The Role of Expertise Judgments in Children's Social Learning

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Abstract

Previous research has examined how children judge sources of information (Corriveau & Harris, 2009; Corriveau, Pickard, & Harris, 2010; Koenig & Harris, 2005), but no studies have attempted to increase or decrease a children's trust in informants, measure learning from that informant, and analyze how that learning persists over time. The current study examined if children's trust in informants can be manipulated, and how this trust relates to learning STEM concepts from a video of the character in question. Fifty-seven 3- to 6-year-olds were visited in their preschool classrooms at 3 different time points. Children watched a video of Sid from *Sid the Science Kid* solving a problem. After the video, children were tasked with solving an analogically-similar problem. Children were tested for verbal reasoning, concept formation, visual matching, executive function, character realism, identification with the character, theory of mind, and character trust (belief in Sid's expertise in problem-solving). Presenting Sid to the participants as either clever or clumsy did not affect character trust or learning. Children's belief in Sid's expertise also did not affect learning; however, levels of learning remained stable over time. Identification with Sid may play a role in how children viewed Sid and learned from him.

Keywords: learning, source judgment, media, STEM, identification

The Role of Expertise Judgments in Children's Social Learning

How do we decide whether to trust a source of information? On the surface, this seems like a simple question. We would follow the advice of a mechanic, for example, on how to fix a car rather than that of a massage therapist. If we need legal advice, it is likely that we would visit a lawyer rather than our primary care physician. However, a quick look at any popular social media site will reveal that adults are not masters at source judgment. A recent study found that true news stories posted on social media took six times as long as false stories to reach 1,500 people, especially when the story had to do with politics (Vosoughi, Roy, & Aral, 2018). Additionally, true stories rarely reached more than 1000 people, while false stories reached up to 100,000. Researchers believe this occurred because false information tends to be more exciting and provocative than true information (Vosoughi et al., 2018), but this study shows us that adults are not perfect at source judgment.

If adults are not great at judging whether to trust a source of information, then how do children perform? At 3 years old, children's trust in a familiar teacher is not greatly affected by watching that teacher make errors, but by the ages of 4-5, children's trust in a familiar teacher is diminished after watching that teacher inaccurately name objects (Corriveau & Harris, 2009). In fact, when faced with evidence of an informant's inaccuracy, 4-year-olds were able to predict whether that informant would be accurate in the future, and they correspondingly solicited and favored information from accurate sources over inaccurate ones (Koenig & Harris, 2005). At 4 years old, children can even predict the expertise of an informant in a specific area of knowledge when they are shown to be accurate (Corriveau, Pickard, & Harris, 2010). When children watched two informants name familiar objects and use familiar words (one teacher did so accurately, and the other did not), children were more likely to turn to the accurate informant to

teach them novel information in the same field. Children can also differentiate expertise in others, to some extent. When presented with familiar experts, such as a doctor or car mechanic, children correctly attributed knowledge to those experts in their given fields. For example, they are more likely to associate a sickness with a doctor than with a mechanic. However, this did not carry over to unfamiliar experts, such as a bicycle or eagle expert (Lutz & Keil, 2002).

In certain situations, children are more likely to trust peer informants over adult informants. Children trust accurate peer informants over previously inaccurate adults (Jaswal & Neely, 2006). Additionally, children recognize that there are areas in which a child might be more knowledgeable than an adult (VanderBorghet & Jaswal, 2009). When children do recognize another child to be an expert informant in one domain, however, they do not necessarily believe that same child informant will be an expert in other domains (Koenig & Jaswal, 2011; Mills, 2013). Few studies have examined how children's source judgments relate to media characters. One study found that younger children were less likely than older children to believe that the things they see on television are useful for their lives (Hawkins, 1977), perhaps deeming television characters to be less knowledgeable informants. Schlesinger, Flynn, and Richert (2016) found that children who believed Sid from *Sid the Science Kid* was a reliable informant correctly remembered how Sid solved a video problem more often than children who did not believe Sid was a reliable informant. From this body of research, the current study hypothesized that presenting Sid to children as either clever or clumsy will effectively alter their beliefs about whether Sid is a reliable informant. Additionally, the current study hypothesized that children who rate Sid's problem-solving expertise higher will be more likely to learn from Sid's problem-solving strategy. The current study also examined whether this learning would persist when measured immediately after viewing the video, and a week later.

Learning

Learning can be conceptualized as a hierarchy of related processes. Bloom, Engelhart, Furst, Hill, and Krathwohl (1956) created a list of educational outcomes with the goal of producing terminology that could be used across topics and people to describe what teachers intend for students to learn as a result of their instruction. This is commonly known as Bloom's Taxonomy, and it describes six main categories of learning that are ordered from simple to complex: Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation. More recently, a revised version of Bloom's Taxonomy was created (Anderson et al., 2001), which renamed and reordered some of the original categories to reflect a more active voice (e.g., "Remember information" versus "The student shall be able to"). The new categories are: Remember, Understand, Apply, Analyze, Evaluate, and Create (Anderson et al., 2001). Like the original taxonomy, these categories are ordered in terms of complexity, with Remember being the simplest form of learning and Create being the most complex form of learning.

Research on children's learning has touched on each category in Bloom's revised taxonomy (Anderson et al., 2001), and in the context of the current study, it is important to understand which measures of learning correspond to which educational outcomes. For example, many researchers have studied memory recall as a learning outcome (Calvert, Strong, Jacobs, & Conger, 2007; Ricci & Beal, 2002; Richert & Schlesinger, 2017; Richert & Smith, 2011; Schlesinger et al., 2016). In Bloom's Taxonomy, memory recall would correspond with the Remember category. In the current study, the memory measure encompasses both the Remember and Understand categories, since children are asked to recall the video they watched but also to describe and explain it as well.

Another learning outcome that has been well-researched is transfer (Crawley, Anderson, Wilder, Williams, & Santomero, 1999; Jowkar-Baniani & Schmuckler, 2009; Richert & Schlesinger, 2017; Richert & Smith, 2011; Schlesinger et al., 2016; Troseth & DeLoache, 1998). Transfer refers to the ability to take knowledge learned in one context and apply it to a different but similar context (Holyoak, Junn, & Billman, 1984). If a child can learn how to solve a problem and is then able to take that solution and apply it to a novel problem (in other words, transfer the problem solution to new contexts), this type of learning would be characterized within Bloom's revised taxonomy as both Applying and Analyzing (Anderson et al., 2001). Children's ability to transfer across learning contexts adapts rapidly in early childhood. Infants under 9 months old can transfer across visual representations (i.e., from 2D to 3D; Jowkar-Baniani & Schmuckler, 2009). Additionally, very young children are able to imitate what they see on television up to a day later (Meltzoff, 1988), even when the action sequences viewed were complex and novel (Barr, Muentener, & Garcia, 2007). Past research has shown that preschool children are able to transfer STEM problem solutions from screen media to real-life, novel situations, especially if they report trust in the character they are watching (Schlesinger et al., 2016).

A third learning outcome that has been the subject of several studies is the concept of divergent thinking (sometimes called flexible thinking or divergent processing; Calvert et al., 2007; Charles & Runco, 2001; Runco, 1986). Divergent thinking is not synonymous with creativity but is a reflection of a person's ability to generate ideas (Charles & Runco, 2001; Runco, 1986). In terms of learning, if a child sees a problem solution modeled for them in a video, and the child comes up with alternate solutions based on the video's content that still accomplishes the goal of the original solution, this would fall under both the Analyze and Create

categories of Bloom's Taxonomy (Anderson et al., 2001). The current study seeks to analyze how judgments about a character's expertise relates to learning, in both its simplest and more complex forms.

Educational Media

Although educational media is generally successful at teaching children school readiness skills in the areas of science, mathematics, and literacy (Bryant, Alexander, & Brown, 1983; Fisch, 2004), research has shown that it does not tend to be successful in teaching children about other concepts, such as prosocial lessons (Mares & Acosta, 2008). In one study, children were shown clips from the television show *Clifford the Big Red Dog* in which a dog with three legs meets Clifford and his friends. In the unedited version of the episode, one of Clifford's friends reacts with fear and hesitation toward the disabled newcomer. An edited version of the episode did not contain these fear responses, instead focusing on the positive resolution, which is that Clifford and his friends accept the new friend and recognize that disabilities are not dangerous. Children who viewed the original version were not able to pick out the prosocial messages of acceptance, while children who viewed the edited version showed higher levels of comprehension of the intended message (Fisch, 2000; Mares & Acosta, 2008).

As previously mentioned, research has suggested that these difficulties may arise because children are not seeing a connection between the fantastical characters in the stories or videos they watch and read, and the people they interact with daily (Mares & Acosta, 2008; Richert & Schlesinger, 2017). However, being able to connect the lessons, whatever the content, to the child personally can assist with learning (Cingel & Krcmar, 2017). In one study, participants watched an episode of *Arthur* that either featured a moral message or did not. Additionally, some participants watched alone, with a parent, or with a parent that was actively mediating the

learning process by discussing the show's content with their children. The results indicated that children who viewed the show with a mediating parent scored higher on comprehension, perspective-taking, and moral reasoning measures than the other groups, because parents were connecting the themes of the show to the children on a personal level (Cingel & Krcmar, 2017). If children can make a connection between themselves and what they are watching, it is possible that these connections can facilitate learning.

In addition to differences in actual content, there are other factors that can help or hinder children's learning from educational media. Research has examined the effect that identifying with media characters has on whether learning from those characters occurs. One approach that researchers have used to characterize identification involves defining it in terms of liking a character, wanting to be like a character, and feeling similar to a character (Calvert et al., 2007; Liebes & Katz, 1990; Maccoby & Wilson, 1957). In fact, some research has shown that if children relate with a character, they will learn better from that character (Calvert et al., 2007). For example, one study found that if children reported higher identification with Dora from *Dora the Explorer*, they were also able to transfer the problem solution that Dora displayed to more contexts. In other words, if children related to Dora, they could come up with more alternative uses for the items that Dora used than children who reported lower levels of identification with Dora (Calvert et al., 2007).

Fantasy content provides another element to children's learning from educational media. Research has shown that children, especially in early childhood, have a hard time distinguishing fantasy from reality effectively, and this ability begins to emerge during the preschool years (Sharon & Woolley, 2004). Children around the age of 4 can correctly identify fantastical characters as being distinct from real people (Skolnick & Bloom, 2006). By this time, they can

also recognize that characters they deem to be pretend would not have human-like qualities, such as needing to eat or being able to go to school (Sharon & Woolley, 2004). Specifically, in relation to children's television programming, children around the age of 5 recognize that fictional programs can contain content that is both fantastical and realistic (Wright, Huston, Reitz, & Piemyat, 1994).

This body of research provides some insight as to what types of information children learn from educational content that contains fantastical elements. In terms of word learning, for example, children are more likely to learn new words from educational content that presents the words in fantastical stories that incorporate impossible events (Weisberg et al., 2015). However, children are less likely to learn causal lessons from fantastical stories than from realistic ones (Walker, Gopnik, & Ganea, 2015). Children are also more likely to transfer information from realistic books versus fantastical books (Richert & Smith, 2011).

To understand why fantasy content and identification are concepts that can either help or hinder learning, we can look to Fisch's (2000) capacity model. The capacity model provides a framework for understanding the role that fantasy content plays in children's learning (Fisch, 2000). It delineates the mechanisms through which the fantasy content of children's educational programming may be related to children's learning from a particular program. Because educational programming often contains both fantastical and realistic elements (e.g., talking animals that attend school), programming targeted to children can be cognitively taxing for them to process. According to the capacity model (Fisch, 2000), children's cognitive system is taxed as they work to identify which elements of the show they should pay attention to in order to apply that content to what they know about the world.

To decide which information they should apply to the real world, children must attend to three elements of the programming: the narrative of the story, the educational content, and how discrepant the two are from each other (Vossen, Piotrowski, & Valkenburg, 2014). According to Fisch (2000), deciding which information to attend to is especially difficult when the narrative elements of the content veer too far from the educational content, causing children's working memory to be strained, which interferes with learning. In other words, when children have to pay more attention to resolving the discrepancies between the narrative content and the educational content in order to process what they are seeing, any potential learning outcomes suffer (Fisch, 2000). As previously discussed, some fantasy content may facilitate learning (Weisberg et al., 2015) or hinder it (Richert & Smith, 2011; Walker, Gopnik, & Ganea, 2015), while being able to relate to the character or the content can facilitate learning, seemingly regardless of the fantasy content (Calvert et al., 2007; Cingel & Krcmar, 2017).

The current study utilized a video about Sid from *Sid the Science Kid* constructing a lever out of a toy block and shovel for the purpose of using it to launch other items across a room. The fantasy content in this video is at a minimum. The current study measured children's pre-existing levels of identification with Sid, as well as a measure of character realism (the extent to which children believed Sid to be real or not). Furthermore, the current study examined all of these factors in relation to children's ability to learn from Sid as measured by memory, analogical transfer, and divergent thinking.

The Current Study

In summary, although many contextual factors play a role in whether children will learn from the media they watch (Cingel & Krcmar, 2017; Crawley et al., 1999; Fisch, 2000; Mares & Acosta, 2008; Richert & Schlesinger, 2017; Richert & Smith, 2011; Troseth & DeLoache, 1998;

Walker, Gopnik, & Ganea, 2015; Weisberg et al., 2015), children tend to learn better from informants they deem to be trustworthy (Corriveau & Harris, 2009; Corriveau, Pickard, & Harris, 2010; Jaswal & Neely, 2006; Koenig & Harris, 2005; VanderBorght & Jaswal, 2009), and from content and characters they can personally relate to (Calvert et al., 2007; Cingel & Krcmar, 2017). While research has examined how factors such as fantasy content, identification, and source judgments relate to learning (Cingel & Krcmar, 2017; Corriveau & Harris, 2009; Richert & Smith, 2011), to our knowledge, no studies have examined how these factors can affect learning over time, when no additional exposure to the learning stimulus is provided.

The goals of the current study are to determine (a) if children's trust in a character's expertise can be increased or decreased, (b) if this increased or decreased character trust is related to learning, (c) if children's self-reported identification with the character relates to learning, and (d) if this learning will persist after a week's time.

Hypothesis 1: Participants' rating of the target character's (Sid) expertise will be related to whether that character was presented to the participant as clever or clumsy.

Hypothesis 2: Participants' ratings of the character's problem-solving expertise will be related to learning from that character as measured by memory, analogical transfer, and divergent thinking.

Hypothesis 3: Participants who report higher identification scores with Sid will be more likely to learn from Sid as measured by memory, analogical transfer, and divergent thinking.

Hypothesis 4: Participants' memory, analogical transfer, and divergent thinking scores will not change from wave 2 to wave 3.

Methods

Participants

Children were recruited through preschools in Riverside County. Researchers called preschools in the area and explained the purpose of the study to the director. After consent was obtained from a preschool's director, researchers dropped off consent forms for the school to send home to parents. A total of 65 children participated from various preschools. Children who only completed Wave 1 were not analyzed, as they would not have been assigned to a condition group until Wave 2. This brought the total number of participants to 57 (32 females).

The ethnic breakdown of participants is as follows: 29.8% White/European American ($n = 17$), 26.3% Hispanic/Latino ($n = 15$), 15.8% Black/African American ($n = 9$), and 28.1% declined to answer ($n = 16$). Participants' ages ranged from 3-5.43 years old ($M = 4.23$, $SD = .68$). Researchers asked for the assent of each teacher in the classroom before setting up and asked for children's assent before beginning the study with them. Participants' schools were compensated with a number of children's books that were donated to the children's classrooms.

Materials

Stories. Two stories were created for the current study, and each child was read one story. The stories presented Sid from *Sid the Science Kid* as either clever or clumsy when finding solutions to three problems. In the first problem (clean-up problem), Sid needs to clean up his blocks in the kitchen and transfer them to his room. In the second problem (lost cat problem), Sid tries to find his lost cat. In the third problem (out-of-order car problem), Sid tries to replace the batteries in his toy car.

In the clever condition ($n = 29$), the stories indicate that Sid is clever because of his problem solutions (e.g., "Look how clever he is! Sid looked around for batteries."). In the clean-

up problem, Sid finds a bowl and uses that to transfer his blocks to his room. In the lost cat problem, Sid listens until he hears his cat meow and follows the sound to find her. In the out-of-order car problem, Sid's toy car doesn't work, so he finds batteries for it. The stories in the clumsy condition ($n = 28$) show Sid solving the problems as well, but his solutions come about either accidentally or because they were easy solutions to begin with. For example, in the clean-up problem, Sid is not described as clever for thinking of using the bowl; rather, the story states, "Look how easy it was. He saw a big plastic bowl on the kitchen table that his mom took out of the cabinet." In the lost cat problem, Sid finds his cat by accidentally tripping over her, and in the out-of-order car problem, Sid is about to give up on his car when he spots batteries on the table.

Video and transfer task materials. Based on stimuli from other research testing children's transfer of learning from video (see Schlesinger et al., 2016), children watched a video clip from *Sid the Science Kid* of Sid using an array of items to build a lever and launch a toy across a room. The video was approximately 1-minute long and was played for the children on an iPad. In the video, Sid creates a lever to help clean up his toys by launching them into his toybox. Sid then uses his invention to help get a toy to his baby brother. After the video, children were presented with an array of relationally similar items to what Sid used in the video. The transfer task consisted of a problem-solving task similar to what has been used in previous studies (Richert et al., 2009). Researchers prompted children to use any two items from the array of items presented to them to make a ball fly through the air. Children were given three trials (verbal prompts) to complete this task. The first two prompts were, "Can you think of a way to use two things on the table to make the ball fly through the air?" If children successfully transferred the solution in the first two trials, the third prompt was the same; if they had not, the

third prompt was, “Think back to that video with Sid. Does that video give you any ideas of how to make the ball fly through the air?”

Recording devices. During wave 1, participants were audio recorded only. During waves 2 and 3, participants were both audio and video recorded for the purpose of coding their performance in the transfer task.

Measures

Measures tested children’s theory of mind, character expertise, verbal comprehension, concept formation, visual matching, executive functioning (inhibitory control), identification with the character (Sid), character realism, and learning (memory, analogical transfer, and divergent thinking).

Theory of mind stories. Children’s theory of mind was tested using a gendered story about two children who find a box on the sidewalk. One of the children (Maggie; Brandon) goes into the house, while the other (Sandy; Shawn) opens the box, sees the contents, and closes the box. The second child then comes back outside and opens the box to see the contents. During the story, children are asked questions such as, “What did Sandy/Shawn think was in the box before s/he opened it?”, and “What does Maggie/Brandon think is in the box?” Each correct answer was scored as a 1, while incorrect answers received a -1 and no answer received a score of 0. Scores could range from -6 to 6.

Character expertise. To measure the extent to which children believed Sid from *Sid the Science Kid* was an expert, children were presented with a picture of a novel object and asked if they knew what it was. Children were then told that only the researcher knew what the object was. Researchers then asked, “If you wanted to know what this is called, who would you ask?”, “If you wanted someone to show you how to use it, who would you ask?”, and “If you wanted to

know how to make a toy fly through the air, who would you ask?” Additionally, between each of these questions, children were also asked, “If s/he didn’t know, who would you ask?” For each question, children were given a choice between Sid, Dora, or Diego from *Dora the Explorer*. Diego was scored as -2, Dora as -1, and Sid as 1, higher scores indicating children’s belief that Sid is an expert. Scores could range from -12 to 6. Additionally, after the stories, children were asked, “How good is Sid at solving problems?” in order to check that the stories were effective. Children could answer *not good*, *a little tiny bit good*, *a little good*, *kind of good*, or *very good*. These were scored 0-4, with 0 being *not good* and 4 being *very good*. These two scores were combined for an overall Sid expertise score that could range from -12 to 10.

Verbal comprehension, concept formation, and visual matching. The *Woodcock-Johnson III Tests of Cognitive Abilities* (WJ III COG; Woodcock, McGrew, & Mather, 2001) was administered during the first of three total waves. Test 1, Verbal Comprehension, includes items that require participants to name pictures, tell the researchers synonyms to provided words, and finish oral analogies. Scores could range from 0-71, with higher scores indicating better verbal comprehension skills. Test 5, Concept Formation, requires participants to figure out a rule that divides a set of pictures in each test item. Scores could range from 0-40, with higher scores indicating better concept formation skills. Test 6, Visual Matching, is a timed test that requires participants to point to two identical pictures in each test item as quickly as possible. Scores could range from 0-26, with higher scores indicating quicker and more accurate visual matching skills. In all three of these subtests, the test was concluded when children gave 3 incorrect responses in a row. The final score for each subtest was obtained by summing each of the answered items.

Executive functioning. Children's executive functioning, specifically inhibitory control, was assessed using two forms of the Stroop task: day/night (Gerstadt, Hong, & Diamond, 1994) and grass/snow (Carlson & Moses, 2001). In this task, children were trained to say "day" when they saw a card with a moon on it, and to say "night" when they saw a card with a sun on it. They were then shown these cards in a random order to complete 16 trials. The grass/snow version of this task was similar, in that children were trained to point to a green card when the researcher said "snow" and a white card when the researcher said "grass". The order in which children received these tasks was counter-balanced across participants. In both task variations, an incorrect response was scored as a 0 and a correct response as 1. The final executive functioning score was obtained by summing all trials across both tasks for a possible range of 0 to 32.

Identification. Children's identification with Sid was measured at various times throughout the study using three questions: 1) How much do you like Sid? 2) How much are you like Sid? and 3) How much do you want to be like Sid? Answer choices were *not at all*, *a little*, or *a lot*. *Not at all* was scored as 0, *a little* was scored as 1, and *a lot* was scored as 2, for a possible range of 0 to 6, with higher scores indicating a higher identification with Sid.

Character realism. To assess children's ability to distinguish between fantasy and reality, children were asked questions about the reality status Sid. These questions assessed children's understanding of Sid's person-like traits (e.g., "Does Sid need to sleep at night?") and Sid's ability to exist in the real world (e.g., "Could you ever see Sid at the store?"; Sharon & Woolley, 2004). Additionally, children were explicitly asked if they believed Sid was real or pretend. Responses were scored as either -1 or 1 (no response or "I don't know" was scored as 0), with higher scores indicating a belief that Sid is real. For each of these items, a follow-up

question of, “Are you really sure, or only a little sure?” was also asked. *Really sure* was given a score of 2, and *a little sure* was given a score of 1. These were then multiplied, and each product was summed for a total character realism score. For example, if a child said they were really sure that Sid needs to sleep at night, this item would receive a score of 2 (1x2); if a child said they were really sure that that could *not* see Sid at the store, that item would receive a score of -2 (1x-2). Wave 1 consisted of 4 questions, with a possible score range of -8 to 8. Wave 2 consisted of 7 questions, with a possible score range of -14 to 14.

Learning outcomes.

Memory. Children’s memory for the video solution was assessed immediately after watching the video of Sid creating a lever during wave 2, and again during wave 3. Children were asked, “Can you tell me what happened in that video with Sid?” and “Do you remember how Sid made the ball fly through the air? How did he do that?” If children gave the correct answer after the first question, they received a total memory score of 2. If children gave the correct response after the second question, they received a memory score of 1. If children did not give the correct response at all, they received a score of 0. If children did not give the correct response during the memory questions, they were reminded of the correct answer (“Sid hit the shovel and the toy flew into the air.”) before proceeding to the analogical transfer task (see Richert et al., 2009). Children’s memory scores therefore ranged from 0 to 2.

Analogical transfer. Analogical transfer was assessed using a transfer task during both waves 2 and 3, as well as follow-up analogical connection questions. Children were given three trials (verbal prompts) to complete the transfer task (described in the Materials section). The transfer task was coded by two independent raters who did not know the hypotheses of the study; additionally, neither rater knew the condition of participants (clever or clumsy) while coding

performance on the transfer task. If a participant reproduced the correct solution during the first trial (using the block as a fulcrum and the spoon as a lever, placing the ball inside the bulb of the spoon, and hitting the handle of the spoon), the participant received a score of 9; if they produced the correct solution during trial 2, they received a score of 8; if they produced the correct solution during trial 3, they received a score of 7. Scores in the range of 6 to 1 indicate that a child displayed a partially correct solution during any of the trials, and a score of 0 indicates that the child did not solve the problem or did not attempt to solve the problem. Therefore, transfer scores ranged from 0-9 each for waves 2 and 3. Cohen's κ was run to determine if there was agreement between the raters. There was high agreement for both waves 2 ($\kappa = .67, p < .001$) and 3 ($\kappa = .76, p < .001$). If disagreements in ratings occurred, the raters watched the video in question together and verbally agreed on a score.

Immediately after the transfer task trials, children were asked questions that required them to make analogical connections between the video they watched and the transfer task they completed. These questions were, "How is what you did like what Sid did in the video?", "Which thing on the table is like Sid's toy?", "Which thing on the table is like Sid's shovel?", and, "Which thing on the table is like Sid's block?". The first question was scored 0, 1, or 2. A 0 indicated no mention of a connection between the video and what the child did or no answer, a score of 1 indicated that the child made the ball fly but with no mention of their solution being similar to Sid's solution, and a score of 2 indicated that the child clearly stated that their solution was similar to Sid's solution. The questions were coded by two independent raters, who did not know the hypotheses of the study; neither knew the condition (clever or clumsy) of the participants while coding. Cohen's κ was run to determine if there was agreement between the

raters; there was very high agreement for both wave 2 (Cohen's $\kappa = .93, p < .001$) and wave 3 (Cohen's $\kappa = .96, p < .001$).

The other three questions were scored as either 0 or 1, depending on children's correct answer (ball, spoon, and block, respectively). Children could either verbally indicate their answer to the last three questions or point to an object to indicate their answer. The analogical connection scores were added to the total transfer scores to obtain the analogical transfer score, which could then range from 0 to 14.

Divergent thinking. Divergent thinking was assessed using children's performance on the transfer task. If children used two items that were not the relationally-similar items (the block and spoon combination to make the ball fly) for all 3 trials, they received a score of 9. If they did this for 2 of the trials, they received a score of 8; if they did this for 1 trial, they received a score of 7. Scores in the range of 6 to 1 indicate varying degrees of using alternative solutions to make the ball fly through the air. A score of 0 indicates that the child either did not attempt the task, or only directly transferred Sid's solution. Divergent thinking was coded by two independent raters, neither of whom knew the hypotheses of the study or the condition of each participant (clever or clumsy) while coding. Cohen's κ was run to determine if there was agreement between the raters; there was high agreement for wave 2 (Cohen's $\kappa = .61, p < .001$) and moderate agreement for wave 3 (Cohen's $\kappa = .58, p < .001$). See Appendix A for the coding instructions for the transfer and divergent thinking task.

Procedure

This study consisted of three waves for each participant, each wave being at least five days apart. Participants were interviewed in their preschool classrooms.

Wave 1. Wave 1 began with the character expertise questions, followed by the questions regarding how much children identified with Sid. After that, children were asked questions regarding Sid's social realism. Lastly, researchers administered the three subtests of the WJ III COG (Woodcock, McGrew, & Mather, 2001). Wave 1 took anywhere from 25-35 minutes per participant.

Wave 2. A week spanned between waves 1 and 2. Wave 2 began with the clever or clumsy stories. After this, children watched the video clip from *Sid the Science Kid*, of Sid creating a lever to launch toys across a room. Children were then asked the two memory questions and administered the transfer task. After the transfer task, children were asked the four analogical connection questions. Children were then asked the three identification questions again, as well as the character knowledge questions. The last part of wave 2 consisted of the seven character realism questions. Wave 2 lasted around 20 minutes per participant.

Wave 3. A week spanned between waves 2 and 3. Wave 3 began with one of the Stroop task variations (day/night or grass/snow). After this, children completed the transfer task again, but did not watch the Sid video. This was followed again with memory and analogical connection questions. Children were then read the theory of mind stories. Females heard the story about Maggie and Sandy, while males heard the same story but with male characters, Brandon and Shawn. Lastly, children received the other variation of the Stroop task. Wave 3 lasted around 10-15 minutes per participant.

Results

Analysis plan

Preliminary analyses examined gender and age differences in outcome variables, as well as attrition analyses. Additionally, potential confounds between conditions were examined by

analyzing condition differences in measures of general cognitive ability (verbal comprehension, concept formation, visual matching, theory of mind, and executive functioning). Relations among outcome variables were also examined. After the preliminary analyses, the hypotheses were tested by analyzing children's belief in Sid's problem-solving skills, as well as differences in learning outcomes (memory, analogical transfer, and divergent thinking) between conditions (clever or clumsy). Finally, analyses examined if learning variables related differently to identification and general cognitive ability in the two conditions.

Exclusion criteria, attrition analyses, and missing data. The initial sample consisted of 65 participants. In wave 2, participants were assigned to a condition (clever vs. clumsy) and learning outcomes were measured for the first time. Therefore, participants who did not complete wave 2 and/or the learning outcome measures in wave 2 were not considered in any analyses ($n = 8$). The final sample consisted of 57 participants ($n_{clever} = 29$, $n_{clumsy} = 28$). All analyses were conducted using the lavaan package in RStudio (Rosseel, 2012), and missing data were addressed using the full information maximum likelihood procedure in Rstudio. Attrition analyses showed that participants who dropped out after wave 2, therefore not completing wave 3, did not differ significantly on any of the outcome variables from participants who completed all 3 waves.

Gender and age differences. All variables were examined for gender and age differences. Females ($M = 3.693$, $SD = 1.815$) showed higher theory of mind scores than males ($M = 2.365$, $SD = 2.166$; $t(55) = -2.518$, $p = .015$, Cohen's $d = .665$). No other gender differences emerged.

Age was significantly correlated with verbal comprehension ($r = .426$, $p = .001$), concept formation ($r = .313$, $p = .019$), and visual matching ($r = .378$, $p = .004$). These correlational

results confirm the validity of these measures, as performance on these measures would be expected to increase with age. Age was not significantly correlated with any other outcome variables.

Outcome variables between conditions. To ensure there were no confounding differences between experimental groups, all non-learning variables were analyzed for condition differences. No group differences were observed for social realism ($t(55) = .699, p = .488$, Cohen's $d = .144$); executive functioning ($t(55) = .224, p = .824$, Cohen's $d = .025$); theory of mind ($t(55) = -.696, p = .489$, Cohen's $d = .184$); verbal comprehension ($t(55) = .278, p = .782$, Cohen's $d = .074$); visual matching ($t(55) = -.758, p = .452$, Cohen's $d = .201$); or identification with Sid ($t(55) = .357, p = .722$, Cohen's $d = .185$). There was a significant difference between the clever ($M = 4.471, SD = .876$) and clumsy ($M = 4.689, SD = 1.261$) groups in concept formation ($t(55) = 2.565, p = .013$, Cohen's $d = .678$).

Children's belief in Sid's problem-solving skills. To test Hypothesis 1, a t -test was conducted examining children's ratings of Sid's expertise between conditions (clever vs. clumsy). Although children in the clever condition ($M = 1.191, SD = 2.835$) rated Sid's expertise as higher than children in the clumsy condition ($M = 1.034, SD = 2.332$), there was not a significant difference ($t(55) = .228, p = .821$, Cohen's $d = .060$; see Figure 1).

Differences in learning outcomes by condition. To test Hypotheses 2 and 3, bivariate correlations were run between all outcome variables with the learning variables (see Table 1). There was a strong correlation between social realism and verbal comprehension ($r = -.577, p < .001$), and a moderate correlation between social realism and identification with Sid ($r = .308, p = .020$). Verbal comprehension was moderately correlated with concept formation ($r = .308, p = .020$) and strongly with visual matching ($r = .572, p < .001$), and moderately correlated with

identification with Sid ($r = -.311, p = .018$). Concept formation was moderately correlated with visual matching ($r = .345, p = .009$) and with identification with Sid ($r = -.347, p = .008$). Visual matching was also moderately correlated with identification with Sid ($r = -.420, p = .001$). The learning outcomes (memory, analogical transfer, and divergent thinking) were not correlated with any other variables. (However, analogical transfer and divergent thinking were moderately correlated with each other ($r = -.270, p = .043$), but this is to be expected, given the schemes with which they were coded.) Identification with Sid was strongly correlated with belief about Sid's expertise ($r = .332, p = .012$), suggesting that the more children identified with Sid, the higher they rated Sid's expertise at solving problems.

To test Hypothesis 2, t -tests were conducted to examine differences in learning outcomes between groups (clever vs. clumsy). No significant differences were found between groups in memory scores ($M_{clever} = 2.386, SD = 1.375; M_{clumsy} = 1.970, SD = 1.277; t(55) = 1.186, p = .241$, Cohen's $d = .314$), analogical transfer scores ($M_{clever} = 15.886, SD = 8.331; M_{clumsy} = 16.408, SD = 7.013; t(55) = -.256, p = .799$, Cohen's $d = .068$), or divergent thinking scores ($M_{clever} = 3.208, SD = 4.527; M_{clumsy} = 4.037, SD = 4.420; t(55) = -.699, p = .487$, Cohen's $d = .185$). See Table 1 for information about means and standard deviations between groups, and Figures 2, 3, and 4 for a visualization of these t -test results.

To test Hypothesis 3, bivariate correlations were conducted examining relationships between identification with Sid and the learning outcomes (memory, analogical transfer, and divergent thinking). There was a small but nonsignificant correlation between identification and memory ($r = .058, p = .669$), analogical transfer ($r = -.023, p = .866$), and divergent thinking ($r = .087, p = .522$).

Correlations by condition. To further examine what might be happening in each condition group, bivariate correlations were conducted within both condition groups. The bivariate correlations included memory, analogical transfer, divergent thinking, social realism, identification with Sid, theory of mind, and belief in Sid's expertise. In the clever condition (see Table 3), memory scores were moderately correlated with analogical transfer scores ($r = -.382, p = .041$). There were no other significant correlations in the clever condition. In the clumsy condition (see Table 4), analogical transfer was moderately correlated with theory of mind scores ($r = .456, p = .015$). Additionally, character realism was strongly correlated with belief in Sid's expertise ($r = .584, p = .001$), indicating that the more children believed Sid was real, the more they also believed him to be an expert at solving problems. Lastly, identification with Sid was moderately correlated with theory of mind scores ($r = .401, p = .035$), indicating that the more sophisticated theory of mind a child had, the more they identified with Sid.

Differences between waves. To examine differences between conditions in the outcome variables by waves, *t*-tests were conducted, which showed that no differences existed between the following variables by wave between conditions: memory (wave 2: $t(55) = 1.271, p = .209$, Cohen's $d = .337$; wave 3: $t(55) = .975, p = .334$, Cohen's $d = .258$), analogical transfer (wave 2: $t(55) = -.437, p = .664$, Cohen's $d = .116$; wave 3: $t(55) = -.692, p = .492$, Cohen's $d = .182$), divergent thinking (wave 2: $t(55) = -.941, p = .351$, Cohen's $d = .249$; wave 3: $t(55) = .289, p = .774$, Cohen's $d = .076$), character realism (wave 2: $t(55) = .884, p = .164$, Cohen's $d = .374$; wave 3: $t(55) = .429, p = .948$, Cohen's $d = .881$), identification with Sid (wave 1: $t(55) = .930, p = .351$, Cohen's $d = .250$; wave 2: $t(55) = .480, p = .722$, Cohen's $d = .529$), and belief in Sid's expertise (wave 1: $t(55) = .729, p = .937$, Cohen's $d = .021$; wave 2: $t(55) = .009, p = .372$, Cohen's $d = .239$).

To test Hypothesis 4, equivalence tests (two-one-sample tests, or TOST; Lakens, 2017) were conducted to assess whether there were differences in outcome variables between waves. For memory scores, the TOST procedure indicated that the observed effect size ($d_z = 0$) was significantly within the equivalent bounds of $-.4$ and $.4$ scale points ($t(56) = 3.09, p = .002$). For transfer scores, the TOST procedure indicated that the observed effect size ($d_z = .04$) was not significantly within the equivalent bounds of $-.4$ and $.4$ scale points ($t(56) = -.1, p = .461$). For divergent thinking scores, the TOST procedure indicated that the observed effect size ($d_z = .1$) was not significantly within the equivalent bounds of $-.4$ and $.4$ scale points ($t(56) = -.350, p = .363$). In other words, memory scores remained persisted across waves, but transfer and divergent thinking scores did not. Transfer and divergent thinking scores increased across waves, but not significantly so (transfer: $t(56) = -.299, p = .766$; divergent thinking: $t(56) = -.729, p = .469$).

However, character realism significantly increased from wave 2 to wave 3 ($t(56) = -3.314, p = .002$), Cohen's $d = .341$). Belief in Sid's problem-solving expertise increased significantly from wave 1 to wave 2 ($t(56) = 6.275, p < .001$, Cohen's $d = 1.166$), and identification with Sid significantly increased from wave 1 to wave 2 as well ($t(56) = 2.206, p = .032$, Cohen's $d = .274$).

Discussion

The current study examined (a) if children's trust in a character's expertise can be increased or decreased, (b) if this increased or decreased character trust is related to learning, (c) if children's self-reported identification with the character relates to learning, and (d) if this learning will persist after a week's time. Past research has examined children's ability to judge sources of information (Corriveau & Harris, 2009; Corriveau, Pickard, & Harris, 2010; Jaswal &

Neely, 2006; Koenig & Harris, 2005; VanderBorghet & Jaswal, 2009), and how fantasy content and identification relate to learning from educational media (Calvert et al., 2007; Cingel & Krcmar, 2017; Richert & Smith, 2011), but to our knowledge, no study has sought to examine how all of these factors contribute to learning over time. The children in this study did not display higher levels of trust in the character's expertise, despite the character being presented to them as either clever when solving problems or clumsy. Additionally, children's trust in Sid's expertise was not related to any of the learning outcomes of memory, analogical transfer, or divergent thinking. Children to whom Sid was presented as clever or clumsy did not differ from each other in any of the learning outcome variables. Children's levels of identification with Sid were not related to whether they learned from Sid, and memory scores did not significantly change after one week.

Some more recent research has shed light on how children judge sources of information, which might help to explain why no relation was found between trust in the character's expertise and learning in the current study. Landrum, Mills, and Johnston (2013) found that when children were given information about whether informants were nice or mean, children often chose the nice expert over the mean one, even when the nice expert's expertise was irrelevant to the claim children were being asked to evaluate. While the Landrum et al. (2013) study does not provide the entire answer as to how children judge informants, it does show that there is more to discover about the way children decide whether or not to trust information.

An interesting identification-related finding did emerge. Identification with Sid was strongly correlated with belief about Sid's expertise, suggesting that the more children identified with Sid, the higher they rated Sid's expertise at solving problems. This finding might have emerged because of children's tendency to rate their own skills and abilities highly. One study

found that when children were asked to rate how they believed they would perform on several physical tasks, they overestimated on almost all tasks, based on their actual performance (Almeida, Luz, Martins, & Cordovil, 2017). Additionally, young children have been found to overestimate their memory recall abilities, and that these judgments are only minimally informed by their previous performance (Yussen & Levy, 1975). A different series of studies found that young children overestimate their skills on academic tasks and have unrealistic expectations for their future performance (Stipek, 1981; Stipek & Hoffman, 1980; Stipek, Roberts, & Sanborn, 1984). Given this body of research, it might be that children believe their own problem-solving skill-level to be high, and if they identify with Sid, then naturally his problem-solving skills would be high as well. This is also possibly reflected in the finding that the more children believed Sid was real, the more they also believed him to be an expert at solving problems. If Sid is real, he is more like them, and therefore more likely to be good at solving problems.

A few other interesting findings came out of the analyses conducted within conditions. In the clumsy condition, analogical transfer was moderately correlated with theory of mind scores, such that children transferred more when they had a more sophisticated theory of mind. Additionally, the more sophisticated theory of mind a child had, the more they identified with Sid. This is perhaps explained best when considering the content of the stories these children heard about Sid. Sid “solves” problems accidentally or with little effort because solutions fall into his lap. It is probable that at 3-6 years of age, children are not typically devoting special time and effort to problem-solving, and that when they do have a problem, an adult will step in to help solve it (thus, a solution is falling into their lap). Especially considering that the entire sample for this study consisted of children that attend preschool, this explanation can make even more sense, since these children are being aided daily by both parents and teachers. When Sid is

presented as being clumsy, it is possible children can truly relate to this version of Sid more, rather than the version of Sid that is an expert problem-solver.

In the clever condition, an intriguing finding emerged. In the clever condition, memory scores were negatively correlated with analogical transfer scores, suggesting that the more children remembered Sid's solution, the less they transferred it to a novel but similar context. This can be explained using Fisch's capacity model (2000). It is possible that the stories in the clever condition were more taxing for children's working memory, since it required them to pay attention to the steps Sid took to solve the problem, whereas in the clumsy condition, children simply watched as solutions "happened" to Sid. When children's working memory is taxed, this hinders their ability to learn (Fisch, 2000), which could explain why we see a breakdown in the higher levels of learning (Anderson et al., 2001).

Almost none of the hypothesized relationships existed in the data, pointing to the need for more research regarding how to increase or decrease children's trust in an informant, and also the need for more research examining how this increased or decreased informant trust relates to learning. Learning outcomes did not change between waves 2 and 3, but based on the correlational data, this stability is not related to children's trust in Sid's expertise, their identification with Sid, or whether Sid was presented to them as being clever or clumsy. Clearly, the stability of the learning scores is due to something not measured in this study, and future research should examine what contributes to how long children retain STEM-related problem-solving information from educational media. Additionally, since identification with Sid seemed to be related to different variables depending on the condition children were in, future research should attempt to unpack how identification with a media character relates to learning from that character.

Limitations

A limitation in this study is the amount of missing data. From a total of 65 participants, the analyzable sample had to be reduced to 57 due to attrition (children only completing wave 1). Because of this, a second limitation occurred: the clever condition only had 29 participants, while the clumsy condition had 28. A sample size this small in each condition makes it difficult to run more sophisticated statistical testing, and the true effects of any of the outcome variables or the conditions on children's learning is hard to assess.

Another limitation can be found within the manipulation: whether Sid is presented as clever or clumsy. The stories in the clever condition are clear, in that Sid is clearly presented as being clever in each story. However, in the clumsy condition, Sid is portrayed as either clumsy (accidentally tripping over his cat in a search for her, thus finding her) or as solving the problems with low effort ("Look how easy it was!"). Being clumsy and putting in low effort are not interchangeable concepts. Additionally, neither of them is technically opposite of being clever. The stories in the clumsy condition do not indicate that Sid did not *need* to put in low effort, merely that he did not put in high effort because his solutions were either easy or accidental. Future research can change the wording of the stories in the clumsy condition to make them more similar to each other, and also more opposite from the stories in the clever condition.

Conclusions

The current study examined whether children's trust in a character's expertise can be manipulated by how that character is presented to the child. It also examined whether children's trust in a character's expertise is related to how much and whether a child will learn from that character. The current study looked at whether a child's level of identification with a media character increases their learning from that character, and lastly, if their learning from the

character in question will persist over time. While the current study did not find that the presentation of the character related to beliefs about the character's expertise, future research can strengthen this manipulation by clarifying the language used in the stories. Additionally, the current study did not find that believing Sid to be good at solving problems led to increased learning from Sid. Again, strengthening the manipulation used can give a clearer picture of whether a relationship between these two constructs exists.

In the clever condition, children who remembered Sid's solution did worse on the transfer task, indicating a possible working memory tax (Fisch, 2000), which would hinder higher levels of learning (Anderson et al., 2001), such as transfer. However, the clumsy condition produced several interesting relationships between theory of mind, identification, and belief in Sid's expertise. Future research should examine further the role that identification plays in believing a media character to be an expert, and how this can possibly relate to learning STEM concepts from that character.

References

- Almeida, G., Luz, C., Martins, R., & Cordovil, R. (2017). Do children accurately estimate their performance of fundamental movement skills? *Journal of Motor Learning and Development*, 5(2), 193-206. doi: 10.1123/jmld.2016-0030
- Anderson, L. W. (Ed.), Krathwohl, D. R. (Ed.), Airasian, P. W., Cruikshank, K. A., Mayer, R. E., Pintrich, P. R., Raths, J., & Wittrock, M. C. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's Taxonomy of Educational Objectives* (Complete edition). New York: Longman.
- Barr, R., Muentener, P., & Garcia, A. (2007). Age-related changes in deferred imitation from television by 6- to 18-month-olds. *Developmental Science*, 10(6), 910-921. doi: 10.1111/j.1467-7687.2007.00641.x
- Bryant, J., Alexander, A. F., & Brown, D. (1983). Learning from educational television programs. In M. J. A. Howe (Ed.), *Learning from television: Psychological and educational research* (pp. 1-30). London: Academic Press.
- Bloom, B. S. (Ed.), Engelhart, M. D., Furst, E. J., Hill W. H., & Krathwohl, D. R. (1956). *Taxonomy of educational objectives: The classification of educational goals. Handbook 1: Cognitive domain*. New York: David McKay.
- Calvert, S. L., Strong, B. L., Jacobs, E. L., & Conger, E. E. (2007). Interaction and participation for young Hispanic and Caucasian girls' and boys' learning of media content. *Media Psychology*, 9(2), 431-445. doi: 10.1080/15213260701291379
- Charles, R. E., & Runco, M. A. (2001). Developmental trends in the evaluative and divergent thinking of children. *Creativity Research Journal*, 13(3-4), 417-437. doi: 10.1207/S15326934CRJ1334_19

- Corriveau, K., & Harris, P. L. (2009). Choosing your informant: Weighing familiarity and recent accuracy. *Developmental Science*, 12(3), 426-437. doi: 10.1111/j.1467-7687.2008.00792.x
- Corriveau, K., Pickard, K., & Harris, P. L. (2010). Preschoolers trust particular informants when learning new names and new morphological forms. *British Journal of Developmental Psychology*, 29(1), 46-63. doi: 10.1348/2044-835X.002009
- Crawley, A. M., Anderson, D. R., Wilder, A., Williams, M., & Santomero, A. (1999). Effects of repeated exposures to a single episode of the television program *Blue's Clues* on the viewing behaviors and comprehension of preschool children. *Journal of Educational Psychology*, 91(4), 630-637. doi: 10.1037/0022-0663.91.4.630
- Fisch, S. M. (2000). A capacity model of children's comprehension of educational content on television. *Media Psychology*, 2(1), 63-91. doi: 10.1207/s1532785xmep0201_4
- Fisch, S. M. (2004). *Children's learning from educational television: Sesame Street and beyond*. Mahwah, N.J.: Lawrence Erlbaum Associates.
- Hawkins, R. P. (1977). The dimensional structure of children's perceptions of television reality. *Communication Research*, 4(3), 299-320.
- Holyoak, K. J., Junn, E. N., & Billman, D. O. (1984). Development of analogical problem-solving skill. *Child Development*, 55(6), 2042-2055. doi: 10.2307/1129778
- Jaswal, V. K., & Neely, L. A. (2006). Adults don't always know best: Preschoolers use past reliability over age when learning new words. *Psychological Science*, 17(9), 757-758. doi: 10.1111/j.1467-9280.2006.01778.x

- Jowkar-Baniani, G., & Schmuckler, M. A. (2011). Picture perception in infants: Generalization from two-dimensional to three-dimensional displays. *Infancy*, 16(2), 211-226. doi: 10.1111/j.1532-7078.2010.00038.x
- Koenig, M., & Harris, P. L. (2005). Preschoolers mistrust ignorant and inaccurate speakers. *Child Development*, 76(6), 1261-1277. doi: 10.1111/j.1467-8624.2005.00849.x
- Koenig, M. A., & Jaswal, V. K. (2011). Characterizing children's expectations about expertise and incompetence: Halo or pitchfork effects? *Child Development*, 82(5), 1634-1647. doi: 10.1111/j.1467-8624.2011.01618.x
- Lakens, D. (2017). Equivalence tests: A practical primer for *t* tests, correlations, and meta-analyses. *Social Psychological and Personality Science*, 8(4), 355-362. doi: 10.1177/1948550617697177
- Landrum, A. R., Mills, C. M., & Johnston, A. M. (2013). When do children trust the expert? Benevolence information influences children's trust more than expertise. *Developmental Science*, 16(4), 622-638. doi: 10.1111/desc.12059
- Liebes, T., & Katz, E. (1990). *The export of meaning: Cross-cultural readings of "Dallas."* New York: Oxford University Press.
- Lutz, D. J., & Keil, F. C. (2002). Early understanding of the division of cognitive labor. *Child Development*, 73(4), 1073-1084. doi: 10.1111/1467-8624.00458
- Maccoby, E. E., & Wilson, W. C. (1957). Identification and observational learning from films. *The Journal of Abnormal and Social Psychology*, 55(1), 76-87. doi: 10.1037/h0043015
- Mares, M-L., & Acosta, E. E. (2008). Be kind to three-legged dogs: Children's literal interpretations of TV's moral lessons. *Media Psychology*, 11, 377-399. doi: 10.1080/15213260802204355

- Meltzoff, A. N. (1988). Imitation of televised models by infants. *Child Development*, 59(5), 1221-1229. doi: 10.2307/1130485
- Mills, C. M. (2013). Knowing when to doubt: Developing a critical stance when learning from others. *Developmental Psychology*, 49(3), 404-418. doi: 10.1037/a0029500
- Ricci, C. M., & Beal, C. R. (2002). The effect of interactive media on children's story memory. *Journal of Educational Psychology*, 94(1), 138-144. doi: 10.1037/0022-0663.94.1.138
- Richert, R. A., & Schlesinger, M. A. (2017). The role of fantasy-reality distinctions in preschoolers' learning from educational video. *Infant and Child Development*, 26(e2009). doi: 10.1002/icd.2009
- Richert, R. A., & Smith, E. I. (2011). Preschoolers' quarantining of fantasy stories. *Child Development*, 82(4), 1106-1119. doi: 10.1111/j.1467-8624.2011.01603.x
- Rosseel, Y. (2012). Lavaan: An R package for structural equation modeling and more. Version 0.5-12 (BETA). *Journal of Statistical Software*, 48(2), 1-36.
- Runco, M. A. (1986). Divergent thinking and creative performance in gifted and nongifted children. *Educational and Psychological Measurement*, 46(2), 375-384. doi: 10.1177/001316448604600211
- Schlesinger, M. A., Flynn, R. M., & Richert, R. A. (2016). US preschoolers' trust of and learning from media characters. *Journal of Children and Media*, 10(3), 321-340. doi: 10.1080/17482798.2016.1162184
- Sharon, T., & Woolley, J. D. (2004). Do monsters dream? Young children's understanding of the fantasy/reality distinction. *British Journal of Developmental Psychology*, 22, 293-310. doi: 10.1348/026151004323044627

- Skolnick, D., & Bloom, P. (2006). What does Batman think about SpongeBob? Children's understanding of the fantasy/fantasy distinction. *Cognition*, 101(1), B9-B18. doi: 10.1016/j.cognition.2005.10.001
- Stipek, D. J. (1981). Children's perceptions of their own and their classmates' ability. *Journal of Educational Psychology*, 73(3), 404-410. doi: 10.1037/0022-0663.73.3.404
- Stipek, D. J., & Hoffman, J. M. (1980). Development of children's performance-related judgments. *Child Development*, 51(3), 912-914. doi: 10.2307/1129485
- Stipek, D. J., Roberts, T. A., & Sanborn, M. E. (1984). Preschool-age children's performance expectations for themselves and another child as a function of the incentive value of success and the salience of past performance. *Child Development*, 55(6), 1983-1989
- Troseth, G. L., & DeLoache, J. S. (1998). The medium can obscure the message: Young children's understanding of video. *Child Development*, 69(4), 950-965. doi: 10.1111/j.1467-8624.1998.tb06153.x
- VanderBorgh, M., & Jaswal, V. K. (2008). Who knows best? Preschoolers sometimes prefer child informants over adult informants. *Infant and Child Development*, 18(1), 61-71. doi: 10.1002/icd.591
- Vosoughi, S., Roy, D., & Aral, S. (2018). The spread of true and false news online. *Science*, 359(6380), 1146-1151. doi: 10.1126/science.aap9559
- Vossen, H. G. M., Piotrowski, J. T., & Valkenburg, P. M. (2014). Media use and effects in childhood. In J. F. Nussbaum (Ed.), *The handbook of lifespan communication* (pp. 93-112). New York: Peter Lang Publishing.

- Walker, C. M., Gopnik, A., & Ganea, P. A. (2015). Learning to learn from stories: Children's developing sensitivity to the causal structure of fictional worlds. *Child Development*, 86(1), 310-318. doi: 10.1111/cdev.12287
- Weisberg, D. S., Ilgaz, H., Hirsh-Pasek, K., Golinkoff, R., Nicolopoulou, A., & Dickinson, D. K. (2015). Shovels and swords: How realistic and fantastical themes affect children's word learning. *Cognitive Development*, 35, 1-14. doi: 10.1016/j.cogdev.2014.11.001
- Woodcock, R. W., McGrew, K. S., & Mather, N. (2001). *Woodcock-Johnson III Tests of Cognitive Abilities*. Itasca, IL: Riverside Publishing.
- Wright, J. C., Huston, A. C., Reitz, A. L., & Piemyat, S. (1994). Young children's perceptions of television reality: Determinants and developmental differences. *Developmental Psychology*, 30(2), 229-239. doi: 10.1037/0012-1649.30.2.229
- Yussen, S. R., & Levy, V. M. (1975). Developmental changes in predicting one's own span of short-term memory. *Journal of Experimental Child Psychology*, 19(3), 502-508. doi: 10.1016/0022-0965(75)90079-X

Appendix A

STEM XP
Analogical Transfer Tasks
Coding Manual

Coding the Transfer Task (record the largest number)

- 9 – After initial prompt (during the first trial), a) puts spoon on block AND b) puts ball in spoon AND c) pushes down on the other side of the spoon.
- 8 – After secondary prompt, a) puts spoon on block AND b) puts ball in spoon AND c) pushes down on the other side of the spoon
- 7 – After a third prompt (video hint), a) puts spoon on block AND b) puts ball in spoon AND c) pushes down on the other side of the spoon
- 6 – After initial prompt (during the first trial), does a & b OR a & c OR b & c
- 5 – After secondary prompt, does a & b OR a & c OR b & c
- 4 – After a third prompt (video hint), does a & b OR a & c OR b & c
- 3 – After initial prompt (during the first trial), does a OR b OR c
- 2 – After secondary prompt, does a OR b OR c
- 1 – After a third prompt (video hint), does a OR b OR c
- 0 – Does not solve problem; does not attempt OR attempts but does not create lever successfully

***Codes 9-7 identify they made a lever and used it to accomplish the task.**

Divergent Thinking – Divergent Thinking scores indicate to what extent children come up with alternate solutions to the transfer task that are successful. If they use the spoon and block to make a lever, that would NOT count towards divergent thinking scores, but WOULD count as accomplishing the transfer task. Using the spoon OR block can count toward divergent thinking scores. The order of trials in which a child uses one or two items does not matter.

Coding for Divergent Thinking

- 9 – For each trial, child uses a combination of items other than the block and spoon combination to make the ball fly through the air.
- 8 – For two trials, child uses a combination of items other than the block and spoon combination to make the ball fly through the air AND uses 1 item in the last trial to make the ball fly through the air.
- 7 – For one trial, child uses a combination of items other than the block and spoon combination to make the ball fly through the air AND uses 1 item in the other two trials to make the ball fly through the air.
- 6 – For each trial, child uses 1 item to make the ball fly through the air.
- 5 – For two trials, child uses a combination of items other than the block and spoon combination to make the ball fly through the air AND uses 0/no items/block-spoon combination in the last trial to make the ball fly through the air.
- 4 – For one trial, child uses a combination of items other than the block and spoon combination to make the ball fly through the air AND for another trial, child uses 1 item to make the ball fly through the air AND uses 0/no items/block-spoon combination in the last trial to make the ball fly through the air.

- 3 – For **two** trials, child uses 1 item to make the ball fly through the air **AND** uses 0/no items/block-spoon combination in the last trial to make the ball fly through the air.
- 2 – For **one** trial, child uses a combination of items *other than* the block and spoon combination to make the ball fly through the air **AND** uses 0/no items/block-spoon combination in the other two trials to make the ball fly through the air.
- 1 – For **one** trial, child uses 1 item to make the ball fly through the air **AND** uses 0/no items/block-spoon combination in the other two trials to make the ball fly through the air.
- 0 – For **each** trial, child uses 0/no items/block-spoon combination to make the ball fly through the air.

*If using more than two items, items must be functional to solving the problem

Table 1

<i>Group Means and Standard Deviations</i>		
	Clever ($n = 29$)	Clumsy ($n = 28$)
	$M (SD)$	$M (SD)$
Age (years)	4.228 (.653)	4.211 (.711)
Verbal Reasoning	4.920 (.885)	4.861 (.707)
Concept Formation	4.838 (1.363)	3.372 (1.862)
Visual Matching	4.471 (.876)	4.689 (1.261)
Executive Functioning	1.862 (4.139)	1.771 (3.040)
Memory	2.386 (1.375)	1.970 (1.268)
Analogical Transfer	15.886 (8.332)	16.408 (7.013)
Divergent Thinking	3.208 (4.527)	4.037 (4.420)
Identification	7.931 (3.474)	7.318 (3.130)
Character Realism	2.396 (9.909)	3.800 (9.599)

Table 2

Correlations among Age, Standardized Variables, Learning Outcomes, Identification, Character Trust, and Character Realism

Overall Correlations											
	Verbal Reasoning	Concept Formation	Visual Matching	ToM	EF	Character Realism	ID	Character Trust	Memory	Analogical Transfer	Divergent Thinking
Age (years)	.426**	.313*	.378**	.077	-.022	-.065	-.168	.110	-.067	.191	.033
Verbal Reasoning		.308*	.572**	-.245	-.071	-.577**	-.311*	.121	.139	.219	.011
Concept Formation			.345**	.100	-.061	-.168	-.347**	.117	-.120	.048	-.007
Visual Matching				-.217	-.184	-.161	-.420**	.058	-.014	.083	.140
Theory of Mind					-.003	.069	.139	-.065	.047	.204	-.057
Executive Functioning						.132	-.063	-.149	.215	-.237	-.085
Character Realism							.308*	.257	-.080	-.138	-.006
Identification								.332*	.058	-.023	.087
Character Trust									-.072	.087	-.143
Memory										-.116	-.025
Analogical Transfer											-.270*

* $p < .05$; ** $p < .01$

EF = Executive Function

ToM = Theory of Mind

ID = Identification

Table 3

Correlations among Learning Outcomes, Character Realism, Identification, Theory of Mind, and Character Trust in the Clever Condition

	Analogical Transfer	Divergent Thinking	Character Realism	Identification	Theory of Mind	Character Trust
Memory	-.382*	.176	-.247	.119	-.119	-.161
Analogical Transfer		-.589**	-.100	.028	-.016	.312
Divergent Thinking			-.008	.156	-.041	-.155
Character Realism				.316	-.018	.013
Identification					-.085	.353
Theory of Mind						-.266

* $p < .05$; ** $p < .01$

Table 4

Correlations among Learning Outcomes, Character Realism, Identification, Theory of Mind, and Character Trust in the Clumsy Condition

	Analogical Transfer	Divergent Thinking	Character Realism	Identification	Theory of Mind	Character Trust
Memory	.248	-.225	.136	-.051	.255	.034
Analogical Transfer		.121	-.195	-.085	.456*	-.248
Divergent Thinking			-.019	.026	-.092	-.123
Character Realism				.319	.142	.584**
Identification					.401*	.302
Theory of Mind						.176

* $p < .05$; ** $p < .01$