observer can interact with the model in the real world, and that the model has similar attributes as the observer, may impact the process for integrating the model's performance into self-efficacy (Bond & Calvert, 2014; Calvert et al., 2007; Calvert & Richards, 2014; Giles, 2002; Richert, Robb, & Smith, 2011; Richert & Schlesinger, in press; Schlesinger, Flynn, & Richert, 2016). Similarity beliefs may lead to greater

attention toward the model and a desire to keep learned behaviors as similar to the observed behaviors when cognitively processing the observations (Bandura, 1977). Disdain for the model may contribute to lack of attention to the model and interpreting the model's persistence, success, or failure as not worth integrating into self-efficacy (Bandura, 1977).

**Self-efficacy and young children.** There has been limited research on young children's self-efficacy. Much past research has concerned disentangling if young children can differentiate self-concept judgments in different domains. The construct of self-efficacy is a measure of perceived capability (e.g., the greatest level one believes they can achieve in the future); this construct includes the culmination of judgments about current abilities, beliefs about future opportunities to further develop abilities, and achievement level after further developing such abilities (Bandura, 2006). Self-efficacy therefore encompasses capacity judgments (e.g., the greatest level one can achieve currently; Valeski & Stipek, 2001), but also integrates judgments about environmental and social affordances impacting future development and ability. Most research concerning young children has measured children's self-capacity judgments, not self-efficacy explicitly; therefore much of this section will focus on children's capacity judgments, which is considered an integral part of the construct of self-efficacy.

It is generally believed children younger than age 8 are unable to understand or perceive their self-concept, self-capacity, and self-efficacy due to their cognitive immaturity, and children's fuzzy conceptions of self-perceptions lead children to reporting inflated perceptions of their abilities (Marsh, Craven, Debus, 1991; Nicholls,

1978; Stipek, 1981; Stipek & Mac Iver, 1989; Wigfield, Eccles, Yoon, Harold, Arbreton, Freedman-Doan, & Blumefeld, 1997). This position likely stems from little empirical evidence examining children's self-concept, self-capacity, and self-efficacy perceptions prior to age 8. Although research is limited, the following empirical work found support that before age 8, there is variability in children's responses when evaluating self-concept, self-capacity, or self-efficacy. This work provides support that although evaluating self-efficacy with young children is difficult, statistical variability in responses confirms researchers can reliably evaluate young children's self-perceptions, and children do understand there are distinct constructs that constitute the self.

Researchers examining if self-concept could be assessed with children younger than age 8 administered a measure of positive self-concept to 5- to 7-year-old children (Marsh et al., 1991). The authors argued a positive self-concept is likely a mediator of academic success, and therefore understanding self-concept of young children is imperative for predicting their academic success. Marsh et al. (1991) evaluated children's self-concept in a variety of domains including reading, mathematics, and social relationships. Results indicated greater variability in children's self-concept perceptions by domain as they aged; that is self-perceptions of different domains were greater for oldest children. However, there was still significant variability for even the youngest children in the sample by domain (e.g., reading, mathematics, and social relationships), providing evidence that although children's self-concept perceptions become more fine-tuned throughout development, even 5-year-olds can discriminate in their self-concept of different domains (Marsh et al., 1991). Although this measure was not designed to assess

self-efficacy (Marsh et al., 1991), self-concept constitutes the construct of self-efficacy, and therefore provides evidence children can distinguish aspects of their self-efficacy beliefs between different constructs (Bandura, 1977).

Further research examining children's competences between different domains evaluated kindergartners' and first graders' perceived self-competences for mathematics and reading (Valeski & Stipek, 2001). Children were asked to report about multiple facets of each domain (e.g., how good are you at math, how much do you know about math). Although children's mathematics and literacy self-concepts were significantly related, children were able to discriminate between self-concepts for different domains (e.g., mathematics and reading). Finding variability between children's responses for different domains provides additional support that young children differentiate in their self-concepts for different domains (Valeski & Stipek, 2001).

One published study attempted to evaluate if self-efficacy could be measured reliably in young children, and how well young children differentiate self-efficacy between different domains (Wilson & Trainin, 2007). The authors evaluated self-efficacy in reading, writing, and spelling of first graders, and hypothesized children would readily differentiate these constructs, because in practice reading, writing, and spelling are typically taught and evaluated separately (Wilson & Trainin, 2007). The mean self-efficacy scores for reading, spelling, and writing were significantly different from each other, with self-efficacy for writing greater than self-efficacy for spelling, and both writing and spelling greater than self-efficacy for reading. These differentiating self-efficacy judgments were supported by Schunk's (1999) social interaction model;

Schunk (1999) argued the more feedback and social comparison in which a child engages, the better awareness of their actual level of competency (e.g. their self-efficacy is similar to their actual performance). The authors argued, in first-grade classrooms children receive more feedback on reading than both spelling and writing, and therefore their reading self-efficacy is lower because they have more experience (Wilson & Trainin, 2007). This finding that children's self-efficacy was lower for domains children have more experience receiving feedback for is also consistent with previously mentioned studies of self-competence and self-capacity, in which older children who had more experience with feedback had greater variability in their self-competence or self-capacity (Marsh et al., 1991; Valeski & Stipek, 2001).

The little research that has examined young children's self-concept, self-competence, and self-efficacy has indicated that although there is less variability during early childhood, young children can differentiate between different facets and domains of self-perception; therefore young children should additionally be able to discriminate between different domains of self-efficacy.

## Observational Learning Subprocesses

Vicarious experiences are experiences observing others; Bandura argued observational learning is a social cognitive process, integrating social information from the environment and cognitively transforming it to produce a new behavior (Bandura, 1977; 1989; 1997). Although in the following section, the term behavior will be used to describe the observational learning subprocesses for brevity, vicarious experiences are not only limited to learning behaviors, but also to attitudes, skills, and rote information as

well. Bandura identified specific theoretical subprocesses as explaining the social cognitive process of observational learning. To engage in observational learning, the observer must attend (*attentional processes*) to the model displaying particular behaviors. Second, the observer must retain (*retention processes*) the information, which involves processing the information by transforming it into symbols. Once the information is retained, a new behavior is produced (*production processes*) through comparing the current behavior to the modeled behavior. Not all learned behavior is performed; the observer will perform the behavior only when motivated (*motivational processes*) (Bandura, 1977; 1986; 1997).

The observational learning subprocesses are impacted by the aforementioned personal, environmental, and behavioral factors (Bandura, 1977; 1986; 1997). Attention to the model is the most critical aspect to engaging in observational learning; without attending to the model, nothing can be observed. Children's developing abilities to remember the observations will impact retention, including symbolic transformations and cognitive rehearsal, as well as production processes. Limited motor functions or access to similar tools used by the model will limit retention processes, as children will be unable to rehearse similar enactive behaviors as the model. Behavioral processes impact the observational learning subprocesses through seeking out experiences to attend to models and deliberately choosing to engage in retentional and production processes. Previous behaviors will impact motivation to engage in the new learned behavior. Environment will impact the underlying processes, as the environment supplies the observed behaviors and feedback to the observer (Bandura, 1997; 1986; 1997; Putnam,

2005). The feedback then influences both personal factors (e.g., self-efficacy) and behavioral factors (Bandura, 1997; 1986; 1997)

When engaged in an observational learning experience, children's initial self-efficacy when entering the experience acts as a filter for the observational learning experience, and self-efficacy will be readjusted following an experience (Bandura, 1977; 1986; 1997). For example (Bandura, 1977; 1986; 1997; Usher & Pajares, 2008; 2009), self-efficacy judgments that are the culmination of months of high achievement or mediocre performance in a chemistry class will lead to differences in performance on a pop quiz (keeping content knowledge consistent). Earning a perfect score on or failing a pop quiz will lead to reevaluations of self-efficacy, or confirmation in self-efficacy beliefs. Being efficacious in a new situation, as the culmination of success or positive outcomes in similar situations, will lead to purposeful attention and retention in the new situation. Entering an observational learning situation highly efficacious will also promote perseverance to engage in production and motivation to perform the behavior. Being inefficacious for a specific context may lead to a purposeful lack of attention, disrupting observational learning processes; however, assuming there is initial attention to the model, inefficacious children may have worse retention, either in a purposeful failure to engage in memory strategies, or in an increased cognitive load leading to difficultly storing the information. Inefficacious children will be less motivated and persevere less in production and motivational processes (Bandura, 1977; 1986; 1997).

Within social cognitive theory, self-efficacy is a key aspect for engagement in observational learning. Therefore, it is important to examine how model perceptions

contribute to observational learning and how observational learning contributes to self-efficacy. A key research question focuses on the theoretical relations of self-efficacy and observational learning. Because the observational learning subprocesses are theoretical, they cannot be directly measured, however, a variety of learning outcomes can act as proxies for measuring the observational learning subprocesses, such as recall (e.g., retention, including cognitive rehearsal and cognitive transformation of observations into new behaviors). Additionally, critical thinking and divergent thinking likely represent the production and motivational processes, capturing children's recall of the observation, and children's complex cognitive engagement with the observation. Although it is theorized vicarious experiences can promote children self-efficacy and self-efficacy can promote learning from vicarious experiences (Bandura, 1977; 1986; 1997), there is no published empirical work directly testing these relations. A purpose of this dissertation is to examine if vicarious perceptions promote science self-efficacy for young children. Because model and learning context factors likely impact the relations, and learning outcomes should reflect self-efficacy, all these factors must be considered. If vicarious perceptions can promote science self-efficacy for children before starting grade school, children will start elementary school engaging in efficacious practices, setting children on a path for science achievement.

## Analogical Transfer

Analogical transfer highlights the importance of recognizing analogical similarities between contexts, and transferring relevant information between similar contexts (Holyoak, Junn, & Billman, 1984). Utilizing analogical transfer as a means of

measuring observational learning, a method that can easily capture scientific concepts presented in the video stimuli is ideal for measuring learning of problem solving solutions. The complex nature of analogical transfer allows for great variability in success rates, as to solve analogical transfer problems, children must (a) recall the elements of the initial context, (b) recognize analogical similarities between the initial context and new problem, and (c) apply the solution from the initial context to the new problem. Successful analogical transfer is greatest for young children when the initial story is simple and the characters are familiar and meaningful, which are typical aspects of young children's educational media (Goswami, 2001; Holyoak et al., 1984; Lauricella et al., 2011; Richert et al., 2009; Schlesinger, et al., 2016; Singer-Freeman, 2005; Tunteler & Resing, 2002).

Recent research has found 3-½- to 6-year-old children's vicarious perceptions of media characters relate to their analogical transfer. Prior research has examined how children's trust of, realism beliefs of (e.g., the extent to which children believe they could interact with the characters), and identification with an animated character related to young children's transfer of how to create and use a lever from a television clip to a novel real-life problem (Schlesinger et al., 2016). Participants who successfully transferred use and creation of a lever after a hint, or scaffold, to think back to the original video, had significantly higher character trust than children who transferred without a hint or did not transfer all. Social realism and identification were unrelated to transfer, and the difference between trust and transfer groups was likely due to children's high trust of the character changing the nature of the observational learning subprocesses. That is,

children with high trust of the character may have discriminately applied information from that character to a novel situation when the interviewer noted that it was appropriate to do so, compared with children who applied the information without concern about the character's trustworthiness (Schlesinger et al., 2016).

Related research on how children's realism and fantasy beliefs, including the extent to which children believe they can interact with television characters, has found an interaction between the relevance of fantasy in the video clips and children's transfer from those clips (Richert & Schlesinger, accepted). Participants watched videos that were low in fantasy content, high in fantasy content that was relevant to the educational curriculum, and high in fantasy content that was irrelevant to the curriculum. Children were most likely to learn from programs in which fantastical content was relevant to the educational curriculum or when there was little fantastical content, compared to when fantasy was unrelated and distracting from the educational curriculum. In support of a capacity model hypothesis, this study provided evidence that when fantastical aspects are unrelated and distracting to the educational curriculum, children do not have the cognitive capacity to process both the fantastical aspects and the educational curriculum (Fisch, 2000). Additionally, children who transferred from the videos had more accurate understandings of what is impossible and possible in real life (Richert & Schlesinger, accepted). These studies highlight the importance of considering vicarious perceptions in relation to learning, and how these vicarious processes impact the observational learning subprocesses.

**Divergent reasoning.** Divergent reasoning, the use of unique ideas (Calvert et al, 2007) or unique methods (Lloyd & Howe, 2003) for problem solving, has been previously related to advanced cognitive development (Lloyd & Howe, 2003). Although often discussed as a dichotomy, divergent and convergent reasoning are conceptually related. There are benefits for engaging in convergent reasoning, such as solving problems efficiently, recognizing the intended purposes of specific tools, and benefits to divergent reasoning, such as recognizing diverse uses for open-ended and multi-use materials, and using such tools in unintended ways to solve problems (Lloyd & Howe, 2003). Therefore, both convergent and divergent thinking may develop simultaneously, and promote cognitive development (Lloyd & Howe, 2003). Prior research has found the number of unique or divergent or unintended uses preschoolers listed for a familiar item was related to model similarity with an on screen character (Calvert et al., 2007). The more children identified with the character, the more unique and unintended uses for sticky tape they listed; which could reflect how vicarious perceptions, in this case identification, impact the observation learning subprocesses, and therefore learning outcomes.

Other work has argued for positive relations between solitary, imaginative play and divergent reasoning (Lloyd & Howe, 2003). Engaging in fantasy or pretend play, which is known to be a cognitively stimulating or cognitively advanced activity for young children due to the necessity for juggling multiple realities, is related to creative problem solving and developing problem solving skills (Lloyd & Howe, 2003; Richert & Smith, 2011); that is, as young children solve problems within a fantastical, explicitly

make believe, or pretense context they have opportunities to integrate divergent uses for objects and creative solutions. Analogical problem solving is an ideal context for studying divergent problem solving, as children have the opportunity to use novel objects or familiar objects in unintended ways to solve a problem.

**Science Content.** Related to analogical transfer and divergent reasoning, this dissertation focuses on physical science curriculum, primarily learning about the creation and uses of simple machines. There is a lack of social cognitive research on young children's conceptions of physical sciences involving simple machines; however, based on the California Core Early Childhood Standards (2014), young children are expected to have conceptual understandings of simple machines before reaching first grade. In the California Core Early Childhood Standards (2014), by the end of kindergarten, children are expected to recognize (a) properties and characteristics of nonliving objects, (b) changes in nonliving objects, (c) that properties of objects can be observed and predicted, (d) that objects can change and can be mobile, and (e) causes and effects of acting on objects. Paralleled with the expectation there are constraints on children's learning, verbal responses, and concept categorization, it is additionally expected during preschool children will develop a conceptual knowledge of the natural and physical world, including conceptual understanding of simple machines (CA Core Standards, 2014; Gelman, 2009; Wellman & Gelman, 1992).

Evaluating learning of scientific concepts, particularly simple machines, is ideal for use in analogical transfer and divergent reasoning methodologies. Young children's verbal explanations for how simple machines operate are limited by their verbal abilities,

and limitations for explaining abstract scientific causal structures (Gelman, 2009; Wellman & Gelman, 1992). However, analogical transfer allows children to display they have learned about a specific concept without having to rely heavily on verbal explanations. As simple machines are solutions to problem, teaching participants about simple machines, and evaluating their learning by providing them with the opportunity to create and appropriately use a simple machine to solve a problem, is ideal.

## Educational Media

Educational media created for young children are media that include specific curriculum goals, usually similar to those found in a preschool curriculum (Fisch, 2000). Although historically mired in controversy and causing debate within academia and politics, high-quality educational media can provide children with school readiness skills necessary for success in elementary school, when viewed by children in developmental periods the curriculum targets (Anderson, 1998; Anderson, Bryant, Wilder, Santomero, Williams, & Crawley, 2000; Anderson, Huston, Schmitt, Linebarger, & Wright, 2001; Kirkorian, Wartella, & Anderson, 2008; Fisch, 2000; Rice et al., 1990; Wright et al., 2001). Focusing on longitudinal studies of the benefits of consuming curriculum-based educational media, there have been few, but significant differences between regular and irregular consumers of educational media.

A two-year longitudinal study with 3- to 5-year-old children examined the impact of television viewing on school readiness skills (Rice et al., 1990). The 3-year-old cohort who viewed *Sesame Street* regularly had significantly improved vocabulary at age 5, compared to irregular viewers and 7-year-olds. This improvement was independent of

parent education and parent attitudes toward viewing *Sesame Street* (Rice et al., 1990). A longitudinal study focusing on 2- to 7-year-olds from low income families over three years examined the relation of educational television consumption to skill improvement; through a path model, the researchers examined how educational television predicts later school readiness skills, reading skills, numeric skills, and vocabulary (Wright et al., 2001). Consumption of educational media regularly at ages 2 or 3 significantly predicted children's academic skills at a follow-up at age 3 (Wright et al., 2001). However, educational television viewing at ages 4 and 6 were unrelated to children's academic measures at ages 5 and 7, respectively; both results held when controlling for parent education, quality of the home environment, and initial language skills (Wright et al., 2001). Other longitudinal research focused on the impact of *Blue's Clues* on 2- to 5-year-old children's cognitive development over a two-year exposure period (Anderson et al., 2000). Children who had access to *Blue's Clues* in their home during the two years (compared to those without cable) had greater rates of show-taught content acquisition, as well as higher cognitive assessment scores for riddles, Gestalt closure, and matrices at posttest. Although, there was no significant difference for expressive vocabulary, according to caregiver ratings, viewers had significantly greater flexible thinking, problem solving, and social behaviors than non-viewers (Anderson et al., 2000).

There is no direct causal claim between media consumption and child differences. These findings are reflective of the triadic reciprocal relations of personal, environmental, and behavioral factors in social cognitive theory (Bandura, 1986; 1996). Regardless of the causal mechanism initially contributing to these differences, children who are regular

viewers of educational media may choose to engage in different behaviors than irregular viewers, and through consuming educational television have different exposure to educational content impacting their cognitive development differently (Anderson et al., 2001). Additionally, parents who encourage their children's engagement with educational (compared with purely entertaining or violent) media may also provide their children with other socially- or cognitively-stimulating activities (Kirkorian et al., 2008). Follow-up research with high school students examining how their exposure to educational media during preschool related to a variety of outcomes during adolescence, indicating children exposed to educational media during early childhood were set on a path for success by preparing children for elementary school success (Anderson et al., 2001).

Speculating high consumers of educational television had greater content knowledge, greater inhibitory control, and greater interest in learning than other children (Anderson et al., 2001), the same argument can be made for science success. Children who are exposed to science learning in a comfortable and entertaining environment during early childhood will enter grade school with greater content knowledge, greater interest, and likely greater confidence for science learning than children without such exposure, which would promote efficacious practices for science engagement throughout development. Therefore, it is important to understand how young children perceive science and how exposure to vicarious experiences relates to children's science learning and self-efficacy. Unlike the constructs constituting general school readiness skills measured in the previous studies, perceptions of science have gender biases, and young

children are aware of cultural stereotypes about gender and science (Schlesinger & Richert, accepted).

## Fantasy

An important feature of educational media for young children is the use of fantastical aspects, including impossible storylines, anthropomorphized animals and objects, and violations of physical laws. These fantastical features have rarely been highlighted when discussing young children's learning from educational media; however, there is evidence fantastical features impact young children's learning from educational media (Bonus and Mares, 2015; Mares & Sivakumar, 2014; Richert & Schlesinger, in press; Richert & Smith, 2011; Walker, Gopnik, & Ganea, 2015). Young children recognize differences between fantastical characters and real people, onscreen programs may contain and realistic and fantastic content, and impossible situations are possible in fantastical stories and not the real world (Morison & Gardner, 1978; Rosen et al., 1997; Skolnick & Bloom, 2006; Subbotsky, 1994; Wright, Huston, Reitz, & Piemyat, 1994). Similarly, young children are more likely to personify (or attribute human-like qualities to) characters they believe are real than those they believe are pretend (Sharon & Woolley, 2004).

The presence of fantasy likely impacts young children's learning from educational media. Storybook research has indicated children are more likely to transfer from realistic stories than books with fantastical context (Richert, Shawber, Hoffman, & Taylor, 2009; Richert & Smith, 2011; Walker et al.2015). Two studies found children read realistic storybooks had higher rates of analogical transfer from the story to a real

world problem than children who were read the same stories with fantastical characters (Richert et al., 2009; Richert & Smith, 2011). Similarly, when presented with a story with a novel causal event, children who were read a story with no violations of reality were more likely to apply the event to the real world than children who were read a story with fantastical features (Walker et al., 2015).

In terms of television, recent studies have replicated findings from storybook studies. Young children who believed novel foreign-language words were real, rather than just pretend, were more likely to learn the definitions of the novel words (Mares & Sivakumar; 2014). Likewise, children were more likely to learn a novel cultural activity from an episode of *Sesame Street* if they believed it was a realistic, rather than fantastical, activity (Bonus and Mares; 2015). Additionally, we have recently found an interaction between young children's belief in fantasy and the amount of fantasy in a video clip relating to successful analogical transfer (Richert & Schlesinger, in press). Children with a greater understanding that fantastical features from the videos cannot happen in the real world were more likely to transfer problem-solving solutions from videos low in fantasy or with fantasy relevant to the solution in the video, than videos with fantasy that was irrelevant to the solution in the video (Richert & Schlesinger, in press). Overall, because of the presence of fantasy in young children's media, and the evidence that fantasy may impact the observational learning subprocesses, fantasy understanding was evaluated.

## Selective Trust

Paralleling children's perceptions of models, a distinct line of research has examined children's selective trust of novel informants (Corriveau & Harris, 2009;

Corriveau, Pickard, & Harris, 2011; Harris, 2012; Jaswal, McKercher, & VanderBorght, 2008; Koenig, 2012; Koenig & Harris, 2005; Landrum, Mills, & Johnston, 2013; Lutz & Keil, 2002; Nurmsoo & Robinson, 2009). Previous research concerning informant characteristics has found 3- to 5-year-old children are more likely to trust reliable compared with unreliable or ignorant informants (Corriveau & Harris, 2009; Corriveau et al., 2011; Koenig & Harris, 2005), expert over inexpert or neutral informants (Koenig & Jaswal, 2011; Landrum et al., 2013; Lutz & Keil, 2002), and nice and neutral informant over mean expert (Landrum et al., 2013). Preschool-aged children understand people have different expertise, such as mechanics being better at fixing cars than doctors, or eagle experts knowing more about birds than cars (Koenig & Jaswal, 2011; Landrum et al., 2013; Lutz & Keil, 2002).

Additionally, once negative trust judgments are established, they are difficult to revise. Research has indicated that after establishing trust of a reliable informant and less trust of an unreliable informant, some children were told the unreliable informant wore a blindfold, and therefore could not provide accurate information (Nurmsoo & Robinson, 2009). Children acknowledged the blindfold caused the inaccuracy for the unreliable informant, but 4- to 5-year-old children still preferred the reliable over unreliable informant even when the blindfold was removed. Children are unlikely likely to forgive past inaccuracy, even when they are aware of the reason for the inaccuracy (Nurmsoo & Robinson, 2009).

Less work has evaluated how children's trust of media characters is related to learning from those characters (Schlesinger et al., 2016). Prior research has found young

children who attempted to engage in analogical transfer from a short clip of an animated character creating and using a lever was related to participants' character trust. Participants who created and used a lever after hearing a prompt to "think back to the video," which is a typical scaffold in analogical transfer literature, had significantly greater trust of the on-screen character than children who transferred without a scaffold or did not transfer at all (Schlesinger et al., 2016). This research points to important individual differences in young children's learning from media and analogical transfer, and how these differences are relate to children's social cognitive beliefs about characters.

## Research Goals

This dissertation had three research goals: (1) Establish that self-efficacy can be measured during early childhood, (2) explore whether self-efficacy and learning are significantly related during early childhood, and (3) examine how aspects of an observational model (model trust, model similarity) relate to children's self-efficacy and learning from the model. Study 1 was designed to accomplish each research goal, creating a large correlational study allowing for exploring specific relations between variables. Study 2 examines how the impact of divergent reasoning and fantastical aspects of the model may change the relations between variables found in Study 1.

## Chapter 2: Study 1

Study 1 focused on establishing relations between self-efficacy and the hypothesized antecedents of self-efficacy (Bandura, 1997; Britner & Pajares, 2006; Usher & Pajares, 2008). By designing a large correlational study, relations between children's self-efficacy, learning from characters, and beliefs about characters could be examined.

There were two primary hypotheses for Study 1. The first hypothesis was relations between self-efficacy and the antecedents of self-efficacy would replicate prior research. It was hypothesized that learning (i.e., mastery experiences) would be the most significant predictor of self-efficacy, and that vicarious perceptions would also relate to self-efficacy, but have a less significant influence on self-efficacy than mastery experiences (Britner & Pajares, 2006; Usher & Pajares, 2008). The second hypothesis was vicarious perceptions would explain the relation between self-efficacy and learning. It was hypothesized that participants' character trust, identification, social realism beliefs, and personification of the primary character would mediate or disrupt otherwise strong relations between children's self-efficacy and learning from the character.

The conceptual model (Figure 1) illustrates Bandura's (1997) hypothesized model, and the potential relations between self-efficacy and behavior. Study 1 focuses on exploring the impact of mastery experiences and vicarious perceptions on self-efficacy.

Study 1 was broken into Study A and B for data collection. Methodological differences between Study A and B are described in the methods section, and data from Study A and Study B are combined for results and discussion.

## Methods

### Participants

**Study 1A.** Sixty-eight (51.5% male) 3.5- to 6.5-year-old ($M_{age}$ = 4.80, $SD_{age}$ = 0.88) children were interviewed for Study A. Race and ethnicity breakdown: 30.9% European-American, 26.5% Latino-American, 5.9% African American, 1.5% Asian-American, and 26.5% multiethnic. Of those with multiple races or ethnicities, 5.9% identified as both European-American and Latino-American, 4.4 wrote *biracial* or *mixed*, and the remaining identified as Asian and Latino-American, Asian and African-American, African and Latino-American, Asian and European-American, African and European-American, and European and Native-American. 10.3% did not report a race or ethnicity. In terms of parents' education level, 14.7% had an advanced degree, 19.1% had a Bachelor's degree, 30.9% attended some college, vocational school, or had an Associate's degree, 7.4% had a high school diploma or a GED, 4.4% did not complete high school, and 22.1% did not report. With regards to yearly income, 19.1% of families reported earning less than $29,999 per year, 8.8% of families earning between $30-49,999, 27.9% of families earning between $50-$89,000, 14.7% of families earning more than $90,000 yearly, and 29.4% not reporting.

Of these participants, 4 children were pilot participants, 3 children did not assent to video recording, 5 children requested to end early, and 13 children refused to respond to questions or did not understand the measurement scales and did not complete the full study. The final sample for Study 1 included 43 children (51.2% male) 3.5- to 6.5-year-old ($M_{age}$ = 5.14, $SD_{age}$ = 0.82). The final sample for Study 1 was significantly older than

children who did not complete the full study because they did not understand the measurement scales or refused to respond to questions ($M = 4.00$, $SD = 0.31$), $t(54) = 4.87$, $p < 0.001$, Cohen's $d = 1.84$.

Race and ethnicity breakdown of the final sample: 32.6% Latino-American, 27.0% European-American, 9.3% African American, and 27.9% multiethnic. Of those with multiple races or ethnicities, 9.3% identified as both European-American and Latino-American, and the remaining identified as Asian and Latino-American, Asian and African-American, African and Latino-American, Asian and European-American, African and European-American, and European and Native-American. 2.3% did not report a race or ethnicity. In terms of parents' education level, 20.9% had an advanced degree, 23.3% had a Bachelor's degree, 32.6% attended some college, vocational school, or had an Associate's degree, 11.6% had a high school diploma or a GED, 4.7% did not complete high school, and 7.0% did not report. With regards to yearly income, 18.6% of families reported earning less than $29,999 per year, 13.9% of families earning between $30-49,999, 32.6% of families earning between $50-$89,000, 18.6% of families earning more than $90,000 yearly, and 18.6% not reporting.

**Study 1B.** Due to problems young children had with a scale from Study 1A, a revised scale (see Measures section) was used for data collection with young children for Study 1B. Thirty-four (61.8% male) 3.5- to 6.5-year-old ($M_{age} = 4.46$, $SD_{age} = 0.93$) children were interviewed for Study 1B. Race and ethnicity breakdown: 32.35% Latino-American, 17.6% European-American, 5.88% African American, 2.9% Asian-American, and 35.3% multiethnic. Of those with multiple races or ethnicities, 14.7% identified as

both European-American and Latino-American, and the remaining identified as African and Latino-American, Asian and European-American, Asian American, European American, European American, and Native American. 8.8% did not report a race or ethnicity. In terms of parents' education level, 2.9% had an advanced degree, 7.4% had a Bachelor's degree, 23.5% attended some college, vocational school, or had an Associate's degree, 7.4% had a high school diploma or a GED, and 8.82% did not report. With regards to yearly income, 14.7% of families reported earning less than $29,999 per year, 17.6% of families earning between $30-49,999, 26.5% of families earning between $50-$89,000, 11.8% of families earning more than $90,000 yearly, and 26.5% not reporting.

Of that group, 7 children requested to end early or did not respond to a substantial amount of questions, and did not complete the full study; the final sample for Study 1B included 27 children (51.9% male) 3.5- to 6.5-year-old ($M_{age} = 4.51$, $SD_{age} = 0.89$). Race and ethnicity breakdown of the final sample: 33.3% Latino-American, 18.5% European-American, 7.4% African American, and 37.0% multiethnic. Of those with multiple races or ethnicities, 18.5% identified as both European-American and Latino-American, and the remaining identified as African and Latino-American, Asian and European-American, African and European-American, and Asian American, European American, European American, and Native American. In terms of parents' education level, 7.4% had an advanced degree, 18.5% had a Bachelor's degree, 59.3% attended some college, vocational school, or had an Associate's degree, 11.1% had a high school diploma or a GED, and 3.7% did not report. With regards to yearly income, 14.8% of families

reported earning less than $29,999 per year, 22.2% of families earning between $30-49,999, 33.3% of families earning between $50-$89,000, 18.5% of families earning more than $90,000 yearly, and 11.1% not reporting.

**Study A + Study B.** The final sample, combining Study A and Study B for analyses, included 70 children (51.4% male) 3.5- to 6.5-year-old ($M_{age}$ = 4.89, $SD_{age}$ = 0.90). Children in Study 1 ($M$ = 5.15, $SD$ = 0.82) were significantly older than the children in Study 2 ($M$ = 4.51, $SD$ = 0.89), $t(68) = 3.072$, $p = 0.003$, Cohen's $d = 0.75$. The different age groups between the two studies was intentional; younger participants were recruited for Study B because younger participants had refused to answer questions or were unable to comprehend the scales in Study A. Race and ethnicity breakdown of the final sample: 32.9% Latino-American, 25.7% European-American, 8.6% African American, 1.4% Asian-American, and 31.4% multiethnic. Of those with multiple races or ethnicities, 12.9% identified as both European-American and Latino-American, 5.7% identified as both African and Latino-American, 4.3% identified as both Asian and European-American, 4.3% identified as both African and European-American, and the remaining identified as Asian and Latino-American, European and Native-American, and Asian American, European American, European American, and Native American, with 1.4% not reporting. In terms of parents' education level, 15.7% had an advanced degree, 21.4% had a Bachelor's degree, 42.9% attended some college, vocational school, or had an Associate's degree, 11.4% had a high school diploma or a GED, 2.9% did not complete high school, and 5.7% did not report. With regards to yearly income, 15.7% of families reported earning less than $29,999 per year, 14.3% of families earning between

$30-49,999, 31.4% of families earning between $50-$89,000, 22.9% of families earning more than $90,000 yearly, and 15.7% not reporting.

**Measures**

**Parasocial Relationship Interview.** Children's one-sided emotional relationships with the featured character in the study were evaluated using Calvert and colleagues' Parasocial Relationship Interview for children (unpublished, adapted from Bond & Calvert, 2014). The interview consisted of 12 questions overall, broken into three question categories: identification, social realism, and personification. Each question was asked and immediately followed by orally describing response options (e.g., not at all, a little, a lot).

*Identification.* To evaluate participants' identification or feelings of perceived similarity with Grover, they were asked how much they (a) liked, (b) were like, and (c) wanted to be like Grover, and (d) to what extent Grover has feelings (Calvert et al., 2007; Schlesinger et al., 2016). Participants had the option of responding a lot (2), a little bit (1), or not at all (0). Responses to all four questions were averaged (Cronbach's $a$ = 0.76), creating a continuous identification scale ranging from strongly identify (2) to not identifying at all (0).

*Social Realism.* Participants' social realism, or beliefs about whether they could interact with Grover in real life, were evaluated by asking if they believed they could (a) play tag with the character, (b) see the character at the store, (c) if the character could attend their school, and (d) if the character is their friend (Richert & Schlesinger, in press; Schlesinger et al., 2016). Participants had the option of responding yes a lot (2), yes a

little bit (1), or never (0). Responses to all four questions were averaged (Cronbach's *a* = 0.79), creating a continuous social realism scale ranging from believing they can often interact with the character (2) to believing they can never interact with the character in real life (0).

*Personification.* Personification beliefs, or to what extent participants believed Grover had human-like qualities or needs, were evaluated by asking if participants believed the character (a) needed to eat, (b) needed to sleep at night, (c) got older every year, and (d) is cute (Richert & Schlesinger, in press). Participants had the option of responding yes a lot (2), yes a little bit (1), or never/not at all (0). Responses to all four questions were averaged (Cronbach's *a* = 0.85), creating a continuous personification variable ranging from believing the character is highly human-like (2) to not believing the character is biologically human-like at all (0).

**Trust.** Participants' selective trust was evaluated by asking which characters from the video they would ask for help solving the problems in the three videos and the three lab problems. The number of times Grover was selected first (out of six) was summed to create a Grover trust variable (Schlesinger et al., 2016), and the number of times other video characters were selected first (out of six) were summed to create an other-character trust variable. The Grover trust variable was subtracted from the other-character trust variable, creating a trust difference score ranging from -6 to 0 to +6 (Schlesinger & Richert, accepted). Positive scores indicate children have higher trust of the other characters in the videos than trust of Grover, negative scores indicate children

have higher trust of Grover, and scores towards 0 indicate children have similar trust of Grover and the other video characters.

**Divergent Reasoning.** Participants' divergent reasoning was evaluated by asking participants to list unique solutions to problems and unique uses for problem solutions. The divergent reasoning variable was derived from Calvert et al.'s (2007) measure of divergent reasoning about unique uses for a familiar tool. In Study 1, participants were asked to continue listing answers to nine questions until they ran out of ideas or repeated the same answer twice. Participants who responded, "I don't know" or did not respond, received a 0 for each question. Children's responses to nine questions were averaged to create a divergent reasoning score, three question types divided up the nine questions into three categories: unsolvable problem solutions, video solution uses, and video problem solutions (Cronbach's $a = 0.81$).

***Unsolvable problem solutions***. Participants were presented with three seemingly unsolvable physical problems in the laboratory, and asked to list unique solutions for solving each problem. Participants were not allowed to solve the problems prior to the activity, and were not exposed to any suggestions, curriculum, or scaffolds for solving the problems. These unsolvable problems would later become the analogical transfer problems. Participants could list as many ideas as they wished, so the range is not constrained; the actual range for each problem was from 0 to 9.

***Video solution uses***. After watching videos and solving transfer tasks, participants were asked to list how many unique uses they could think of for the solution in the three videos. The actual range for each problem was from 0 to 8.

***Video problem solutions***. After responding to the video solution uses question, participants were asked how they would solve the three video problems if they did not have the solution from the videos. The actual range for each problem was from 0 to 8.

**Analogical Transfer.** Participants' analogical transfer, or display of learning from each video, was evaluated by (a) asking participants to recall the solution to the problems in the videos, (b) asking participants to solve a problem analogically similar to the problem presented in the videos, and (c) asking participants to make an explicit analogical connection between the solution in the videos and solution in the transfer tasks. Responses to the recall question were coded by whether participants correctly (1) or incorrectly (0) named or described the solution in each video; those who did not remember or incorrectly described the video solutions were reminded of the correct video solutions (Schlesinger et al, 2016). This extra reminder was done because recalling and comprehending the *source* problem is a vital and necessary step in successful analogical transfer; without understanding or remembering the initial problem, no information can be transferred from the source to the target problem (Richert & Smith, 2011; Schlesinger et al., 2016). Responses to the explicit analogical connection questions were coded by whether participants correctly (1) or incorrectly (0) named or described the analogically similar solution from the videos and the lab problems (Richert & Schlesinger, accepted).

Participants were offered three opportunities to solve the analogical problems. Successful problem solving was coded by whether participants applied the analogically similar solution from the video to the in-lab task (1), or used a different solution (0), or did not attempt to solve (0). Successful problem solving was summed with whether

recall and analogical connections questions were answered correctly, creating three analogical transfer scores ranging from 0 to 3. The analogical transfer scores for each video-task pair were averaged creating a continuous analogical transfer score (Cronbach's $a$ = 0.68) with higher scores indicating greater analogical transfer.

*Wheels*. For the wheels problem, participants were reintroduced to the box they had seen during the divergent reasoning unsolvable problem task, and were told, "do you remember the really heavy box from earlier today, now I want you to find a way to get this box from here, to that wall over there, you can use any of the tools or toys in front of you." In front of the box were 5 potential solutions: wheeled scooter the size of the box, a Duplo train with wheels, a golf club (analogically similar to one in the video), a plastic lid roughly the size of the box, and a hook that could fit on the box handles. The analogical solution was to put the box on the scooter and push it over to the wall. To evaluate comprehension of the wheels video, participants were asked how the block of ice was moved. To evaluate participants' analogical connections between the wheels video and wheels transfer problem, they were asked what in the room was like the wheels from the video.

*Lever*. For the lever problem, participants were reintroduced to the pillow they had seen during the divergent reasoning unsolvable problem task, and were told, "do you remember the very tiny pillow from earlier today, now I want you to find a way to get this pillow from this table, to that wall over there, but you have to sit in the chair [at the table] the whole time, you can use any of the tools or toys in front of you." In front of the pillow were 5 potential solutions: two spoons taped together with a bowl on either end, a

small bowl half the length of the spoons, a small wooden stick (analogically similar to one in the video), a water bottle lid, and a plastic spring. The analogical solution was to put the pillow on one end of the spoon, and pull that end backwards like a catapult. To evaluate comprehension of the lever video, participants were asked what the chicken used to get over the wall. To evaluate participants' analogical connections between lever video and lever transfer problem, they were asked what in the room was like the lever from the video.

*Ramp.* For the ramp task, participants were reintroduced to the pig they had seen during the divergent reasoning unsolvable problem task, and were told, "do you remember the pig from earlier today, now I want you to find a way to get the pig from this table onto the floor without breaking the pig, and the only rule is that you cannot use your hands [to place it on the floor], you can use any of the tools or toys in front of you." In front of the pig were 5 potential solutions: 3-foot long plastic lid, 18-inch long piece of paper, cardboard stairs, a plastic cooking spoon, and a small bowl. The analogical solution was to lean the plastic against the table, and roll the pig down the lid onto the floor. To evaluate comprehension of the ramp video, participants were asked what the cow used to get down. To evaluate participants' analogical connections between the ramp video and the ramp transfer problem, participants were asked what in the room was like ramp from the video.

**Self-Efficacy.** Self-efficacy was evaluated through four question types for each video-task pair: divergent reasoning, pre-transfer, post-transfer, and video problem. Self-efficacy questions were adapted from prior measurements (Holden, Moncher, Schinke, &

Barker, 1990; Wilson & Trainin, 2007) and based primarily on explicit recommendations "for constructing self-efficacy scales with children" (Bandura, 2006). Participants had the option of responding really good (2), a little good (1), or not good (0) to each of the 12 questions. Responses to the four questions for each of the three video-task pairs, totaling 12 questions, were averaged creating one continuous self-efficacy variable ranging from 0 to 2, with higher scores indicating greater self-efficacy (Cronbach's $a$ = 0.82).

*Divergent reasoning.* To evaluate children's self-efficacy for divergent reasoning, participants were asked how good they were at coming up with different ways solve Tasks A, B, and C.

*Pre-transfer*. After participants evaluated their divergent reasoning self-efficacy, participants were asked how good they would be at actually solving Tasks A, B, and C.

*Post-transfer*. After participants attempted to solve the in-lab problems, they were asked how good they were at solving Tasks A, B, and C.

*Video Problem*. Participants were asked how good they would be at solving the problems presented in Videos A, B, and C.

**Cognitive Battery**. Participants were administered two measures of cognitive development, a measure of verbal abilities and a measure of problem solving (i.e., riddles), from the Kaufman Assessment Battery for Children. The verbal measure examines expressive vocabulary by asking participants to name the objects displayed in the drawings until incorrectly labeling four items in a row. The riddles assessment requires the interviewer to describe a concept and the participant then names that concept

until incorrectly labeling four items in a row. Both measures were standardized by age according to the Kaufman Assessment Battery for Children manual prior to analyses.

**Scale transformation**

Due to the amount of children who were unable to complete Study 1A because they were unable to understand the measurement scale or refused to respond to questions, a new scale was created for Study 1B. In order to analyze datasets for Study 1A and Study 1B together, the 5-point response scales from Study 1A were transformed into a 3-point scale for analysis.

To determine the most appropriate way to transform the 5-point scale in Study 1A to a 3-point scale, the response rates to the scale items were compared between Study 1A and Study 1B. For example, the percentage of children who chose *not at all* to the question, how much do you like [the character], were compared for Study 1A and 1B. Because the original 5-point scale anchor was 0, and the percentages of children choosing the 0 option for both studies was comparable (e.g., on both scales 0 indicated never, nothing, or not at all), the scale transformation was determined by whether the collapsed response rates to options 1, 2, and 3 in the Study 1A 5-point scale were comparable to the response rate of option 1 in the Study 1B 3-point scale, or whether the collapsed response rates to options 1 and 2 in Study 1A's 5-point scale were comparable to the response rates to option 1 in Study 1B's 3-point scale. Transformed Scale I for Study 1A was selected as the response rates were more comparable to Study B overall (see Appendix A). Response option 0 in Study 1A stayed 0, response options 1, 2, and 3 in Study 1A were

transformed to 1, and response option 4 in Study 1A was transformed to 2. For the following analyses and measures, responses to Study 1A and Study 1B are collapsed.

**Materials**

**Videos.** Participants watched three videos of Super Grover 2.0 from *Sesame Street* helping animals in trouble solve physical problems using engineering solutions. Each video was edited down from 6 minutes to 4 minutes and 45 seconds, and each video included the same amount of problem solving attempts.

***Wheels video***. In the wheels video, Super Grover attempts to help a group of penguins move a giant block of ice that is on their dance floor. Grover attempts to hit the ice with a golf club, and fails at moving it. The penguins notice the wheels on Grover's car, take the wheels off the car, put the wheels under the ice, and successfully move the ice.

***Lever video***. In the lever video, Super Grover attempts to help a chicken get over a high wall. Grover attempts to make a hole or break the wall by hitting it with a short pole, but fails at breaking the wall. The chicken realizes that a long pole, instead of Grover's short pole, could be used as a lever (or catapult), and finds a long pole, and pole-vaults over the wall.

***Ramp video***. In the ramp video, Super Grover attempts to help a cow get down who refuses to use the stairs. Grover holds a board up over his head for the cow to walk across, and accidently drops the board at a 45-degree angle. The cow realizes she can walk down the board like a ramp, and walks down the board without any issue.

**Analogical transfer.** Participants' analogical transfer, or display of learning from each video, was evaluated by asking children to solve a problem analogically similar to the problem presented in the videos. As with prior research, participants were offered three opportunities to solve the problems (Schlesinger et al., 2016).

*Wheels Task*. For the box problem, participants were reintroduced to the box they had seen earlier, and were told, "do you remember the really heavy box from earlier today, now I want you to find a way to get this box from here, to that wall over there, you can use any of the tools or toys in front of you." In front of the box were 5 potential solutions: wheeled scooter, a Lego train with wheels, a golf club (analogically similar to one in the video), plastic lid roughly the size of the box, and a hook that could fit on the box handles. The analogical solution was to put the box on the scooter and push it over to the wall.

*Lever Task*. For the pillow problem, participants were reintroduced to the pillow they had seen earlier, and were told, "do you remember the very tiny pillow from earlier today, now I want you to find a way to get this pillow from this table, to that wall over there, but you have to sit in the chair [at the table] the whole time, you can use any of the tools or toys in front of you." In front of the pillow were 5 potential solutions: two spoons taped together, a small bowl half the length of the spoons, a small wooden stick (analogically similar to one in the video), a water bottle lid, and a plastic spring. The analogical solution was to put the pillow on one end of the spoon, and pull that end backwards like a catapult.

*Ramp Task.* For the pig problem, participants were reintroduced to the pig they had seen earlier, and were told, "do you remember the pig from earlier today, now I want you to find a way to get the pig from this table onto the floor without breaking the pig, and the only rule is that you cannot use your hands [to place it on the floor], you can use any of the tools or toys in front of you." In front of the pig were 5 potential solutions: 3-foot long plastic lid, 18-inch long piece of paper, cardboard stairs, a plastic cooking spoon, and a small bowl. The analogical solution was to lean the plastic against the table, and roll the pig down the lid onto the floor.

**Procedure**

Study 1 occurred during one 90-minute visit to a university laboratory. After obtaining parental consent and child assent, all children started out with a warm up exercise and scale training. Following, participants took the initial divergent reasoning measurement and their critical thinking and pre-transfer self-efficacy was measured. Then, participants watched videos, attempted to solve the transfer tasks, answer recall and analogical connections questions, and take the remaining divergent reasoning measures in one of six counterbalanced orders. Video viewing, recall questions, transfer task, analogical connections questions, divergent reasoning questions were always administered in the same order, but the video viewing order (and therefore related tasks) were counterbalanced. After the final divergent reasoning task, participants took the Kaufman Assessment Battery for Children vocabulary and riddles measures, which were followed by the final self-efficacy questions. Parents received $20 travel reimbursement and children received a small toy for their participation.

## Results

### Variable Overview

Participants' vocabulary and riddles scores were standardized by age according to the Kaufman Battery for Children manual. Children's vocabulary scores ranged from 4 to 19, with children averaging about 12 points ($M$ = 11.90, $SD$ = 2.91); riddles scores ranged from 4 – 17, averaging about 10 points ($M$ = 10.10, $SD$ = 3.11).

In terms of character variables, identification, social realism, and personification ranged from 0 to 2. Overall, children had moderate similarity beliefs ($M_{\text{identification}}$ = 0.88, $SD_{\text{identification}}$ = 0.66, low belief they could interact with the character in real life ($M_{\text{social realism}}$ = 0.42, $SD_{\text{social realism}}$ = 0.56), and moderate personification ($M_{\text{personification}}$ = 0.78, $SD_{\text{personification}}$ = 0.71). Overall, children felt somewhat similar to Grover, but did not believe they could interact with him in real life.

The divergent reasoning variable was the average of children's total responses to three divergent thinking problem-solving tasks for each video problem. Because children's responses were not limited, the possible range was not constrained. After averaging responses for the nine questions, responses ranged from 0 to 9, with participants stating about four responses each question ($M$ = 4.38, $SD$ = 2.70).

Analogical transfer scores are the sum of participants' successful transfer (+1), accurately recalling solutions to video problems (+1), and making a correct analogical connections between the video problem solutions and the lab solutions (+1). Summed responses were averaged across the three videos, creating one analogical transfer score

ranging from 0 to 3. Participants averaged about two points ($M = 1.89$, $SD = 0.71$), indicating participants responded to two of the three questions accurately.

The self-efficacy variable was the average of the 12 self-efficacy questions ranging from 0 to 2, representing global self-efficacy, or self-efficacy for problem solving. Participants had moderate self-efficacy ($M = 1.32$, $SD = 0.53$), meaning they overall believed they were a little good at solving problems.

**Preliminary Results**

All outcome variables were examined for relations with each other, gender, age, and standardized cognitive measurements.

**Gender.** All variables were examined for significant relations with child gender.

Divergent reasoning significantly differed by child gender, $t(68) = 2.50$, $p < 0.05$, Cohen's $d = 0.77$. Girls ($M = 5.18$, $SD = 2.69$) had significantly higher divergent reasoning scores than boys ($M = 3.18$, $SD = 2.52$). No other variables significantly differed by gender.

**Age.** All variables were examined for significant relations with child age.

Age was positively correlated with trust, $r = 0.33$, $p < 0.01$; the older children were, the greater their trust of other video characters, not Grover (see Table 1). Age was positively correlated with transfer, $r = 0.41$, $p < 0.001$, the older children were, the greater their transfer scores. Age was positively correlated with self-efficacy, $r = 0.28$, $p < 0.05$; the older children were the greater their overall self-efficacy. Age was not significantly related to any other variables.

Table 1: Study 1 Correlation Matrix

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Mean (SD) | 11.90 (2.91) | 10.10 (3.11) | 4.90 (0.90) | 0.83 (0.66) | 0.42 (0.56) | 0.78 (0.71) | -2.37 (3.67) | 4.38 (2.70) | 1.89 (0.71) | 1.32 (0.53) |
| 1. Vocabulary | - | | | | | | | | | |
| 2. Riddles | .561*** | - | | | | | | | | |
| 3. Age | -0.133 | -0.212 | - | | | | | | | |
| 4. Identification | -0.103 | -0.069 | -0.034 | - | | | | | | |
| 5. Social Realism | -0.171 | -0.148 | -0.055 | .533*** | - | | | | | |
| 6. Personification | -0.112 | -0.210 | -0.029 | .537*** | .433*** | - | | | | |
| 7. Trust | 0.038 | -0.033 | .327** | -0.114 | -0.092 | -0.048 | - | | | |
| 8. Divergent Reasoning | -0.095 | -0.004 | 0.049 | -0.015 | -0.078 | -0.071 | 0.113 | - | | |
| 9. Transfer | .389*** | .482*** | .412*** | -0.020 | -0.100 | -0.116 | 0.091 | 0.086 | - | |
| 10. Self-Efficacy | 0.297* | 0.342** | 0.277* | 0.298* | 0.230** | 0.114 | 0.248* | 0.155 | 0.340** | - |

**Kaufman ABC.** Two measures from the Kaufman Assessment Battery for Children were examined in relation to other variables, vocabulary and riddles. Both measures were scaled with age prior to analysis.

Vocabulary and riddles were significantly positively correlated with each other, $r = 0.56$, $p < 0.01$; children with stronger vocabulary scores had greater performance on the riddles task. Vocabulary, $r = 0.39$, $p < 0.001$, and riddles, $r = 0.48$, $p < 0.001$, were significantly positively related to transfer; children with greater performance on the standardized tasks had higher performance on transfer tasks.

**Character Variables.** Certain character variables were significantly correlated with each other. Identification, social realism, and personification were all significantly positively correlated with each other (see Table 1). However, identification, social realism, and personification were not significantly related to trust.

Identification, $r = 0.30$, $p < 0.05$, social realism, $r = 0.23$, $p < 0.01$, and trust, $r = 0.25$, $p < 0.05$, were positively correlated with self-efficacy. Overall, character variables were positively related to self-efficacy; the closer children felt to Grover, the greater their self-efficacy. Character variables did not have significant relations with other variables, with the exception of trust being positively correlated with age, $r = 0.33$, $p < 0.01$.

**Divergent Reasoning.**

Divergent reasoning was not significantly related to any other variables.

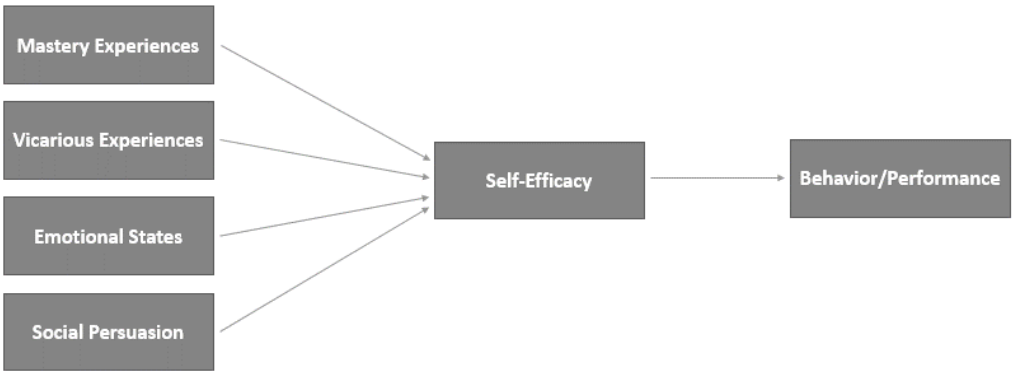
**Analogical Transfer.**

Analogical transfer was positively correlated with vocabulary, $r = 0.39$, $p < 0.001$, riddles, $r = 0.48$, $p < 0.001$, age, $r = 0.41$, $p < 0.001$, and self-efficacy, $r = 0.34$, $p < 0.01$.

## Analysis Plan

Remaining data analysis will take two forms. First, the impact of analogical transfer and vicarious perceptions on self-efficacy will be tested; first entering analogical transfer (representing mastery experiences), and second entering vicarious perceptions. This order will allow for examining the independent contribution of mastery experience in the first step, and to examine the effect of vicarious experiences after controlling for mastery experience. Because prior literature has found mastery experiences to account for more variance in self-efficacy than other variables, by controlling for mastery in the second step, any independent contribution of vicarious perceptions will be found. Second, the relations between analogical transfer and self-efficacy will be tested, while controlling for other variables that may contribute to the construct of self-efficacy.

Figure 1: Bandura's Self-efficacy model (Bandura, 1997)




## Conceptual Model Components

A hierarchical multiple regression was run predicting self-efficacy from variables representing mastery experience and vicarious perceptions; only variables significantly correlated with self-efficacy (see Table 1) were included in the regression (see Table 2).

Model 1, predicting self-efficacy scores from analogical transfer, was significant, $R^2_{adjusted} = 0.10$, $F(1, 68) = 8.65$, $p < 0.01$. Transfer positively predicted self-efficacy, for every point increase in transfer there was a .34 increase in self-efficacy. Model 1 accounted for 10.2% of the variance in self-efficacy.

Model 2 added the effect of vicarious perceptions on self-efficacy, and was significantly better than Model 1, $R^2_{adjusted} = 0.28$, $R^2_{\Delta} = 0.21$, $F(3, 65) = 6.32$, $p < 0.001$. Social realism positively predicted self-efficacy; for every point increase in social realism, there was a .35 increase in self-efficacy. Trust positively predicted self-efficacy; for every increase in trust there was a .26 increase in self-efficacy. Transfer continued to positively predicted self-efficacy. Model 2 accounted for an additional 20.5% of the variance in self-efficacy. Both models accounted for 32% of the variance in children's self-efficacy scores.

Table 2: Hierarchical multiple regression predicting self-efficacy from mastery experience and vicarious perceptions

| Model | Variable | B | B SE | β | t | p | 95% CI for β | | F change | Adjusted $R^2$ | $R^2$ Change |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Lower | Upper | | | |
| 1 | (Constant) | 0.827 | 0.179 | | 4.617 | 0.000 | 0.470 | 1.185 | 8.651** | 0.116 | 0.116 |
| | Transfer | 0.263 | 0.089 | 0.340** | 2.941 | 0.005 | 0.084 | 0.441 | | | |
| 2 | (Constant) | 0.692 | 0.181 | | 3.831 | 0.000 | 0.331 | 1.052 | 6.319*** | 0.320 | 0.205 |
| | Transfer | 0.268 | 0.081 | 0.348** | 3.297 | 0.002 | 0.106 | 0.431 | | | |
| | Social Realism | 0.275 | 0.118 | 0.292* | 2.331 | 0.023 | 0.039 | 0.512 | | | |
| | Identification | 0.122 | 0.101 | 0.151 | 1.206 | 0.232 | -0.080 | 0.325 | | | |
| | Trust | 0.038 | 0.015 | 0.257** | 2.455 | 0.017 | 0.007 | 0.068 | | | |

**Mastery Experience**

A hierarchical linear regression was run predicating transfer from self-efficacy, after controlling for significant vicarious perception variables. Model 1 entered the effect of identification, social realism, and trust on transfer, and was not significant, $R^2_{\text{adjusted}} = 0.00$, $F(3, 66) = 0.65$, $p > 0.10$. The lack of significance is not surprising given that none of the predictors were significantly correlated with transfer. Model 1 accounted for 2.9% of the variance in transfer.

Model 2 entered the effect of self-efficacy on transfer, and was significant, $R^2_{\text{adjusted}} = 0.12$, $R^2_{\Delta} = 0.14$, $F(1, 65) = 10.87$, $p < 0.01$. Self-efficacy significantly positively predicted transfer; for every point increase in self-efficacy there was a .42 point increase in transfer. Additionally, social realism negatively predicted transfer; for every point increase in social realism, there was a .28 decrease in transfer. Model 2 accounted for an additional 14.3% of the variance in transfer. Overall, both models accounted for 17.2% of the variance in transfer.

Table 3: Hierarchical multiple regression predicting transfer from self-efficacy after controlling for vicarious perceptions.

| Model | Variable | B | B SE | β | t | p | 95% CI for β | | F change | Adjusted $R^2$ | $R^2$ Change |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Lower | Upper | | | |
| 1 | (Constant) | 1.894 | 0.145 | | 13.081 | 0.000 | 1.605 | 2.183 | 0.646 | 0.000 | 0.029 |
| | Social Realism | -0.218 | 0.180 | -0.178 | -1.212 | 0.230 | -0.577 | 0.141 | | | |
| | Identification | 0.147 | 0.155 | 0.140 | 0.952 | 0.345 | -0.162 | 0.457 | | | |
| | Trust | 0.014 | 0.024 | 0.074 | 0.596 | 0.553 | -0.033 | 0.061 | | | |
| 2 | (Constant) | 1.236 | 0.241 | | 5.129 | 0.000 | 0.754 | 1.717 | 10.869** | 0.120 | 0.143 |
| | Social Realism | -0.337 | 0.171 | -0.276† | -1.970 | 0.053 | -0.679 | 0.005 | | | |
| | Identification | 0.059 | 0.147 | 0.056 | 0.400 | 0.691 | -0.234 | 0.351 | | | |
| | Trust | -0.009 | 0.023 | -0.046 | -0.379 | 0.706 | -0.055 | 0.037 | | | |
| | Self-efficacy | 0.549 | 0.167 | 0.423** | 3.297 | 0.002 | 0.216 | 0.882 | | | |

## Study 1 Discussion

Study 1 had two primary hypotheses. The first hypothesis, that relations between self-efficacy and the antecedents of self-efficacy would replicate prior research, was not supported. An unexpected pattern emerged, with vicarious perceptions having a similar contribution to self-efficacy as mastery experiences. The second hypothesis, that character trust, identification, social realism beliefs, and personification of the primary character would mediate or disrupt otherwise strong relations between children's self-efficacy and analogical transfer, was indirectly supported. As vicarious perceptions were not significantly related to transfer, there was not a direct or appropriate way to test the second hypothesis; however, the unexpected finding that social realism marginally negatively predicted transfer when self-efficacy was in the model does support the hypothesis that vicarious beliefs impact the relation between self-efficacy and learning. The discussion for Study 1 is divided into sections expanding key findings, relations to the conceptual models, and motivation for Study 2.

**Key findings.**

Due to the circular and reevaluate nature of self-efficacy (e.g., self-efficacy is reevaluated constantly throughout the study, primarily during video viewing and problem solving), the primary finding, exploring relations between self-efficacy, model perceptions, and mastery, was presented in two ways. First, the hypothesized antecedents of self-efficacy were examined in relation to each other and to self-efficacy (Bandura, 1997; Britner & Pajares, 2006; Usher & Pajares, 2008). Prior research has found standardized measurements of mastery experiences, vicarious experiences, social

persuasions, and physiological states were significantly and positively correlated with each other, but with all four variables in a regression analysis, only mastery experiences significantly predicted self-efficacy (Britner & Pajares, 2006; Usher & Pajares, 2008). Due to the vast majority of previous self-efficacy literature focusing on young adults, the variables representing the constructs of mastery experiences, vicarious experiences, social persuasions, and physiological states in the adult literature could not be seamlessly adapted for use with 3- to 6-year-old children. Therefore, due to the differences between the validated adult measures, and child measures in Study 1, the findings from Study 1 should be noted as a starting point for future research.

The first set of analyses explored the theoretical construct of self-efficacy during early childhood. Overall these results supported Bandura's theoretical model for self-efficacy, replicating previous work (Britner & Pajares, 2006; Usher & Pajares, 2008) and providing evidence that mastery experiences, vicarious experiences, emotional states, and social persuasion are critical aspects of self-efficacy even during early childhood. Unlike previous research that found mastery experiences to be the only significant predictor of self-efficacy during adolescence (e.g., higher grades predicting greater self-efficacy; Britner & Pajares, 2006), Study 1 found mastery and vicarious perceptions both significantly predicted self-efficacy. Mastery experiences (i.e., analogical transfer) did consistently predict self-efficacy, even after adding additional factors to the models; however, certain vicarious perceptions (social realism and trust, not identification or personification) significantly contributed to self-efficacy, which was unexpected given prior research.

A key difference in the variables and measurements in Study 1 (and Study 2) and prior self-efficacy research with adults (Britner & Pajares, 2006; Usher & Pajares, 2008) was the use of measures that were conceptually appropriate for representing the constructs of mastery experiences and vicarious experiences, but had not been used in prior research on self-efficacy. The measurements representing mastery experiences and vicarious experiences in Study 1 had been validated in prior research and were appropriate to administer to children (Bond & Calvert, 2014; Richert & Schlesinger, in press; Richert & Smith, 2011; Schlesinger et al., 2016; Schlesinger & Richert, accepted), but had never been examined in relation to self-efficacy and were not adapted directly from prior research on the antecedents of self-efficacy (Britner & Pajares, 2006; Usher & Pajares, 2008). Therefore, the primary findings from Study 1 will be discussed with the perspective that the measures used to capture the antecedents of self-efficacy may not be the most valid measures of the components of self-efficacy.

**Testing the self-efficacy conceptual model.** The first primary analysis from Study 1 concentrated on testing Bandura's (1997) conceptual model that mastery experiences and vicarious experiences significantly impact self-efficacy. With the exception of identification, social realism, and personification being related, the remaining variables were not significantly related to each other. This lack of significant relations differs from prior research examining the relations of mastery experiences, vicarious experiences, social persuasions, and emotional states in adults; all of which are typically significantly related to each other (see Usher & Pajares, 2008 for review). Additionally, with analogical transfer (representing mastery experiences) and trust and

social realism (representing vicarious experiences) in the model predicting self-efficacy, these variables were significantly predictive of self-efficacy. This differs from prior research with adults finding mastery experiences are the greatest and often only significant predictor of self-efficacy when all other constructs are in a model predicting self-efficacy (Britner & Pajares, 2006; Usher & Pajares, 2008).

The fact that mastery experience in Study 1 did not significantly relate to vicarious perceptions variables, not replicating adult research, nor supporting Bandura's speculations, could be due to (a) the fact that these variables were not derived from measures explicitly meant to evaluate mastery experiences and vicarious experiences from adult literature, and therefore a measurement validity issue, or (b) due to the relations between these antecedents of self-efficacy differing during different times in development. As the importance that the measurements in Study 1 are not identical to the measurements in prior adult research meant to examine the same constructs has been discussed above, the following discussion will focus on the relations of the antecedents of self-efficacy may differ during different times in development.

*Development.* Previous self-efficacy research with adolescents and adults has found their variables used to measure different constructs hypothesized to predict self-efficacy to be highly correlated (Britner & Pajares, 2006), although that was not the case in Study 1. All variables entered into the regression were significantly correlated with self-efficacy. This difference between the highly correlated nature of variables in prior work and lack of significant relations in Study 1 may indicate that the variables used in the current study are capturing very distinct constructs of childhood that may not overlap

in the same way during adulthood. For example, children's evaluations about a character who failed on screen may not impact children's performance attempting to solve an analogically similar problem in the lab the way that during adulthood various experiences watching a typically successful peer fail impact personal performance. Study 1 indicated multiple variables that are not highly correlated account for similar amounts of the variance in children's self-efficacy, distinct from adulthood, during which hypothesized predictors of self-efficacy are highly correlated with each other and only mastery experiences significantly predicts self-efficacy.

From a developmental perspective, it is important to consider why the relations between mastery, vicarious perceptions, and self-efficacy differ during early childhood and adulthood. This is likely due to how influences on self-perceptions, self-concept, and self-efficacy differ during early childhood and adulthood. Bandura (1997) argued the greatest influence of self-efficacy is mastery experience; one's own actual experiences in the domain of the judgment will be the strongest determinant of self-efficacy. Whereas other aspects, such as vicarious experiences watching others, social persuasion from others, and emotional and physiological states are less directly related to personal experiences and require additional social cognitive processing to interpret and assimilate into self-efficacy. However, that speculation was for adults and older children with adult-like cognition; for young children this speculative process likely differs.

Young children are reliant on the trust and testimony of others and at this time in development, are readily developing their abilities to make accurate trust judgments of informants (Corriveau & Harris, 2009; Corriveau et al., 2011; Dore, Jaswal, & Lillard,

2015; Harris, 2012; Jaswal, McKercher, & VanderBorght, 2008; Koenig, 2012; Koenig & Harris, 2005; Landrum et al.,, 2013; Lutz & Keil, 2002; Nurmsoo & Robinson, 2009; Schlesinger et al., 2016). Although young children are able to make accurate trust judgments of novel informants at above chance rates, they still make errors (e.g., preferring unreliable or ignorant informants over reliable or expert informants). These errors indicate that young children are more reliant on the testimony of others than are adults (Corriveau & Harris, 2009; Corriveau et al., 2011; Koenig & Harris, 2005; Koenig & Jaswal, 2011; Landrum et al., 2013; Lutz & Keil, 2002; Nurmsoo & Robinson, 2009).

This is not to say young children are overly credulous (Woolley & Ghossainy, 2013), they often make accurate trust judgments, but the majority of research on young children's trust has been conducted with novel informants. Research on children's trust of familiar informants or dynamic informants (e.g., informants with diverse experiences, or who display unique traits depending on their environment), such as a media character (Schlesinger et al., 2016; Schlesinger & Richert, accepted) or the participants' mother (Corriveau et al., 2009), has been scarcer, and is not overwhelmingly conclusive about how children make trust judgments of familiar and dynamic individuals. That is, although there are relations between children's trust judgments and overall perceptions of others, this work has not supplied evidence for how trust is developed for informants children rely on in everyday life, but still supports the notion that children rely on others (Corriveau et al., 2009; Schlesinger et al., 2016; Schlesinger & Richert, accepted).

In relation to children's trust, a discussion on the measurement of trust in Study 1 is necessary. Trust was revised from a traditional measurement of how much children

trust a particular informant (Schlesinger et al., 2016) to a difference score, with more positive numbers indicating higher trust of the characters who actually solved the problems in the video compared to the primary character of interest (Schlesinger & Richert, accepted). This unusual (although not unprecedented; see Schlesinger & Richert, accepted) variable creation was necessary due to particularly undesirable traits in the main character. Although Grover may reflect the behaviors of a typical 5-year-old who believes he is a superhero, Grover is arrogant, ignores and is inconsiderate of others' suggestions and opinions, and despite his desire to help those in trouble he does not want to collaborate, but rather be a hero. The other characters in the video start off helpless, but display critical thinking and divergent reasoning skills by listening to Grover's suggestions, and transform those suggestions into successful solutions. Therefore, the trust measure reflects children with greater understanding that the *helpless* characters are self-sufficient and good problem solvers, and Grover offers help as the superhero, but is unable to provide any true aid beyond contributing to brainstorming. Overall, young children's reliance on others for learning about their world could explain the Study 1 findings that trust (representing vicarious perceptions) is significantly predictive of self-efficacy. Therefore, children's self-efficacy and self-perceptions may be similarly influenced by vicarious experiences and mastery experiences. Similarly, if the construct of self-efficacy does truly differ during early childhood and adulthood, this leaves the door open for self-efficacy interventions starting during early childhood, when self-efficacy would be equally influenced by vicarious and observational experiences and mastery or personal experiences.

*Measurement.* As described above, based on prior speculations (Bandura, 1997) and research (Britner & Pajares, 2006; Usher & Pajares, 2008), it was hypothesized that the constructs of mastery and vicarious experiences would be significantly related to each other, and they were not. Of greater concern than the lack of conceptual relations are measurement relations; analogical transfer was not significantly related to identification, social realism, personification, or trust. Prior research from where these measurements were adapted had found under specific circumstances these variables are related to each other. Trust has been related to analogical transfer (Schlesinger et al., 2016), social realism and personification collapsed with other variables measuring children's fantasy understanding have been related to analogical transfer (Richert & Schlesinger, in press), and trust and identification have been significantly related within character gender (Schlesinger and Richert, accepted). The lack of replications of prior findings (with the exception of social realism and identification being significantly related; Bond & Calvert, 2014; Schlesinger et al, 2016), could signal the complications and difficulty extrapolating unique variables within a larger vicarious perceptions and parasocial relations construct (Brunick, Putman, McGarry, Richards, & Calvert, 2016; Bond & Calvert, 2014; Richards & Calvert, 2017; Schlesinger & Richert, accepted).

Specifically, there is difficulty creating unique variables to measure concepts falling under the umbrella of larger constructs; for example, although the definitions of identification (e.g., similarity to a model) and social realism (e.g., extent one can interact with a model) are different from each other, both variables fall under the larger construct of parasocial relationships or vicarious perceptions. Under the framework of vicarious

perceptions, the concepts of identification and social realism have a fluid relation; both concepts are used to determine the distance between a child and a character from the perspective of the child (Schlesinger et al., 2016; Wright et al., 1994).

Although the example focused on identification and social realism, the takeaway is that this difficulty in differentiating individual concepts from larger constructs in studying children's learning from media has made it difficult to examine relations of vicarious perceptions with learning outcomes (Brunick et al., 2016; Bond & Calvert, 2014; Richards & Calvert, 2017; Richert & Schlesinger, in press; Schlesinger et al., 2016; Schlesinger & Richert, accepted). That is, Study 1 was unable to replicate prior research, but other researchers have reported similar issues applying their measurements of children's vicarious perceptions to learning outcomes. For Study 1 it was hypothesized there would be relations between analogical transfer and vicarious perception variables because of conceptual reasons (e.g., Bandura, 1997), prior speculations of unexplored contributions to observational learning from characters (Richert, Robb, & Smith, 2011), previous empirical research (Richert & Schlesinger, in press; Schlesinger et al., 2016). However, the lack of significant relations between vicarious and mastery experiences was not surprising, as vicarious perceptions have been inconsistently related to learning outcomes in prior research.

**Observational learning subprocesses**. In contrast to testing Bandura's (1997) self-efficacy conceptual model, the primary analyses in Study 1 were also represented a different way, attempting to test Bandura's observational learning subprocesses model. The observational learning subprocesses model could not be directly tested, as there was

no measure of attention, and measurements of recall, production, and motivational processes were collapsed into the analogical transfer variable. Therefore, the concepts underlying the subprocesses, such as self-efficacy, trust, identification, and social realism were examined as predicting analogical transfer.

A regression tested the extent to which self-efficacy, as an underlying social cognitive process impacted observational learning, or in this case, analogical transfer. The vicarious perception variables (i.e., identification, social realism, and trust) were entered into the regression in the first step as control variables for self-efficacy, and were not significantly predictive of transfer. However, when self-efficacy was entered into the model, social realism was marginally negatively predictive of analogical transfer. Although the analysis was meant to test the effect of self-efficacy on transfer, which was positively predictive, the standout finding stemmed from that social realism variable. Because social realism is only predictive after controlling for self-efficacy, this points to the importance of vicarious perceptions on learning, and the necessity to continue to extract individual variables from larger constructs to examine their individual effect.

The trending impact of social realism is likely pointing to how beliefs that participants can interact with the characters in real life is negatively related to transfer once self-efficacy is parsed out of the analyses. That is, self-efficacy is a stronger influence on learning outcomes than social realism beliefs, and could explain why previous research has revealed inconsistent relations between social realism and transfer (Richert & Schlesinger, in press; Schlesinger et al., 2016). Because social realism only became a notable predictor after self-efficacy was controlled for highlights the

importance of continuing to examine these social cognitive processes, particularly in circumstances in which other variables may be masking the independent impact of, for example, social realism on transfer. Because the influence of social realism could not be explained by the design of Study 1, Study 2 was designed to parse the impact of social realism. Additionally, the potential impact of children's reasoning about fantasy, reality, and similarity on self-efficacy and transfer from moderately fantastical media was examined. Specifically, the video stimuli in Study 1 was mass produced, and integrated impossible and fantastical aspects that prior work has indicated may influence children's learning (Richert & Smith, 2011; Richert & Schlesinger, in press). Study 2 attempted to remedy confounds of fantasy in the videos that could have contributed to the social realism finding from Study 1.

**Summary.**

Overall, Study 1 examined how self-efficacy, mastery experiences, and vicarious perceptions related to each other. Self-efficacy related to each construct, but not every variable in the study. The significant positive relations between self-efficacy and mastery likely reflect children's accurate self-evaluations; children who solved more problems also had greater self-efficacy for their ability to solve problems; therefore reflecting that self-efficacy can be measured during early childhood. Study 1 supported the three primary research goals: (1) self-efficacy was measured, (2) self-efficacy and learning are significantly positively related, (3) and vicarious perceptions are related directly to self-efficacy and indirectly related to learning. The results of Study 1 provided a framework for the experimental manipulation in Study 2.

## Chapter 3: Study 2

The primary motivation for the design of Study 2 was to follow up on an important finding from Study 1, the unexpected relation between social realism and analogical transfer. An explanation for the social realism finding in Study 1 is that it may have stemmed from the moderately fantastical aspects of the video stimuli. Specifically, participants' social realism judgments could have been confounded with the anthropomorphized animals and physical law violations in the video stimuli, due to the nature of social realism evaluations being dependent on the fantastical nature of the learning context (Richert & Schlesinger, in press). The less fantastical a character acts, the more likely children may believe that they can interact with the character in real life, and conversely, the more fantastical traits a characters has the less likely children may believe they can interact with the character in real life (Hawkins, 1977). The stimuli in Study 1 had a moderate mix of realistic principles and educational curriculum, and fantastical aspects and violations of reality. This mixture of anthropomorphized animals, characters who can fly and pull giant items out of their sock, realistic settings, and realistic and accurate scientific principles, may have resulted in children having difficulty distinguishing the realistic scientific curriculum from the fantastical aspects (Fisch, 2000). Because of the social realism result in Study 1, it is possible that stimuli that better differentiates between videos having fantastical aspects and lacking in fantasy in Study 2 will help explain the impact of social realism in Study 1. Specifically, social realism beliefs may be stronger only for participants who watch a low fantasy video, or social realism beliefs may predict transfer, or explain differences in transfer between

children who watch a less or more fantastical video. Therefore, Study 2 sought to further evaluate how children's beliefs in the distance between themselves and the onscreen characters was related to children's learning, character perceptions, and self-efficacy. Study 2 added additional measurements of fantasy, reality, and similarity to the onscreen characters, and experimentally manipulating the amount of fantasy in the video stimuli.

Study 2 had three goals. The first goal was to control for how self-efficacy changes (or is revised) in response to different experiences, and focus on changes in self-efficacy before and after video exposure and transfer. The second goal was to examine the potential impact of fantasy beliefs, realism beliefs, and similarity beliefs on self-efficacy and learning, and differences in self-efficacy and learning by the amount of fantasy in the video stimuli. The second goal attempts to unpack the relations between social realism and learning in Study 1. The third goal was to highlight the potential role of divergent reasoning on children's social cognitive development. Study 2 adapted each measure from Study 1 to be appropriate for a shortened, in-school protocol; therefore, the measures, as described in the Study 2 methods section, are derived from the same sources as the measures in Study 1, but the language used in the particular questions and variable creation differed between Study 1 and Study 2 where noted in the methods section.

Study 2 has three hypotheses. First, it is hypothesized that children will have greater learning (e.g., recall, analogical transfer, analogical connections) in the low fantasy condition, compared to the high fantasy condition, and that fantasy beliefs, realism beliefs, and similarity beliefs will describe the social cognitive processes driving differences in learning outcomes by condition. Second, there will be a significant change

in self-efficacy from pre-video exposure to pre-transfer, and from pre-transfer to post-transfer. It is hypothesized that vicarious perception variables (e.g., expertise, trust, similarity, realism, and fantasy beliefs) will mediate changes between pre-video exposure and pre-transfer, and mastery experiences (e.g., recall, transfer, and analogical connections) will mediate the changes from pre-transfer to post-transfer. Third, self-efficacy variables, vicarious perception variables, and mastery experiences (e.g., recall and analogical connections) will differ by transfer group. This is an exploratory hypothesis; it is hypothesized that these variables will differ by transfer group. Given prior research has highlighted the cognitive benefits to both divergent and convergent reasoning (Lloyd & Howe, 2003), it is only hypothesized that both transfer groups will have higher scores than the low transfer group. Specifically, participants with greater convergent and/or divergent reasoning abilities are hypothesized to be more likely to notice and articulate analogical similarities between video problems and analogical transfer tasks that would lead to differences from the successful transfer groups to the unsuccessful transfer group. Similarly, given that divergent reasoning has been studied in the context of solitary, pretense, and fantasy play (Lloyd & Howe, 2003), there is reason to believe that participants who solve the transfer problem using divergent methods will either have strong fantasy and similarity beliefs to the video characters (e.g., their potential heightened engagement in fantasy play will lead to stronger beliefs they can interact with the character), or conversely, will have more accurate fantasy and similarity beliefs (e.g., their potential heightened engagement in fantasy play will lead to more accurate beliefs about the limits of interacting with on screen characters),

## Methods

### Participants

Data collection occurred in local child development centers; 93 parents consented to their children participating. Of 93 possible, 66 children assented to being interviewed. Six (6) of the 66 assenting participants had substantial missing data that could not be imputed (see results section), and were not considered in the analyses, leaving a final sample of 60. Of all 3- to 6-year-old ($M$ = 4.13, $SD$ = 0.84) children interviewed, the majority were female (62.3% female). Regarding participant race and ethnicity breakdown, parents of almost half of the child participants identified their children as non-White Hispanic or Latino (36.4%) or White Hispanic or Latino (18.2%), 18.2% identified as White, Caucasian, or European American, 15.2% identified as Black or African American, 3% identified as American Indian or Alaska Native, 1.5% identified as Asian or Pacific Islander, and 6% identified as multiracial/ethnic.

More than half of participants (63.3%) attended a county-subsidized child development center, which requires families live at or below the poverty line to attend. The remaining participants attended one of three local private child development centers, daycares, or preschools. Parent letters and consent forms were sent home with parents of all 3- to 6-year-old typically-developing children attending each research site in English and Spanish; only children who had signed parental consent forms were invited to participate, children had to give verbal assent to participate, and children had to be comfortable speaking English to be interviewed. Children did not receive direct

compensation for participation; however, an honorarium of picture books was provided to each research site at the completion of the study.

**Materials**

**Videos.** Participants watched one of two videos of a muppet-style genderless, non-descript species puppet named Squeak creating and using a lever made out of a toy shovel and a lego block to get a yellow star to fly through the air. Squeak orally described the problem as needing to get the star to fly through the air, and Squeak orally described and visually displayed the solution of how to create and appropriately use a lever twice in the 90-second videos. Both videos were identical with two exceptions. In the less fantastical video, Squeak described the star as (a) a toy with the goal of getting the star into the treehouse up high, and (b) the cat on screen meowed and physically reacted when Squeak spoke. In the more fantastical video, Squeak described the star as (a) a real star with the goal of getting the star back into the sky, and (b) the cat wore human clothes and spoke English at the appropriate moments when the cat would meow in the less fantastical video. Participants were randomly assigned to condition.

**Transfer.** To examine analogical transfer from the videos, participants were asked to find a way to get a ball to fly through the air using two of the six items provided. Materials provided were a typically-sized plastic spoon, two-inch circular yellow maze-game turned upside-down, a three-inch long toy magnifying glass that was much smaller, but saliently similar to the spoon, a 1 x ½ x 2-inch plastic blue block, a four-inch long clear stick meant for a hot-glue gun, and a two-inch square red maze-game turned upside-down.

## Measures

**Video and Problem Solution Recall.** Immediately after watching the video, participants were asked to describe what happened in the video. Participants who did not spontaneously describe construction of a lever were prompted to explain how Squeak got the star into the air (Schlesinger et al, 2016). Recall responses were categorized by whether participants correctly (1) verbally explained and/or physically demonstrated how to construct a lever or how a lever works, or incorrectly (0) described a lever, (0) reported irrelevant aspects of the video, or (0) did not respond. Participants who did not recall or comprehend how to construct and use a lever were reminded how to create a lever and the purposes of a lever prior to administering the transfer task. This extra reminder was administered due to the necessity of recalling the *source* problem for successful analogical transfer; without remembering the initial problem, no information can be transferred from the source to the target problem (Richert & Smith, 2011; Schlesinger et al., 2016).

**Transfer.** To measure analogical transfer, participants were asked to find a way to get a ball to fly through the air using two of the objects provided. Children were given three opportunities to solve the problem; participants were prompted a maximum of three times to solve the problem, to provide several opportunities for them to transfer the solution from the video to the analogically-similar real world problem, consistent with prior research (Schlesinger et al., 2016). Participants were coded as having displayed convergent analogical transfer from the video to the novel task if they (a) placed the spoon on top of the blue block, (b) put the ball on top of the bowl of the spoon, and (c)

push down on the other end of the spoon sending the ball up into the air (Schlesinger et al., 2016).

Participants who used other objects, and still successfully created and used the lever, were recorded as having displayed analogical transfer with divergent solutions (Lloyd & Howe, 2003; Trawick-Smith et al., 2011). Divergent coding provided credit for participants who created a lever, but used objects that were less perceptually similar to the objects in the video (Lloyd & Howe, 2003), or for participants who engaged in additional steps to create the lever or used tools that were more difficult to use than those expected in convergent analogical transfer coding (e.g., the magnify glass does not have a bowl so the ball had to be balanced carefully, stacked maze toys slide off each other easily). The divergent category represents participants who may have recognized distant analogical similarities between video objects and problem solving objects that were not recognizable to children who transferred using convergent methods. Participants who did not attempt, or did not successfully create a lever at all were coded as not displaying analogical transfer. Participants were grouped by whether they did not transfer at all, displayed convergent analogical transfer, or displayed divergent analogical transfer.

*Piloting.* Pilot interviews with children from prior research with the same problem solving task indicated children in this age range are unlikely to spontaneously create and appropriately use a lever without exposure to someone modeling creation and use of a lever first (Schlesinger et al., 2016).

*Transfer Coding.* Two trained independent coders coded participants' problem solving attempts using a coding manual to differentiate between participants who used a

convergent analogical solution to create a lever, a divergent analogical solution to create a lever, and did not create a lever. Agreement for codes was relatively high (Cohen's kappa = 0.81), and disagreements were settled by a third coder.

**Analogical connections.** After attempting to solve the transfer problem, participants were asked to make three explicit connections between the video and objects in the transfer problem. Participants received one point for accurately recognizing which item available to solve the transfer problem was like the (a) shovel, (b) block, and (c) star from the video. Participants received credit for making connections to the objects intended for convergent analogical transfer, and the objects participants actually used if they were coded as displaying divergent analogical transfer. Participants could earn up to three points, creating an analogical connections score ranging from 0 to 3, with higher scores indicating greater explicit analogical connections between the video and transfer task (Richert & Schlesinger, in press).

**Self-efficacy.** Participants were asked nine self-efficacy questions, to which they could respond they were/would be really good (2), a little good (1), or not good (0) at completing a specific goal. At three points during the interview (pre-video exposure, post-video/pre-transfer, and post-transfer), participants were asked how good they are at (a) getting a ball to fly through the air (e.g., solving the transfer problem), (b) getting a real star into the sky, and (c) getting a toy star into a treehouse. Children's responses to each unique question were averaged for the three different points during the interview to create three continuous self-efficacy scores ranging from 0 to 2: pre-exposure

(Cronbach's *a* = 0.78), post-exposure / pre-transfer (Cronbach's *a* = 0.83), and post-transfer (Cronbach's *a* = 0.72).

**Character beliefs.** Participants' beliefs about the characters' expertise and trustworthiness for solving problems relevant to the transfer problem were evaluated through measures of expertise and specific trust.

*Character expertise.* Character expertise was evaluated by asking children how good Squeak was at getting a star to fly through the air, immediately following video exposure (Schlesinger, Richert, & Franchak, 2016). Participants could respond really good (2), a little good (1), or not good (0), creating an expertise score ranging from 0 to 2, with higher scores indicating greater expertise beliefs.

*Character trust*. Participants' character trust was evaluated through questions adapted from prior measures of specific trust (Schlesinger et al., 2016; Schlesinger & Richert, accepted). Images of Squeak from the video, the cat from the video, and a rabbit puppet (as a distractor) (e.g., Schlesinger et al., 2016) were placed in front of participants. Participants were asked which character they would ask first if they wanted to learn more about (a) getting a real star from the sky to fly through the air, (b) getting a toy star to fly through the air, (c) getting a ball to fly through the air, and (d) making a lever. The number of times participants chose Squeak first were summed, creating a specific trust score ranging from 0 (no trust) to 4 (high trust), representing children's trust of the character to have relevant information.

**Fantasy, realism, and similarity beliefs.** Measures of participants' beliefs about fantasy, reality, and similarity to the video characters were adapted from prior measures

about fantasy understanding (Richert & Schlesinger, in press), realism understanding (Richert & Schlesinger, in press), and perceptions of similarity to fictional characters (Calvert et al., 2007; Schlesinger et al., 2016; Schlesinger & Richert, accepted; Wright, Huston, Reitz, & Piemyat, 1994) using 15 questions.

*Fantasy beliefs.* Beliefs about fantasy were evaluated through three questions about the video character and two questions about impossible events related to the video (Richert & Schlesinger, in press; Schlesinger et al., 2016). Participants were asked if they could see Squeak at the store, Squeak could go to their school, they could play tag with Squeak, whether a child could touch a real star, and whether a real child could get a real star into the air in real life (Richert & Schlesinger, in press; Schlesinger et al., 2016). Participants received one point for each statement they believed was true, and positive responses were summed creating a fantasy belief score ranging from 0 to 5 (Cronbach's *a* = 0.72); with higher scores representing stronger beliefs that impossible and fantastical events could occur in the real world.

*Realism beliefs.* Beliefs about realistic events and character traits were evaluated through three questions about the video character and two questions about possible events related to the video (Richert & Schlesinger, in press). Participants were asked if Squeak needed to sleep at night, the character ate food, the character got older every year, whether a child could touch a toy star, and whether a real child could get a toy star into the air in real life (Richert & Schlesinger, in press). Participants received one point for each statement they believed was true, and positive responses were summed creating a realism belief score ranging from 0 to 5 (Cronbach's *a* = 0.75); with higher scores

representing stronger beliefs that possible events could occur in the real world and the character had human-like traits.

*Similarity beliefs.* Beliefs about how similar the video events and characters were to the real world were evaluated through two questions about participants' personal similarity to Squeak and three questions about how similar participants believed Squeak was to other people in the real world (Calvert et al., 2007; Schlesinger et al., 2016; Schlesinger & Richert, accepted; Wright et al., 1994). Participants were asked if they were like Squeak and wanted to be like Squeak, if Squeak looked "like kids around here," if Squeak talked "like kids around here," and if Squeak did "stuff like kids around here." Participants received one point for each statement they believed was true, and positive responses were summed, creating a similarity belief score ranging from 0 to 5 (Cronbach's $a = 0.84$); with higher scores representing stronger beliefs that the video characters were similar to the participants and people in the real world.

**Procedure.**

Participants were interviewed in a quiet corner of their classroom by two trained researchers after obtaining child assent. First, participants were shown the ball used in the transfer task and were told, "Later today, I'm going to ask you to find a way to get this ball to fly through the air." After this prompt, children were asked the pre-video exposure self-efficacy questions. Next, participants were shown a video of Squeak and the cat creating and using a lever; viewing was immediately followed by recall questions, character expertise questions, and post-exposure / pre-transfer self-efficacy questions. Then participants had the opportunity to solve the transfer problem. The order of

material placed in front of participants was counterbalanced across participants and conditions. Children who created the lever were recorded as having displayed analogical transfer from the video. Participants were prompted with three explicit attempts to solve the problem; after two unsuccessful attempts, participants were prompted by the researcher to think back to the video and to consider whether the video provides any new or different ideas. Afterwards, participants' analogical connections, specific trust, fantasy beliefs, realism beliefs, and similarity beliefs were evaluated. Finally, participants were asked the post-transfer self-efficacy questions.

## Results

### Overview.

There was a small amount of missing data; 10% of participants had some missing data, and all variables had some missing data. Using SPSS 24, Little's Missing Completely at Random (MCAR) test revealed no systematic patterns of missingness. Data were analyzed with and without missing data, and results followed similar patterns. Therefore, multiple imputation using fully conditional specification (MCMC) was used to impute missing data. Data were only imputed for trust, fantasy, realism, and similarity belief variables; therefore, cases with missing transfer, recall, analogical connections, and self-efficacy were excluded from the remainder of analyses. Forty imputations were conducted, and the pooled data of the 60 participants (after excluding those with missing data that could not be imputed, $n = 6$) was used in all analyses. There were no significant differences between participants in gender, age, research site, or condition who were included in and excluded from final analyses.

Table 4: Study 2 Correlation Matrix

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Age | - | | | | | | | | | |
| 2. Analogical Connections | .266* | - | | | | | | | | |
| 3. Pre-Exposure Self-Efficacy | 0.219† | 0.196 | - | | | | | | | |
| 4. Pre-Transfer Self-Efficacy | .296* | 0.193 | .641*** | - | | | | | | |
| 5. Post-Transfer Self-Efficacy | .259* | 0.048 | .565*** | .516*** | - | | | | | |
| 6. Character Expertise | 0.065 | 0.211 | .623*** | .583*** | .412*** | - | | | | |
| 7. Character Trust | 0.031 | 0.092 | 0.076 | -0.075 | -0.105 | 0.058 | - | | | |
| 8. Fantasy Beliefs | -0.052 | 0.008 | 0.154 | 0.212 | 0.167 | 0.081 | -0.074 | - | | |
| 9. Realism Beliefs | 0.135 | -0.152 | 0.067 | 0.165 | 0.111 | 0.112 | 0.018 | .612** | - | |
| 10. Similarity Beliefs | 0.010 | 0.120 | 0.044 | 0.111 | -0.062 | 0.103 | -0.094 | .439*** | .319** | - |

**Preliminary Analyses.**

**Gender differences.** Independent Samples *t*-tests examined differences between male ($n = 23$) and female participants ($n = 38$). Only character trust significantly differed, $t(59) = 3.09$, $p < 0.01$, Cohen's $d = 0.81$. Girls ($M = 1.79$, $SD = 0.87$) had higher character trust than boys ($M = 1.04$, $SD = 0.98$). Pearson's Chi-Square indicated transfer groups were evenly distributed by gender, $X^2$ (1, N = 60) = 4.44, $p > 0.10$.

**Research site differences.** Because of the socioeconomic differences between children who attended the subsidized ($n = 38$) and private ($n = 22$) preschools, Independent Samples *t*-tests examined differences between children who attended the different schools (see Table 5). Participants from the subsidized preschool were significantly younger than participants from the private schools, $t(59) = 2.11$, $p = 0.04$, Cohen's $d = 0.59$. Participants from the subsidized preschool had significantly lower post-transfer self-efficacy, $t(59) = 2.58$, $p < 0.05$, Cohen's $d = 0.66$, than children from the private schools. To examine the effect of age on research site and post-transfer self-efficacy, an ANCOVA, with post-transfer self-efficacy as the dependent variable, research site as the independent variable, and age as a covariate, indicated a main effect of post-test self-efficacy (same pattern as the *t*-test), and no main effect of, or interaction with age, $F(1, 57) = 4.41$, $p < 0.05$, $\eta^2 = 0.073$. Additionally, there was a trend for children from the subsidized preschool to have higher similarity beliefs than participants in the private schools, $t(59) = 1.76$, $p = 0.084$, Cohen's $d = 0.47$. Pearson's Chi-Square indicated that transfer groups were evenly distributed across research sites, $X^2$ (2, N = 60) = 0.89, $p > 0.10$.

Table 5: Study 2 Means (SD) by research site, and *t*-tests

| | Full sample | Subsidized Preschool | Private Preschool | |
|---|---|---|---|---|
| | Mean (SD) | Mean (SD) | Mean (SD) | *t-test* |
| Age | 4.13 (.84) | 4.07 (.46) | 4.43 (.86) | $t(59) = 2.11$, $p = 0.040$, Cohen's $d = 0.59$ |
| Analogical Connections | 0.80 (.95) | 0.77 (.9) | 0.86 (1.04) | $t(59) = 0.37$, $p = 0.71$, Cohen's $d = 0.09$ |
| Pre-Exposure Self-Efficacy | 1.22 (.70) | 1.11 (.68) | 1.42 (.71) | $t(59) = 1.71$, $p = 0.93$, Cohen's $d = 0.44$ |
| Pre-Transfer Self-Efficacy | 1.31 (.69) | 1.21 (.67) | 1.48 (.7) | $t(59) = 1.50$, $p = 0.14$, Cohen's $d = 0.38$ |
| Post-Transfer Self-Efficacy | 0.96 (.71) | 0.79 (.58) | 1.26 (.83) | $t(59) = 2.58$, $p = 0.013$, Cohen's $d = 0.66$ |
| Character Expertise | 1.33 (.83) | 1.23 (.81) | 1.50 (.86) | $t(59) = 1.22$, $p = 0.23$, Cohen's $d = 0.32$ |
| Character Trust | 1.50 (.98) | 1.49 (1.02) | 1.55 (.91) | $t(59) = 0.22$, $p = 0.83$, Cohen's $d = 0.062$ |
| Fantasy Beliefs | 3.13 (1.34) | 3.10 (1.29) | 3.18 (1.44) | $t(59) = 0.22$, $p = 0.83$, Cohen's $d = 0.67$ |
| Realism Beliefs | 3.49 (1.29) | 3.38 (1.31) | 3.68 (1.25) | $t(59) = 0.87$, $p = 0.39$, Cohen's $d = 0.23$ |
| Similarity Beliefs | 3.05 (1.55) | 3.31 (1.54) | 2.59 (1.5) | $t(59) = 1.76$, $p = 0.084$, Cohen's $d = 0.47$ |

Table 6: Study 2 Means (SD) by condition

| | Full sample | Low Fantasy | High Fantasy | |
|---|---|---|---|---|
| Variable | Mean (SD) | Mean (SD) | Mean (SD) | *t-test* |
| Age | 4.13 (.84) | 4.22 (.58) | 4.03 (1.07) | $t(59) = 0.88, p = 0.38$ |
| Analogical Connections | 0.80 (.95) | 0.85 (.97) | 0.75 (.93) | $t(59) = 0.40, p = 0.67$ |
| Pre-Exposure Self-Efficacy | 1.22 (.70) | 1.18 (.70) | 1.28 (.71) | $t(59) = 0.53, p = 0.60$ |
| Pre-Transfer Self-Efficacy | 1.31 (.69) | 1.29 (.71) | 1.33 (.67) | $t(59) = 0.22, p = 0.82$ |
| Post-Transfer Self-Efficacy | 0.96 (.71) | 0.74 (.63) | 1.24 (.72) | $t(59) = 2.78, p = 0.007$ |
| Character Expertise | 1.33 (.83) | 1.36 (.82) | 1.29 (.85) | $t(59) = 0.36, p = 0.72$ |
| Character Trust | 1.50 (.98) | 1.39 (.90) | 1.64 (1.06) | $t(59) = 0.99, p = 0.33$ |
| Fantasy Beliefs | 3.13 (1.34) | 2.94 (1.46) | 3.36 (1.16) | $t(59) = 1.25, p = 0.23$ |
| Realism Beliefs | 3.49 (1.29) | 3.36 (1.19) | 3.64 (1.39) | $t(59) = 0.83, p = 0.40$ |
| Similarity Beliefs | 3.05 (1.55) | 3.12 (1.58) | 2.96 (1.55) | $t(59) = 0.39, p = 0.70$ |

**Condition differences.** Independent Samples *t*-tests examined differences between participants in the low fantasy condition ($n = 33$) and high fantasy condition ($n = 28$). No variables significantly differed by condition, with the exception of post-transfer self-efficacy, $t(59) = 2.78$, $p < 0.01$, Cohen's $d = 0.74$ (see Table 6). Participants in the low fantasy condition had significantly lower post-transfer self-efficacy than participants in the high fantasy condition. Pearson's Chi-Square indicated that transfer groups were evenly distributed across conditions, $X^2$ (2, N = 60) = 3.10, $p = 0.21$. Pearson's Chi-Square indicated that condition was evenly distributed across research sites, $X^2$ (2, N = 60) < 0.01, $p = 0.96$. Therefore, conditions will be collapsed for the majority of the remaining analyses, except where noted.

**Analogical connections.** On average, participants made one explicit analogical connection between the video and transfer task ($M = 0.80$, $SD = 0.95$). Analogical connections were positively correlated with age, $r = 0.27$, $p < 0.05$; the older children were the more analogical connections they made.

**Self-Efficacy.** Participants had moderate pre-video exposure self-efficacy ($M = 1.22$, $SD = 0.70$), post-video exposure and pre-transfer task self-efficacy ($M = 1.31$, $SD = 0.69$), and post-transfer self-efficacy ($M = 0.96$, $SD = 0.71$). Importantly, participants did not reach ceiling on the self-efficacy measures. Paired Samples *t*-tests revealed post-transfer self-efficacy significantly differed from pre-transfer self-efficacy, $t(59) = 3.94$, $p < 0.001$, Cohen's $d = 0.50$, and pre-video exposure self-efficacy, $t(59) = 3.12$, $p < 0.01$, Cohen's $d = 0.38$; however, pre-video exposure and pre-transfer self-efficacy did not significantly differ from each other, $t(59) = 1.14$, $p > 0.10$, Cohen's $d = 0.05$.

Due to significant differences in post-transfer self-efficacy by condition, a follow up Univariate Analysis of Variance (ANOVA) examined the impact of condition and research site on post-transfer self-efficacy. With post-transfer self-efficacy as the dependent variable, condition and research site as the independent variables, the ANOVA revealed two main effects. There was a significant main effect of condition, $F(1, 56) = 11.24$, $p < 0.001$, $\eta^2 = 0.17$. Reflecting the Independent Samples *t*-test above, participants in the high fantasy condition had significantly greater post-transfer self-efficacy than participants in the low fantasy condition. There was also a main effect of research site, $F(1, 56) = 8.61$, $p = 0.005$, $\eta^2 = 0.13$; again mirroring the Independent Samples *t*-test above, participants from the private child development centers had significantly greater post-transfer self-efficacy than participants from the subsidized child development center. There were no significant interactions between research site and condition, therefore, condition and research site are likely operating independently.

Pre-video exposure, $r = 0.22$, $p = .093$, pre-transfer, $r = 0.30$, $p = .021$, and post-transfer self-efficacy, $r = 0.26$, $p = .046$, were positively correlated with age, and each other. Similarly, pre-video exposure, $r = 0.62$, $p < .001$, pre-transfer, $r = 0.58$, $p < .001$, and post-transfer self-efficacy, $r = 0.41$, $p < .001$, were positively correlated with character expertise. The greater participants' self-efficacy, the stronger their beliefs that Squeak was an expert in solving the video problem.

**Character beliefs.** Participants had moderate expertise beliefs ($M = 1.33$, $SD = 0.83$); that is, children believed the character from the video was a little good at or had some expertise for solving the video problem. In contrast, participants had low character

trust ($M$ = 1.50, $SD$ = 0.98), in that they indicated they would only go to the character 1½ out of every 4 opportunities to ask the character for help solving relevant problems. Character expertise was only significantly correlated with self-efficacy variables (see Table 4), and character trust was not significantly related to any variables.

**Fantasy, realism, and similarity beliefs.** Overall, children had moderate belief in fantastical occurrences ($M$ = 3.13, $SD$ = 1.34), relatively high beliefs in realistic occurrences ($M$ = 3.49, $SD$ = 1.29), and moderate similarity beliefs that Squeak was like them and people in the real world ($M$ = 3.05, $SD$ = 1.55). All three variables were positively correlated with each other (see Table 4). Children had significantly greater realism beliefs than fantasy beliefs, $t(59) = 2.44$, $p < 0.05$, Cohen's $d = 0.31$; that is, children were significantly more likely to believe that realistic and possible events and character traits could occur in the real world than fantastical and impossible events.

**Recall and Analogical Transfer.** Just over half of participants (58.3%) accurately recalled or described the construction of a lever, and just over half of participants (57.4%) successfully transferred the analogical solutions from the video to the novel problem. Breaking down the transfer groups further, 39.4% of participants successfully created a lever and using convergent methods, and 18.0% of participants successfully created a lever using divergent methods. The following analyses examine differences between participants who (a) recalled and did not recall the lever from the video, and (b) transferred using convergent solutions, transferred using divergent solutions, and did not transfer. All recall analyses were examined using Independent Samples $t$-tests with recall as the independent variable, and the variable of interest as the

dependent variable. All transfer analyses were examined using One-Way Analyses of Variance (ANOVA) with transfer groups as the independent variable and the variable of interest as the dependent variable; repeated planned contrasts indicate if the transfer groups differed from each other.

Table 7: Study 2 Means (SD) by recall group, and *t*-tests

| | Full sample | Recalled | Did not recall | |
|---|---|---|---|---|
| | Mean (SD) | Mean (SD) | Mean (SD) | *t-test* |
| Age | 4.13 (.84) | 4.29 (.77) | 4.06 (.42) | $t(59) = 1.36$, $p = 0.18$, Cohen's $d = 0.37$ |
| Analogical Connections | 0.80 (.95) | 1.11 (1.02) | 0.40 (.65) | $t(59) = 3.08$, $p = 0.003$, Cohen's $d = 0.83$ |
| Pre-Exposure Self-Efficacy | 1.22 (.70) | 1.32 (.63) | 1.09 (.76) | $t(59) = 1.31$, $p = 0.20$, Cohen's $d = 0.33$ |
| Pre-Transfer Self-Efficacy | 1.31 (.69) | 1.41 (.62) | 1.17 (.77) | $t(59) = 1.32$, $p = 0.19$, Cohen's $d = 0.34$ |
| Post-Transfer Self-Efficacy | 0.96 (.71) | 1.09 (.65) | 0.77 (.76) | $t(59) = 1.76$, $p = 0.18$, Cohen's $d = 0.45$ |
| Character Expertise | 1.33 (.83) | 1.51 (.70) | 1.04 (.93) | $t(59) = 2.25$, $p = 0.028$, Cohen's $d = 0.32$ |
| Character Trust | 1.50 (.98) | 1.77 (1.06) | 1.12 (.73) | $t(59) = 2.66$, $p = 0.01$, Cohen's $d = 0.71$ |
| Fantasy Beliefs | 3.13 (1.34) | 3.03 (1.42) | 3.32 (1.22) | $t(59) = 0.83$, $p = 0.41$, Cohen's $d = 0.22$ |
| Realism Beliefs | 3.49 (1.29) | 3.51 (1.44) | 3.48 (1.08) | $t(59) = 0.10$, $p = 0.92$, Cohen's $d = 0.02$ |
| Similarity Beliefs | 3.05 (1.55) | 3.03 (1.67) | 3.08 (1.44) | $t(59) = 0.12$, $p = 0.90$, Cohen's $d = 0.032$ |

***Age***. Child age did not differ by recall, $t(59) = 1.36$, $p > 0.10$, Cohen's $d = 0.37$, or transfer group, $F(2, 57) = 0.62$, $p > 0.10$, $\eta^2 = 0.021$.

***Analogical connections***. Analogical connections significantly differed by recall, $t(59) = 3.08$, $p < 0.01$, Cohen's $d = 0.83$ (see Table 7). Participants who accurately recalled video details made significantly greater explicit analogical connections between the video and transfer tasks than children who did not recall. Analogical connections did not significantly differ by transfer group, $F(2, 57) = 1.57$, $p > 0.10$, $\eta^2 = 0.052$.

***Self-efficacy***. Pre-video self-efficacy did not significantly differ by recall, $t(59) = 1.31$, $p = 0.20$, Cohen's $d = 0.33$, or transfer group, $F(2, 57) = 2.43$, $p > 0.10$, $\eta^2 = 0.078$, and pre-transfer self-efficacy did not significantly differ by recall, $t(59) = 1.32$, $p = 0.19$, Cohen's $d = 0.34$, or transfer group, $F(2, 57) = 1.92$, $p > 0.10$, $\eta^2 = 0.063$.

Post-transfer self-efficacy did not significantly differ by recall, $t(59) = 1.76$, $p = 0.18$, Cohen's $d = 0.45$. In contrast, post-transfer self-efficacy did significantly differ by transfer group, $F(2, 57) = 3.15$, $p = 0.05$, $\eta^2 = 0.10$. Repeated planned contrasts indicated a significant effect between the divergent group and other groups. Post-transfer self-efficacy was higher in the divergent group than the convergent group, $t(57) = 2.09$, $p < 0.05$, Cohen's $d = 0.55$, and no transfer group, $t(57) = 2.45$, $p < 0.05$, Cohen's $d = 0.65$. There was no significant difference between the convergent and no transfer groups, $t(57) = 0.40$, $p > 0.10$, Cohen's $d = 0.11$. There was a trending effect between both successful transfer groups and the no transfer group, $t(57) = 1.85$, $p < 0.10$, Cohen's $d = 0.60$; the successful transfer groups had higher self-efficacy than the unsuccessful transfer group.

Table 8: Study 2 Means (SD) by transfer group, and *F*-tests

| | Full sample | Divergent Transfer | Convergent Transfer | Did not transfer | |
|---|---|---|---|---|---|
| | Mean (SD) | Mean (SD) | Mean (SD) | Mean (SD) | One-Way ANOVA |
| Age | 4.20 (.65) | 4.21 (.83) | 4.31 (.73) | 4.10 (.49) | $F(2, 57) = 0.62, p = 0.54, \eta^2 = 0.021$ |
| Analogical Connections | 0.82 (.95) | 0.91 (.83) | 1.04 (1.15) | 0.58 (.76) | $F(2, 57) = 1.57, p = 0.22, \eta^2 = 0.052$ |
| Pre-Exposure Self-Efficacy | 1.22 (.70) | 1.45 (.48) | 1.01 (.76) | 1.36 (.67) | $F(2, 57) = 2.43, p = 0.10, \eta^2 = 0.078$ |
| Pre-Transfer Self-Efficacy | 1.31 (.69) | 1.48 (.54) | 1.12 (.79) | 1.45 (.59) | $F(2, 57) = 1.92, p = 0.16, \eta^2 = 0.063$ |
| Post-Transfer Self-Efficacy | 0.96 (.71) | 1.42 (.51) | 0.82 (.74) | 0.90 (.68) | $F(2, 57) = 3.15, p = 0.05, \eta^2 = 0.10$ |
| Character Expertise | 1.32 (.83) | 1.36 (.81) | 1.61 (.66) | 1.04 (.92) | $F(2, 57) = 3.08, p = 0.060, \eta^2 = 0.98$ |
| Character Trust | 1.50 (.98) | 0.82 (.98) | 1.87 (.76) | 1.46 (1.03) | $F(2, 57) = 4.85, p = 0.010, \eta^2 = 0.15$ |
| Fantasy Beliefs | 3.15 (1.34) | 3.09 (1.51) | 3.52 (1.12) | 2.85 (1.41) | $F(2, 57) = 1.60, p = 0.21, \eta^2 = 0.053$ |
| Realism Beliefs | 3.50 (1.30) | 3.45 (1.63) | 3.78 (1.00) | 3.27 (1.37) | $F(2, 57) = 0.97, p = 0.39, \eta^2 = 0.033$ |
| Similarity Beliefs | 3.05 (1.57) | 3.00 (1.61) | 3.65 (1.50) | 2.54 (1.48) | $F(2, 57) = 3.33, p = 0.040, \eta^2 = 0.11$ |

***Character beliefs***. Character expertise, $t(59) = 2.25$, $p < 0.05$, Cohen's $d = 0.32$, and character trust, $t(59) = 2.66$, $p < 0.01$, Cohen's $d = 0.71$, significantly differed by recall score (see Table 7). Participants who recalled the lever from the video had greater character expertise and character trust scores than children who did not recall.

Character expertise significantly differed by transfer group, $F(2, 57) = 3.08$, $p < 0.10$, $\eta^2 = 0.98$ (see Table 8). Repeated planned contrasts indicated a significant effect between the convergent group and no transfer group, $t(57) = 2.74$, $p < 0.05$, Cohen's $d = 0.72$, but not between the divergent and convergent groups, $t(57) = 0.83$, $p > 0.10$, Cohen's $d = 0.22$, or the divergent and no transfer groups, $t(57) = 1.12$, $p > 0.10$, Cohen's $d = 0.29$. However, both successful transfer groups had significantly higher character expertise ratings than the no transfer group, $t(57) = 2.01$, $p < 0.05$, Cohen's $d = 0.53$.

Character trust significantly differed by transfer group, $F(2, 57) = 4.85$, $p = 0.010$, $\eta^2 = 0.15$ (see Table 8). Repeated planned contrasts indicated a significant effect between the divergent group and other groups. Character trust was significantly lower in the divergent group than the convergent group, $t(57) = 3.10$, $p = 0.01$, Cohen's $d = 0.82$, and there was a trend for character trust to be lower in the divergent group than the no transfer group, $t(57) = 1.94$, $p < 0.10$, Cohen's $d = 0.51$. There was no difference in character trust between the convergent and no transfer groups, $t(57) = 1.54$, $p > 0.10$, Cohen's $d = 0.41$; there was no significant difference between the both successful transfer groups and the no transfer group, $t(57) = 0.47$, $p > 0.10$, Cohen's $d = 0.12$.

***Fantasy, realism, and similarity beliefs.*** Fantasy beliefs, $t(59) = 0.83$, $p > 0.10$, Cohen's $d = 0.22$, realism beliefs, $t(59) = 0.10$, $p > 0.10$, Cohen's $d = 0.02$, and similarity

beliefs, $t(59) = 0.12$, $p > 0.10$, Cohen's $d = 0.032$, did not significantly differ by recall group. Additionally, fantasy beliefs, $F(2, 57) = 1.60$, $p > 0.10$, $\eta^2 = 0.053$, and realism beliefs, $F(2, 57) = 0.97$, $p > 0.10$, $\eta^2 = 0.033$, did not differ by transfer group.

In contrast, similarity beliefs significantly differed by transfer group, $F(2, 57) = 3.33$, $p < 0.05$, $\eta^2 = 0.11$ (see Table 8). Repeated planned contrasts indicated a significant effect between the convergent group and no transfer group, $t(57) = 2.58$, $p < 0.05$, Cohen's $d = 0.68$, but not between the divergent and convergent groups, $t(57) = 1.18$, $p > 0.10$, Cohen's $d = 0.31$, or the divergent and no transfer groups, $t(57) = 0.85$, $p > 0.10$, Cohen's $d = 0.23$. There was a trending effect between both successful transfer groups and the no transfer group, $t(57) = 1.95$, $p < 0.10$, Cohen's $d = 0.45$; the successful transfer groups had higher similarity beliefs than the unsuccessful transfer group.

**Mediation**.

Regression analyses examined the hypothesis that transfer, condition, research site, or character expertise mediated the relations between pre- and post-transfer self-efficacy, which would explain the significant decrease from pre- to post-transfer self-efficacy. There was no evidence for mediation due to any of these variables.

## Study 2 Discussion

Study 2 had three hypotheses. The first hypothesis involved condition differences and was not supported. It was hypothesized that learning outcomes would be greater for the low fantasy sample and participants' fantasy, realism, and similarity beliefs would explain the differences (e.g., Richert & Schlesinger, in press; Richert & Smith, 2011); however, there were no differences in learning outcomes or vicarious perceptions by

condition. The second hypothesis speculated significant changes in self-efficacy from pre-video exposure to pre-transfer, and from pre-transfer to post-transfer, which would be significantly mediated by vicarious perception and learning outcome variables; this was not supported. There was no significant change from pre-video exposure to pre-transfer, and although there was a significant decrease in self-efficacy from pre-transfer to post-transfer, this was not mediated by any variable. The third hypothesis, that self-efficacy variables, vicarious perception variables, and learning outcomes would differ by transfer group, was partially supported. Post-transfer self-efficacy, trust, expertise, and similarity differed between the three transfer groups.

Overall this study provided evidence that certain social cognitive processes differ by children's convergent, divergent, or unsuccessful analogical transfer, and that self-efficacy can be manipulated during early childhood after a short experience.

**Conditions**

In Study 2, participants watched one of two videos containing the same characters, narrative, problem, and solution. The videos differed by the amount of fantasy, particularly whether the secondary character acted like a real cat, or was anthropomorphized, wearing clothes, and speaking. Children's beliefs that they could interact with the characters, that the fantastical aspects of the videos could happen in real life, that the characters had biologically human needs, that the realistic aspects of the videos could happen in real life, and that they were similar to the characters did not differ by condition. This was a primary hypothesis of Study 2: there would be differences between conditions for the variables in Study 2 evaluating children's social realism and

personification collapsed with children's understanding of what is an is not possible in the real world (Richer & Schlesinger, in press). This hypothesis stems from Study 1; the unexpected relations between social realism and learning in Study 1 (after controlling for self-efficacy) may have been due to the moderately fantastical nature of the Study 1 video stimuli. The moderate mix of fantastical elements and realistic principles in Study 1 may have contributed to participants' having difficulty transferring from the video because the fantastical aspects distracted from the curriculum (Fisch, 2000; Richert & Schlesinger, in press). Social realism becoming a significant predictor of learning in Study 1 only after controlling for other variables may have been signaling the importance of vicarious perceptions, therefore, Study 2 sought to unpack this complication by providing children with video stimuli that controlled the amount of fantasy. It was expected that if vicarious perceptions contributed to children's learning, these perceptions would have different relations with learning outcomes depending on how much fantasy is present in the videos.

Importantly, social realism was collapsed with understanding of impossible actions and personification was collapsed with understanding of possible events to create richer variables that were more reflective of children's social cognitive reasoning about fantasy, rather than variables only reflective of the primary character in the videos (Richer & Schlesinger, in press). The measure of similarity collapsed the Study 1 measure of identification with other questions about children's beliefs in the characters' similarity to themselves and people in the real world (Wright et al., 2001). These three variables supplied measurements of the distance between the character and the participant from the child's perspective. Given that there was fantasy in the videos, it was surprising

that fantasy, realism, and similarity were not significantly related to self-efficacy, and neither fantasy nor realism beliefs differed by transfer group. The transfer group differences by similarity beliefs may be due to similarity beliefs being conceptually associated with perceptions of expertise and trust of the video character, rather than children's perspectives of the distance between the video world and the real world.

The truly unexpected finding was that there were only condition differences for one variable: post-transfer self-efficacy. Children in the low fantasy condition had significantly lower post-transfer self-efficacy. Speculations for this result will be discussed in the following section.

**Self-efficacy**

Self-efficacy for Study 2 resulted in three unique variables. Each variable captured children's self-efficacy during a unique time in the study: prior to any video exposure or problem solving experience, post-video exposure and pre-transfer task, and post-transfer task. These three variables revealed a unique pattern: post-transfer self-efficacy was significantly lower than pre-video or pre-transfer self-efficacy. Due to differences only from post-transfer self-efficacy, a post hoc hypothesis was that self-efficacy was mediated by transfer group. However, a mediation analysis examining transfer groups (e.g., convergent, divergent, or no transfer) indicated transfer was not a significant mediator of the change from pre- to post-transfer self-efficacy. That is, mastery experience did not significantly mediate changes in self-efficacy from before and after an attempt at the mastery experience opportunity. Likely the transformation of the self-efficacy questions from abstract mental representations to concrete evaluations after

attempting to solve the transfer problem contributed to the decline in post-transfer self-efficacy (Bandura, 1997). Although the prior speculation of attempting to accomplish the goal might spur changes in self-efficacy, other individual differences may be driving the differences, particularly, socioeconomic status (Bandura et al., 2001).

**Research Site.** Although socioeconomic status data was not collected in Study 2, participants were interviewed in either a subsidized county-run child development center, in which families must live at or below the poverty line to enroll their children, or a private child development center in which parents pay full tuition for childcare. With the exception of age, only post-transfer self-efficacy significantly differed by research site; children in the subsidized school had significantly lower post-transfer self-efficacy than their peers attending a private school. The ANOVA analysis revealed that both research site and condition were operating independently of each other. Additionally, post hoc tests revealed only children in the low fantasy condition or in the subsidized preschool had significant decreases in self-efficacy from pre- to post-transfer.

There are two possible explanations for the decrease in self-efficacy from pre- to post-transfer. First, it is possible there is a greater effect of condition that was not observed from 60 participants. That is, maybe the low fantasy condition (in which the cat acts like a real cat) is similar enough to the real world that the content of the video is influencing self-efficacy. Children in the low fantasy condition may have been anticipating the transfer task to be simpler than it actually was, because the character in the video solved the analogically-similar problem so easily. Therefore, because they had a heightened expectation that the transfer task would be simpler than it was in reality,

their post-transfer self-efficacy significantly decreased after attempting to solve the transfer task. This explanation is consistent with self-efficacy decreasing after a negative or unsuccessful [mastery] experience attempting to accomplish a goal (Bandura, 1997; Usher & Pajares, 2008; Usher & Pajares, 2009). However, there are limitations to this explanation. Transfer group (e.g., successful vs unsuccessful mastery experience) did not mediate the decrease in self-efficacy from pre- to post-transfer. If this decrease in pre- to post-transfer self-efficacy was due to children in the low fantasy group expecting the transfer problem to be simpler than it was in reality, likely transfer would have mediated the decrease. Similarly, there were no differences in analogical connections by condition or transfer group. If participants in the low fantasy group expected the transfer problem to be simpler than it was in reality, they also likely would have made a stronger connection between the video and transfer task, and therefore had significantly higher analogical connections scores than participants in the high fantasy group. Overall, although the Independent Sample's *t*-test examining differences between self-efficacy by condition had a fairly large effect size, it is possible an effect of fantasy, realism, and similarity differing by condition or mediating differences between pre- and post-transfer self-efficacy would have been detected with a larger sample.

Second, and more likely, these changes are being driven by individual differences due to socioeconomic status that were not explicitly measured in Study 2, resulting in differences between research sites being due to heightened test or performance anxiety (Osborne, 2001; Steele, 1992; 1997). This is important to consider for two reasons, a) performance anxiety due to the stereotype threat overwhelming impacts People of Color,

and 80% of the participants from the low income research site were African American, Latino, biracial, or multiethnic, b) the stereotype threat is more likely to impact low income children than more advantaged children (Désert, Préaux, & Jund, 2009; Osborne, 2001). As an aspect of the stereotype threat (i.e., recognition of risk to adhere to negative stereotypes cueing negative performance; Steele, 1992; Steele, 1997), anxiety manifests itself as the result of heightened concern that members of minority groups will adhere or conform to negative stereotypes, this heightened anxiety decreases performance (Osborne, 2001). Research with adolescents has found anxiety about performance on standardized tests account for a significant contribution of performance differences between students of different races (Osborne, 2001). Specifically, even after controlling for test preparedness, anxiety explained a significant proportion of performance differences between white students, and African American and Latino students (Osborne, 2001). Additionally, research comparing performance on Raven's matrices between low- and middle-income 6- to 9-year-old children noted lower performance by the low-income sample, higher stereotype endorsement by the low-income sample, and an interaction of stereotype endorsement and lower performance when participants were primed to believe the test was evaluative compared with non-evaluative (Désert et al., 2009). Therefore, particularly relevant for children in the low-income research site in Study 2 is test anxiety and the stereotype threat. Although Chi Square tests indicated transfer groups were evenly distributed by research site, and therefore it cannot be argued that anxiety and impacted analogical transfer performance in Study 2, anxiety could be explaining post-transfer self-efficacy differences between research sites. Specifically, children in the low

income research site may have been more willing to change their answers about their self-efficacy (e.g., changing answers is a measure of anxiety; Osborne, 2001) due to heightened concern that their initial answer was wrong or that they did not perform well, likely resulting from anxiety or stereotype threats generally, which are more highly associated with the demographic makeup of the low income research site in Study 2.

Related, this anxiety could have spurred from parents of children in subsidized preschool, or the school environment, by potentially reflecting a transmission effect from parents to children: parents may have lower self-efficacy and heightened test anxiety, and therefore, they have taught their young children to have low self-efficacy and heightened test anxiety as well. This could also be an aspect of the shared school environment. Potentially, the impact of teachers' expectations of the children's lower achievement and peers' self-concepts contributes to individual students at the lower income school having lower self-efficacy (Bandura, 1977; 1986; 1997; Rosenthal, 1994).

Interestingly, if the decrease from pre- to post-transfer self-efficacy was due to an environmental transmission of lower self-efficacy for people in lower socioeconomic communities than this would actually reflect children's more highly developed self-perceptions. However, if the lower post-transfer self-efficacy for children in the low income group was solely based on environment, than there would likely be pre-transfer self-efficacy differences by research as well. Therefore, this is likely not simply due to one transmission factor, but an interaction of environment and development. There may have not been any significant differences for pre-video exposure and pre-transfer self-efficacy by research site, because self-efficacy may only decrease after an immediate

exposure to a mastery experience opportunity (Bandura, 1977; 1997). Potentially, both pre-video exposure and pre-transfer self-efficacy in Study 2 represented a more global measure or baseline measure of self-efficacy. However, after the attempt to solve the transfer problem, participants had an experience that could change their self-efficacy, resulting in lower post-transfer self-efficacy. It may be that for children in the low-income group, the mastery experience was enough to trigger a decrease in self-efficacy, whereas participants in the higher income group are not as high risk for decreases (Osborne, 2001). It may be more difficult for mastery experiences to change self-efficacy for participants who are not high risk for low self-efficacy, and in contrast it may be easier to change self-efficacy for children who are high risk for low self-efficacy (Gillen-O'Neel et al., 2011). This differences in post-transfer self-efficacy by research site is likely representing the triadic reciprocal relations of personal factors, behavioral factors, and environmental factors on development (Bandura, 1977; 1986; 1997).

Although socioeconomic status (and the environmental influences of socioeconomic status) could have contributed to lower post-transfer self-efficacy for the low income group, the most likely explanation is an interaction of the physical attempt to accomplish a goal and environment contributing to self-efficacy reevaluations. Which highlights the importance of studying self-efficacy during early childhood with diverse groups. The importance of participants' experience attempting to solve the transfer problem, whether successful or not, cannot be ignored. Pre-transfer self-efficacy questions were based on an abstract representation, and at post-transfer children already had the physical experience of attempting to solve the problem. It was hypothesized that

transfer group, or any other variable that self-efficacy differed by, would explain or mediate this change, but since there was no evidence of a measured variable explaining the decrease in scores, the change may be dependent on experience transforming an abstract concept to a physical experience than a measurable variable. Self-efficacy may decrease after physical experience attempting to achieve a goal (either successfully or unsuccessfully) that was previously an abstract concept, and not as strongly influenced by watching a model successfully achieve an analogically-similar goal (e.g., vicarious experiences watching the video). This would indicate mastery experiences are a primary contribution to self-efficacy during early childhood; particularly because engagement in mastery experiences was the primary activity in between the pre- and post-transfer evaluations of self-efficacy. Significant self-efficacy changes resulting from more mastery experiences is consistent with prior research on children's self-concept development (Valeski & Stipek, 2001) and self-efficacy development (Wilson & Trainin, 2007). Research has indicated kindergarteners and first graders can differentiate their self-efficacy and self-concept between different domains, and have lower and more accurate self-efficacy for domains in which they have more actual experience. Wilson and Trainin (2007) argued children's ability to differentiate between domains was due to social feedback, with more experience in a particular domain the more accurate self-efficacy becomes; reflected in the current study in children's abstract beliefs about their abilities to solve a problem differing after the actual experience. Therefore, the simple act of transforming the abstract mental representation into a physical example may have driven the change.

## Divergent and Convergent Reasoning

Study 2 revealed another important aspect of children's problem solving and learning, the convergent and divergent ways in which they solve problems. Analogical transfer was coded by whether participants displayed convergent analogical transfer (e.g., convergent problem solving, choosing objects closely similar to the video objects), solved using divergent means (e.g., choosing objects saliently differ from the video objects and creating a lever, or using more complicated methods to create a lever), or did not display analogical transfer at all and did not solve the problem.

**Divergent Reasoning.** Little, if any research, has focused on divergent problem solving in analogical transfer. Although, Calvert et al. (2007) indicated children's divergent reasoning, or the number of unique uses they could describe for an object, was positively related to similarity perceptions with a media character using the object in a video clip, using a measure adapted from Calvert et al. (2007) in Study 1 was unrelated to identification, or any other variable. The lack of literature on divergent and convergent problem solving is surprising, given that evaluations of young children's divergent reasoning during play has focused on the transformation of common objects for unexpected purposes (Trawick-Smith et al., 2011), and relating to more advanced cognitive processing, making evaluations of children's unexpected uses for intended objects or expected uses for unintended objects beneficial for studying analogical transfer (Lloyd & Howe, 2003). By accounting for situations in Study 2 in which children used distractor objects to create a lever, or target objects in an unexpected way, there was

room for examining how children who engaged in divergent analogical transfer differed from children who engaged in convergent analogical transfer.

**Experience.** Children who used divergent means to solve the transfer problem may have more experience engaging in divergent reasoning. There are two explanations to support the experience argument. Children's previous experiences using objects in divergent ways may have contributed to their behavior to try less saliently-similar objects to achieve the same goal as children who used convergent means. For example, participants could have recognized that the convergent objects would achieve the goal without needing to make a physical attempt, therefore, they were more interested to test whether the other objects could achieve the same goal as the convergent objects. Given that there were no significant differences in the number of explicit analogical connections between children who used divergent and convergent methods, this is a likely situation.

Although participants who used divergent solutions were given credit if they made an analogical connection between the video items and the objects they used and video objects and the convergent objects, no participants actually listed the divergent items they used in connection with the video objects. Providing credit for making abstract connections between divergent objects and video objects should have resulted in the divergent group having have higher explicit analogical connection scores than the convergent group, because although the explicit analogical connection score range was constrained, participants in the divergent group had additional opportunities to earn points compared to the convergent and no transfer groups. Therefore, the fact that analogical connections do not differ by group supports that children in the divergent

group did recognize similarities between convergent objects and video objects, but chose divergent objects to solve the problem instead.

Alternatively, participants who used divergent methods may have noticed analogical similarities between the unexpected objects they chose and the video objects that were not noticed by participants who used the convergent solution. That is, rather than intentionally choose random objects because they knew the convergent objects would work, they chose specific objects that they recognized to be analogically similar to the video objects. Although, if children chose the divergent objects because they noticed analogical connections with the video objects, than their explicit analogical connection scores should be higher than the other groups, or at least include explicit connections between the divergent objects and video objects. Since the explicit analogical connection scores did not differ by group, the prior explanation is more likely. Future research should parse out these possibilities with additional measures of divergent and convergent reasoning, and more naturalistic observations of pretense and solitary play.

**Vicarious and Mastery Perceptions.** Rather than experience with divergent reasoning driving differences between convergent and divergent groups, children who used divergent means may be less reliant on others (e.g., greater self-perceptions or mastery experience perceptions), and children who used convergent means are more reliant on others (e.g., greater vicarious perceptions and lower self-perceptions). This postulation stems from the differences between vicarious perceptions and self-perceptions between the transfer groups.

Grouping participants by whether they transferred through convergent means, divergently, or not at all revealed important differences between groups. Post-transfer self-efficacy was greater for participants who used divergent solutions, compared with the other groups, and character trust was lower for children who used divergent solutions as well. In contrast, character expertise and similarity beliefs were significantly greater for children who transferred using convergent means, compared to participants who did not successfully transfer; neither differed from the divergent transfer group. Because of the significantly greater post-transfer self-efficacy scores for the divergent group, a discussion about transfer group differences with post-transfer self-efficacy is warranted.

The reason that the divergent transfer group had higher post-transfer self-efficacy may be revealed in comparison to the three other variables that significantly differed by transfer group: character expertise, character trust, and similarity beliefs. There was an overall pattern for children who used the convergent analogical solution to have significantly higher character expertise, character trust, and similarity beliefs than participants in the divergent group. These vicarious perception variables may be indicating children in the convergent group's reliance on, and high expectations for the video character to provide useful and reliable information for solving the transfer problem. In contrast, children in the divergent group had very low character expertise, character trust, and similarity beliefs, and did not rely on or expect useful information from the character to solve the transfer problem. There are two potential ways to discuss this process, within social cognitive theory, and demographic factors.

*Social Cognitive Theory.* Reflective of the observational learning subprocesses in social cognitive theory, greater compared with less dependence on the model may transform observed behaviors differently (Bandura, 1997; 2006). That is, the process of observing, symbolically storing, and engaging in a transformed manifestation of the observed behavior is influenced by belief about the model or vicarious perceptions. More positive vicarious perceptions (e.g., high trust, experience, and similarity) may contribute to mimicry-style (or direct copy) replication of an observed behavior, compared with less positive vicarious perceptions (e.g., low trust, experience, and similarity) may contribute to more divergent and transformative replication of an observed behavior. To expand, the more highly regarded one believes the model to be, the more likely they are to act in a convergent fashion, and directly copy the behavior, making as little change or adaption as possible (e.g., if the model is an expert, why deviate?). In contrast, with less positive perceptions of the model, learning will still occur, but the observer will transform the behavior to reflect personal experiences and to be more adaptive to the environmental needs (e.g., I know better than the model, I will do it this way). Overall, this perspective describes differences between children in the divergent and convergent groups by their vicarious perceptions filtering the observational learning subprocesses (Bandura, 1997).

*Demographic factors*. Divergent reasoning may have been a buffer against decreased self-efficacy from pre- to post-transfer. It is unlikely the process of engaging in divergent problem solving was a direct influence on self-efficacy; if it were, transfer group likely would have mediated the decrease from pre-transfer to post-transfer self-efficacy, and condition and research site would not have independently contributed to the

decrease in scores from pre- to post-transfer self-efficacy. However, it is possible there is an interaction between divergent transfer and research site that was not detected due to power issues.

As divergent reasoning is linked to advanced cognitive development (Lloyd & Howe, 2003; Trawick-Smith et al., 2011), and higher parental education and socioeconomic status similarly related to more advanced cognitive development (Bandura et al., 2001), an interaction of socioeconomic status and divergent reasoning may explain higher post-transfer self-efficacy. The action of engaging in divergent analogical transfer may not have been an explicit buffer preventing the decrease in self-efficacy from pre- to post-transfer found in the other groups, but rather there may be a dynamic effect. If divergent reasoning and strong self-efficacy both stem from advanced cognitive development, self-efficacy contributes to greater motivation and perseverance resulting in more divergent engagement, and divergent behaviors lead to greater reasoning abilities and therefore greater self-efficacy, this would explain the buffering effect in Study 2. Although the results examining relations between research site and transfer group did not indicate any significant interactions of research site (i.e., socioeconomic status) and transfer group, the simplest explanation is that demographic factors, particularly experiences associated with higher socioeconomic status, are contributing to greater reasoning abilities, including problem solving and accurate self-efficacy judgments.

**Summary.** Overall, Study 2 examined changes in self-efficacy over time, and differences between convergent and divergent problem solving. There was a significant

decrease in self-efficacy from pre- to post-transfer, and although there was no statistical explanation, this was likely due to an unmeasured interaction with divergent problem solving. Participants who engaged in divergent problem solving had significantly greater post-transfer self-efficacy, and significantly lower vicarious perceptions compared with participants who used convergent solutions; which is likely reflective of how self and model perceptions influence the observational learning subprocesses. Study 2 supported the three primary research goals: (1) self-efficacy changed from pre- to post-transfer, (2) post-transfer self-efficacy significantly differed by learning outcome (e.g., divergent, convergent, or no analogical transfer, and (3) self-efficacy and vicarious beliefs significantly differed by learning outcome group.

# Chapter 4: Discussion

There were three primary research goals of this dissertation: (1) establish that self-efficacy can be measured during early childhood, (2) explore whether self-efficacy and learning are significantly related during early childhood, and (3) examine how aspects of the model relate to self-efficacy and learning from the model. Each goal was accomplished through two studies. Study 1 was a correlational study, exploring relations between self-efficacy (a measure developed for this dissertation), model perceptions, and learning. The primary findings from the correlational study indicated that self-efficacy and learning are positively related; the more children greater children's self-efficacy, the more they are displaying their learning. Therefore, children have fairly accurate self-evaluations of their own abilities. The second study focused on a more micro-style analysis of self-efficacy changing over time, divergent and convergent problem solving styles, and unpacking unexpected vicarious perceptions results found in Study 1.

## Antecedents and changes of self-efficacy

The correlational results in Study 1 allowed for an argument to be made that both mastery and vicarious perceptions have as strong an influence on self-efficacy as mastery experiences during early childhood. However, Study 2 found no significant change from pre-video exposure self-efficacy to pre-transfer self-efficacy (the video was watched in between), indicating that it is unlikely in Study 2 that vicarious experiences had a significant or direct impact on self-efficacy. With the exception of character expertise being positively significantly related to post-transfer self-efficacy in Study 2, the explanation that video exposure has no impact on self-efficacy decreasing contrasts the

explanation from Study 1. The regression predicting self-efficacy in Study 1 provided support for the speculation that vicarious experiences have a significant contribution to self-efficacy, and that vicarious experiences contribute to self-efficacy to a similar degree as mastery experiences.

In order to apply the Study 1 explanation (vicarious and mastery experiences equally contribute to self-efficacy) to Study 2, Study 2 would have had to reveal either a significant change in self-efficacy from pre-video exposure to post-video exposure, or vicarious perceptions would significantly mediate the decrease from pre-transfer to post-transfer self-efficacy. There is a particular reason that likely explains why the main findings from Study 1 were not replicated in Study 2, which is due to differences in the formation of the self-efficacy variables in both studies. Study 1 was meant to capture a global measure of self-efficacy for problem solving, collapsing self-efficacy revisions into the self-efficacy variable, which allowed for examining larger relations between constructs (e.g., self-efficacy, mastery experiences, and vicarious experiences). In contrast, Study 2 was designed to unpack the findings from Study 1 in terms of children's perceptions of the conceptual distance between the video and the real world, and examine changes in self-efficacy over time. Study 2 allowed for examining changes in self-efficacy, and the revelation that self-efficacy can be changed during early childhood. Therefore, as discussed previously, there could have been a decrease in pre-transfer to post-transfer self-efficacy in Study 1, but it was muddled by a time lag and distractor activities in between evaluations. Future research should both continue to explore unique

formations of self-efficacy in relation to other variables, and attempt to validate self-efficacy variables by replicating prior findings.

**Context**

From a social cognitive theory perspective, this dissertation provided evidence that perceptions of educational television characters who teach scientific concepts (i.e., vicarious perceptions) relates to children's learning scientific problem solving solutions (i.e., mastery experiences) and self-efficacy. Although, the direction of relations between vicarious perceptions (e.g., beliefs about media characters), learning, and self-efficacy was not as straightforward as, for example, stronger identification with a model being positively correlated with greater learning or explaining relations between learning and self-efficacy, vicarious perceptions did play an important role in the relations of self-efficacy and learning (Aschbacher et al., 2010; Bandura et al., 2001; Britner, 2008; Buck et al., 2009; Riegle-Crumb et al., 2010; Gillen-O'Neel et al., 2011; Usher & Pajares, 2008; Usher & Pajares, 2009; Yazilitas et al., 2013). Similarly, a link between high self-efficacy and achievement (as represented by transfer) was established, supporting theory and replicating research with adults (Bandura, 1997; Putnam, 2005; Jinks & Lorsbach, 2003**;** Linnenbrink & Pintrich, 2002; Pintrich & De Groot, 1990**;** Putnam, 2005; Schunk, 2003**;** Schunk & Rice, 1993).

**Self-efficacy and success.** Studies 1 and 2 both found positive relations between self-efficacy and learning outcomes (i.e., mastery experiences). Although very broad (e.g., learning averaged nine items, and self-efficacy averaged 12 items), the connection was clearer in Study 1 than Study 2, finding a significant positive relation between self-

efficacy and the transfer, even when controlling for other factors. Due to the nature of the transfer variable in Study 2 differentiating between divergent transfer, convergent transfer, and no transfer, the relations between self-efficacy and learning were more muddled in Study 2 than the straightforward bivariate correlation in Study 1. Post-transfer self-efficacy was significantly greater in the divergent group in Study 2; however, pre-video exposure and pre-transfer self-efficacy did not differ by group. Meaning, the true difference between groups is noted in the decrease in self-efficacy from pre- to post-transfer. Although transfer groups did not significantly mediate the relations between pre- and post-transfer self-efficacy, the differences between groups could be explaining a larger contribution of self-efficacy development and overall academic achievement: divergent reasoning.

Both divergent and convergent reasoning have been positively related to cognitive development, and are both necessary abilities for high achievement and highly advanced development (Lloyd & Howe, 2003); however, divergent reasoning may provide opportunities for positive self-efficacy development and academic skills development that convergent reasoning does not. Specifically, divergent reasoning may contribute to the development of other cognitive processes, as well as thinking critically and realistically about their own achievements and limitations, whereas convergent reasoning constrains critical thinking and limits opportunities to consider beyond a narrow issue or singular solutions. With the perspective that convergent reasoning is necessary for learning and modern academic achievement, the following section will focus on divergent reasoning as a spectrum (e.g., greater compared with less engagement in

divergent reasoning), rather than a mutually-exclusive dichotomy between convergent and divergent processes.

Potentially, divergent reasoning could be a third variable explaining relations between self-efficacy and academic success. Challenges and difficulties reveal actual self-efficacy (in contrast with measurements of self-efficacy), by motivating efficacious people to take on challenging tasks and persist in the face of difficulty, and conversely, demotivating inefficacious people who therefore avoid attempts to achieve goals of which they believe they will fail (Bandura, 1997; Schunk, 1985). Persistence in challenging circumstances likely represents the extent to which people engage in divergent reasoning; when faced with a challenge and needing to make multiple attempts, people revise their strategy and solutions at each attempt, which would reflect divergent reasoning. Therefore, the extent to which people engage in divergent reasoning in the face of challenges may be a marker for persistence. As discussed previously, divergent reasoning may simply provide opportunities for developing other cognitive abilities, therefore linking persistence in the face of difficulty with cognitive development. That is, divergent reasoning can allow for self-evaluation and reflection, and discovering new solutions through more attempts at solving a difficult problem. Therefore, maybe it is not as simple of a connection that self-efficacy and competency beliefs impact positivity and persistence which results in higher achievement (Bandura, 1997; Usher & Pajares, 2008), but that divergent reasoning and persistence are synchronous processes, and that divergent reasoning provides a context for both metacognition and rote learning (e.g.,

how two objects can be transformed into a new object) that can be transferred, and are both important for academic success and cognitive development.

In relation to Study 1, it is surprising that the measure of divergent reasoning was not significantly related to any other variable, especially mastery experience and self-efficacy. Although there was precedent for using a measure of divergent reasoning reliant on verbal development and critical thinking for Study 1 (Calvert et al., 2007), if divergent reasoning is truly related to self-efficacy, than the measure used in Study 1 was not appropriate. The measure in Study 2 was less reliant on verbal abilities, and simply required the participants understood the interviewers' instructions; and likely a more valid measurement of divergent reasoning (e.g., it does relate to other variables and is not reliant on verbal development). Because the divergent reasoning measure in Study 1 was not significantly related to any other variable, in Study 2 a nonverbal measure, consistent with administering the transfer task was use to attempt to unpack the importance of divergent reasoning during early childhood that could not be revealed during Study 1. Overall, divergent reasoning is an important factor in academic success, and likely an individual difference factor that could potentially explain variations in self-efficacy.

**Revisions and reevaluations.** A key differences between Study 1 and 2 were the self-efficacy variables. Study 1 resulted in one large variable reflecting children's initial and revised self-efficacy judgments for solving problems. The variable was created in this way for three reasons. First, there were no significant differences between pre- post-transfer self-efficacy, which was unexpected, however, it was therefore appropriate to collapse the individual questions. Second, self-efficacy questions for the three

video/transfer task pairs were administered at different times throughout the 90-minute protocol, and due to counterbalancing, different events occurred in between the different self-efficacy questions. Different activities occurring in between pre- and post-transfer tasks in Study 1 could explain the lack of changes in self-efficacy scores. Third, the goal of Study 1 was to get a global measure of self-efficacy for problem solving to capture general relations between self-perceptions and vicarious perceptions. However, in comparison to Study 2, in which there were differences between pre- and post-transfer self-efficacy, it is difficult to argue whether the null (Study 1) or the significant (Study 2) finding is the baseline for future research.

Under the assumption that Study 2's revelation of a significant decrease in self-efficacy scores from pre- to post-transfer is most reflective of natural settings (e.g., there are significant changes in self-efficacy after novel experiences), there are numerous reasons that there was no significant change in Study 1. Initially, there was much more time and more distractions between pre- and post-transfer self-efficacy evaluations in Study 1 than Study 2. There could have been a decrease from pre- to post-transfer, but after a time lag or distractor activities, the decrease was forgotten about or returned to baseline. In contrast, maybe the significant decrease from pre-transfer to post-transfer in Study 2 was actually due to an unmeasured interaction between the divergent problem solving group, the subsidized preschool, and participants in the lower fantasy condition. If so, significant decrease in Study 2 would be an artifact of these seemingly unrelated factors (e.g., the ANOVA indicated they operated independently), and not truly reflective of actual revisions in self-efficacy after a novel experience.

One particular issue is that in Study 2, self-efficacy decreased from pre- to post-transfer. Participants did not reach ceiling for their pre-transfer self-efficacy judgments, and there was room for them to increase their judgments after attempting the transfer problem. Potentially, this could have been an issue with the protocol; participants could have interpreted the repetition of the questions to mean their initial response was incorrect, and therefore changed their judgment with a negative perspective. This is especially possible given that there was a maximum of 10 minutes in between the pre- and post-transfer self-efficacy questions; however, if that were the case, there would likely be a decrease between pre-video and pre-transfer self-efficacy questions as well, when the only distractor in between was the video stimuli and recall questions. Since pre-video and pre-transfer self-efficacy questions did not significantly differ, the decrease from pre- to post-transfer is most likely due to transforming that abstract representation of the self-efficacy questions into being directly reflective of the task they just attempted, as described in greater detail above.

**Diversity**

The lack of gender, racial, and ethnic diversity in science fields (National Science Foundation, 2014), contributed to a motivation to explore differences between gender, race, or socioeconomic groups in self-perceptions, vicarious perceptions, and learning outcomes. This was particularly important to explore given the speculation that low self-efficacy beliefs could be ameliorated during early childhood, and contribute to greater motivation and persistence in school.

There were few gender differences in Studies 1 and 2. In Study 1, girls had higher divergent reasoning scores, and in Study 2, girls had greater character trust. Neither difference is particularly notable; girls typically have higher verbal abilities and cognitive processing during the preschool years, which would explain higher divergent reasoning scores in Study 1. In terms of Study 2 and character trust, Squeak did have pink hair, which could have made boys less likely to trust and like Squeak (see Schlesinger & Richert, accepted), but if that were the case, girls probably would have had higher character expertise and similarity scores than the boys as well. It is possible the differences between boys and girls in character trust is an artifact of the measure itself; character trust is a forced choice measure, but participants did not have to choose Squeak. The forced choice measure does necessarily explain why girls had higher trust of Squeak than boys. It is possible this is a significant finding actually noting differences in boys' and girls' recognition of trustworthy traits, and with a larger sample there would have been significant differences in expertise, favoring girls. In that, girls, more than boys, recognized that Squeak reliably displayed the knowledge to solve the problem, whereas the comparison characters did not. Rarely have gender differences been found in character trust by participant gender, and notably only when comparing trust of characters of different genders (Schlesinger & Richert, accepted), so further research should continue to explore development of character trust, and attempting to unpack the processes that may be driving the development of accurate trust judgments.

More importantly, though, were the differences by research site in Study 2. Research sites were sorted into county-subsidized child development centers that require

families live at or below the poverty line to attend, and full tuition child development centers. For Study 2, post-transfer self-efficacy was significantly lower at the school with a lower income population. As discussed previously, this could be representing important differences in self-efficacy development for children in low or higher income families. Specifically, children from the low-income population may have had higher anxiety about their performance, and were more willing to negatively reevaluate their self-efficacy judgments after their performance, even though they were explicitly told that they achieved their goal and performed well (Désert et al., 2009; Osborne, 2001; Steele, 1992; 1997). Because the stereotype threat was more likely to impact children in the low-income sample, who are traditionally more "high risk", it is important to consider the potential impact the stereotype threat may have on performance in this dissertation. Additionally, future research should consider measures of anxiety and the stereotype threat as control variables when measuring self-efficacy in high risk samples, especially as asking children to make self-efficacy judgments may trigger anxiety or changes in self-efficacy due to the stereotype threat. However, the subsidized preschool also had lower pre-video and pre-transfer self-efficacy mean scores than the private preschool samples, although not significantly lower; and in both the public and private schools post-transfer self-efficacy was significantly lower than the earlier administer measures. The significantly lower post-transfer self-efficacy scores are likely not entirely due to attending a subsidized preschool, or living in a low income home, but it likely has a large contribution. The extremely important aspect is that during the preschool years, children living in low income environments and attending low income schools have lower self-

efficacy than more well off children. This difference is likely setting the stage for greater divides in children's achievement throughout development.

**Guiding research questions**

Overall, this dissertation had three guiding research questions, which focused on whether self-efficacy could be measured during early childhood through its relation to learning, and how model perceptions related to self-efficacy and learning from the model. Specifically, the research questions were: (1) Can self-efficacy be measured during early childhood, (2) are self-efficacy and learning significantly related during early childhood, and (3) do aspects of an observational model relate to children's self-efficacy and learning from the model. Generally, it was hypothesized there would be straightforward relations between perceptions about the model (e.g., vicarious perceptions), self-efficacy for accomplishing goals that the model accomplished, and actually accomplishing those goals (e.g., mastery, transfer). Although significant patterns were revealed relating those variables, the patterns were not straightforward nor consistent between studies.

A primary goal of this dissertation was to examine whether self-efficacy for solving physical problems could be successfully measured during early childhood, with evidence being that self-efficacy (defined as children's beliefs about their capacity to accomplish a goal) would accurately reflect their goal accomplishment. That is, if participants' self-efficacy was reflective of their transfer success then self-efficacy was effectively measured. Although, support that self-efficacy could be measured during early childhood was found in both studies, there were different patterns of relations between self-efficacy and transfer in each study. In Study 1, analogical transfer

(representing mastery) was significantly positively correlated with self-efficacy, indicating the relative accuracy of children's self-efficacy; the greater their goal accomplishment the higher their beliefs that they are able to accomplish related goals. In Study 2, children's self-efficacy was only reflective of their actual mastery experience, or successful analogical transfer, for self-efficacy measured after attempting the transfer task (post-transfer self-efficacy). Children in the divergent transfer group had significantly higher self-efficacy than children in the convergent group and children who did not transfer, reflecting that participants who used divergent and creative methods to successfully accomplish a goal had relatively accurate self-efficacy for their abilities to accomplish that goal. Similarly, participants who did not transfer also had relatively accurate low self-efficacy reflecting their failure to accomplish the goal. Because participants in the convergent transfer group had significantly lower self-efficacy than participants in the divergent group, additional research is needed to understand the low post-transfer self-efficacy for the convergent group. Children in the convergent group did not provide evidence that their self-efficacy is reflective of their actual abilities, because they successfully accomplished the goal, but believed that they were poor at doing so. This disconnect between the subjective self-efficacy and objective performance in the convergent group is reason to continue validating the self-efficacy measures with children in the age group for both problem solving, and many other domains. Additional questions remain to be answered about children in the divergent group, specifically, if children who engage in divergent problem solving have inflated self-efficacy, or always have greater self-efficacy than children who use convergent problem solving methods.

Overall, two primary research goals (measuring self-efficacy, and measuring self-efficacy for specific goals in relation to accomplishing those goals) were accomplished.

An additional research goal was to examine how perceptions of an observational learning model relate to self-efficacy and learning from the model, with the purpose of examining if aspects of an observational model relate to children's self-efficacy and learning from the model. In both studies this question was answered by examining how participants' perceptions of the observational learning model related to their self-efficacy for accomplishing goals that were successfully achieved by the model. In Study 1, there were direct positive correlations between children's perceptions that they could interact with the model in real life and the extent to which they trusted the model to their self-efficacy for accomplishing similar goals as the model. These significant links between model perceptions and self-efficacy support that children's perceptions of the model are likely impacting the extent to which they integrate the model's success or failures into their self-efficacy. This explanation is limiting, as beliefs about the model did not explain changes from pre-transfer to post-transfer self-efficacy, and because it is likely both children's perceptions of the model's performance and children's own performance impacted their self-efficacy. Further research should explore how children integrate beliefs about a model's performance and model traits into self-efficacy, and differentiate that from children's own performance influencing their self-efficacy.

In Study 2, self-efficacy and model perceptions had different patterns of relations with learning from the model; specifically, participants who used divergent methods to accomplish their goals had higher post-transfer self-efficacy than other groups, whereas,

children in the convergent group had high trust, expertise, and similarity beliefs with the model. This difference occurred because the variable that captured "learning from the model" was not continuous, but grouped participants by whether they displayed divergent, convergent, or no transfer from the model. Although self-efficacy was significantly related to character expertise, beliefs about the model were unrelated to self-efficacy generally. Overall, because self-efficacy and model perceptions were greater for different transfer groups, Study 2 did not provide evidence that self-efficacy and model perceptions were related. Overall, the guiding research question evaluating the relations between model perceptions and self-efficacy was answered in the two studies, however, both studies revealed different findings. Due to the lack of consistency between studies, it is important that future research examine the relations between model perceptions and self-efficacy in the context of learning from models.

These findings provide novel information about the relations between model perceptions and self-efficacy, as well as learning from models, particularly how the relations between model perceptions and self-efficacy can differ depending on how learning from the models is evaluated (e.g., how often learning was displayed or unique styles of displaying learning). This dissertation did provide evidence that self-efficacy and model perceptions (e.g., vicarious perceptions) do relate to each other for problem solving self-efficacy, and relate to learning problem solutions from the model. When focusing on children's learning of problem solutions (i.e., analogical transfer), children's beliefs about the characters being good problem solvers related to the extent to which children displayed the problem solution in Study 2; children in the convergent group,

who mimicked the characters' solution, had higher expertise and trust ratings. This dissertation focused on physical problem solving because it is a salient concept that can be displayed on video, children can solve the physical problems themselves, and ideally young children can reflect upon their experiences enough to make accurate judgments about their self-efficacy and the characters' traits. Overall, for problem solving self-efficacy, beliefs about the model and learning from the model related to self-efficacy. Self-efficacy for more abstract concepts may reveal different relations between self-efficacy, model perceptions, and learning; particularly, for concepts that it would be difficult for children to reflect upon (e.g., moral or social lessons). Overall, the research questions were answered in that model perceptions are related to self-efficacy for accomplishing goals accomplished by the model, and self-efficacy for those goals is related to learning from the model; however more research is needed to examine the stability of self-efficacy during early childhood, as well as relations between how children's self-efficacy for accomplishing goals displayed by a model relates to their children's learning from that model.

**Limitations**

As noted in the general discussion for Study 1, a particularly notable limitation of this dissertation was that the measures meant to evaluate the antecedents of self-efficacy were not directly adapted from prior published measures with adults. For practical purposes, the measures representing categories of the antecedents of self-efficacy had not been previously used to measure those constructs in relation to self-efficacy. Instead, the particular measures were selected because they had successfully measured children's

learning from and perceptions of media characters previously. Although Study 1 does validate the use of these measures for representing the antecedents of self-efficacy, future research should be conducted to determine if measures adapted directly from prior research with adults would be more valid for self-efficacy research with young children (Bandura, 1997; Britner & Pajares, 2006; Usher & Pajares, 2008).

Another limitation is the statistical and methodological disconnect between Studies 1 and 2. Although the original measures and questions administered in both studies were as similar as possible with respect to adaption for the appropriate video stimuli and research setting, the measures were transformed into variables in different ways for the two studies. For example, in Study 1 analogical transfer is a continuous variable which collapsed (1) successful transfer, (2) making an explicit analogical connection between the video solution and transfer problem solution, and (3) accurately recalling the video solution, and averaging the correct responses across three videos and transfer tasks. In Study 2, analogical transfer is a categorical variable differentiating between divergent and convergent reasoning. Creating the variables in these unique ways was purposeful as both studies had different goals (e.g., Study 1 explored larger conceptual relations, Study 2 examined differences in problem solving and change over time), however, it does make it difficult to collapse the results of both studies, and to make any arguments that Study 2 replicated Study 1. Similarly, both studies took place in different locations and used different problem solving stimuli and materials. Although the differences between the two studies were purposeful, it is difficult to draw

conclusions about learning from media across the two studies, when the media content different and the transfer problem objects differed by study as well.

**Future research.**

A natural next step for this research is to more closely examine the impact of divergent and convergent reasoning on children's self-efficacy, vicarious beliefs, and learning, including independent measures of divergent and convergent reasoning that are not mutually exclusive from each other, and are separate from the learning outcome variable (Lloyd & Howe, 2003; Trawick-Smith et al., 2011). Similarly, it is important to continue exploring the impact of vicarious perceptions. This is especially necessary, because the hypotheses about vicarious perceptions were not directly supported, and instead, unexpected patterns emerged concerning vicarious perceptions. Given the importance of children's reliance on others to learn and the prevalence of media characters, continued exploration on the impact of vicarious perceptions on self-efficacy, learning, and other social cognitive processes in warranted. Finally, the most important follow up is longitudinal research; although there were significant self-efficacy changes during Study 2, future research is needed to both unpack the cause of the change, the repercussions, and the consistency of self-efficacy during early childhood.

**Conclusions.**

Overall, this dissertation had three particular goals: (1) establish that self-efficacy can be measured during early childhood, (2) explore whether self-efficacy and learning are significantly related during early childhood, and (3) examine how aspects of the model relate to self-efficacy and learning from the model.

Study 1 allowed for a grand analysis of the overall conceptual relations between self-efficacy and some of the antecedents of self-efficacy during early childhood, which there is no published research examining. This correlational study provided a framework for understanding the likely relations between self-perceptions and vicarious perceptions, in relation to learning. Particularly revealing that vicarious perceptions have a strong impact on self-efficacy during early childhood. In contrast, Study 2 revealed a different relation between variables, albeit, the goals of Study 2 were to examine the impact of reasoning and problem solving styles, and changes in transfer, not to replicate the relations in Study 1. Study 2 indicated important differences in divergent and convergent problem solving relate to changes in self-efficacy over time and differences in vicarious perceptions; with children who use divergent methods as having greater self-perceptions and weaker vicarious perceptions, and children who engaged in convergent problem solving having greater vicarious perceptions and similar self-efficacy as those who did not successfully transfer.

Self-efficacy was successfully measured in both studies, both studies established relations between self-efficacy and learning, vicarious perceptions related to self-efficacy, more strongly in Study 1, but explaining important group differences in Study 2. Overall, this dissertation accomplished its goals, and provides a framework for future research on self-efficacy, problem solving, and vicarious beliefs. Both studies together provided evidence that during early childhood self-efficacy is impacted both by mastery experiences and vicarious perceptions. Similarly, both contrasting results between Study 1 and Study 2 support the observational learning subprocesses, and how interactions

between the environment and the self continuously impact the learning process. Particularly notable is the impact of media characters, and perceptions of media characters on children's learning scientific concepts. In sum, both studies highlight the need to continue examining the aspects that contribute to self-efficacy and model perceptions during early childhood, how self-efficacy and model perceptions contributes to learning, and how self-efficacy can impact developmental trajectories.

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Appendix A

Study A 5-point scales transformed into 3-point scale options in comparison to Study B 3-point scales. Scale I include responses 1, 2, 3 collapsed into response category 1, scale II includes responses 1 & 2 collapsed into response category 1 and responses 3 & 4 collapsed into response category 2.

| | Scale | Study 1A 5-point Scale | Study 1A 3-point transformed Scale I | Study 1A 3-point transformed Scale II | Study 1B 3-point scale |
|---|---|---|---|---|---|
| How much do you like Grover? | 0 | 37.20% | 37.2% | 37.2% | 40.0% |
| | 1 | 7.00% | 18.6% | 16.3% | 20.0% |
| | 2 | 9.30% | 44.2% | 46.5% | 40.0% |
| | 3 | 2.30% | | | |
| | 4 | 44.20% | | | |
| How much are you like Grover? | 0 | 41.90% | 41.9% | 41.9% | 58.6% |
| | 1 | 7.00% | 30.3% | 25.6% | 20.7% |
| | 2 | 18.60% | 27.9% | 32.6% | 20.7% |
| | 3 | 4.70% | | | |
| | 4 | 27.90% | | | |
| How much do you want to be like Grover? | 0 | 41.90% | 41.9% | 41.9% | 46.7% |
| | 1 | 7.00% | 30.3% | 25.6% | 30.0% |
| | 2 | 18.60% | 27.9% | 32.6% | 23.3% |
| | 3 | 4.70% | | | |
| | 4 | 27.90% | | | |

| | Scale | Study 1A 5-point Scale | Study 1A 3-point transformed Scale I | Study 1A 3-point transformed Scale II | Study 1B 3-point scale |
|---|---|---|---|---|---|
| Could you see Grover at the store? | 0 | 79.10% | 79.1% | 79.1% | 83.3% |
| | 1 | 2.30% | 11.6% | 9.3% | 13.3% |
| | 2 | 7.00% | 9.3% | 11.6% | 3.3% |
| | 3 | 2.30% | | | |
| | 4 | 9.30% | | | |
| Could Grover go to your school? | 0 | 83.70% | 83.7% | 83.7% | 80.0% |
| | 1 | 4.70% | 7.0% | 4.7% | 6.7% |
| | 2 | 0.00% | 9.3% | 11.6% | 13.3% |
| | 3 | 2.30% | | | |
| | 4 | 9.30% | | | |
| Could you play tag with Grover? | 0 | 65.10% | 65.1% | 65.1% | 76.7% |
| | 1 | 2.30% | 16.3% | 9.3% | 13.3% |
| | 2 | 7.00% | 18.6% | 25.6% | 10.0% |
| | 3 | 7.00% | | | |
| | 4 | 18.60% | | | |
| Does Grover get hungry? | 0 | 46.50% | 46.5% | 46.5% | 37.9% |
| | 1 | 2.30% | 27.9% | 13.9% | 17.2% |
| | 2 | 11.60% | 25.6% | 39.6% | 44.8% |
| | 3 | 14.00% | | | |
| | 4 | 25.60% | | | |

| | Scale | Study 1A 5-point Scale | Study 1A 3-point transformed Scale I | Study 1A 3-point transformed Scale II | Study 1B 3-point scale |
|---|---|---|---|---|---|
| Does Grover get sleepy? | 0 | 41.90% | 41.9% | 41.9% | 48.3% |
| | 1 | 4.70% | 21.0% | 9.4% | 31.0% |
| | 2 | 4.70% | 37.2% | 48.8% | 20.7% |
| | 3 | 11.60% | | | |
| | 4 | 37.20% | | | |
| Does Grover have feelings? | 0 | 55.80% | 55.8% | 55.8% | 53.3% |
| | 1 | 9.30% | 18.6% | 11.6% | 20.0% |
| | 2 | 2.30% | 25.6% | 32.6% | 26.7% |
| | 3 | 7.00% | | | |
| | 4 | 25.60% | | | |
| Is Grover your friend? | 0 | 51.20% | 51.2% | 51.2% | 66.7% |
| | 1 | 2.30% | 20.9% | 9.3% | 16.7% |
| | 2 | 7.00% | 27.9% | 39.5% | 16.7% |
| | 3 | 11.60% | | | |
| | 4 | 27.90% | | | |
| Is Grover cute? | 0 | 46.50% | 46.5% | 46.5% | 23.3% |
| | 1 | 7.00% | 16.4% | 11.7% | 33.3% |
| | 2 | 4.70% | 37.2% | 41.9% | 43.3% |
| | 3 | 4.70% | | | |
| | 4 | 37.20% | | | |