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Children's Causal Learning from Fiction: Assessing the Proximity Between Real and Fictional Worlds

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Abstract

Fictional information presents a unique challenge to the developing child. Children must learn when it is appropriate to transfer information from the fictional space to the real world and what contextual cues should be considered in this decision. The current research explores children's causal inferences between fictional representations and reality by examining their developing sensitivity to the proximity of the fictional world to the real world, and the effect of this judgment on their subsequent generalization of novel causal properties. By 3-years of age, children are able to evaluate the data that they receive from fictional stories in order to inform their generalization of novel story content to the real world. Additionally, as children develop, they become better able to discriminate between close (realistic) and far (fantastical) fictional worlds when assessing which stories are likely to provide relevant causal knowledge.

Keywords: causal inference; fiction; cognitive development; prior knowledge; representation

The 'Reader's Dilemma'

Children's growing knowledge about the world comes from a variety of sources, including their exposure to fictional material. In fact, much of the unfamiliar information that children encounter appears in the context of stories and fantastical representations of the world. Children, like adults, therefore often encounter the "reader's dilemma": the need to compartmentalize fictional information to insulate real world knowledge from false facts, and the simultaneous need to incorporate this information due to its potential application to a host of real world topics (Gerrig & Prentice, 1999; Potts, St. John, & Kirson, 1989). There is substantial evidence in developmental psychology that indicates that the ability to distinguish reality from fiction develops significantly during the preschool years (e.g., DeLoache, Pierroutakos, Uttal, Rosengren, & Gottlieb, 1998; Flavell, Flavell, & Green, 1989; Woolley & Cox, 2007; Woolley & Wellman, 1990; Woolley & Van Reet, 2006). However, very little research has explored children's ability to learn causal information about the real world from their exposure to fictional material.

Fictional information presents a unique challenge to the developing child. Research has shown that the transfer of knowledge is generally facilitated by similarity between the context in which the information is learned, and the context in which it is to be applied (Catranbone & Holyoak, 1989; Spencer & Weisberg, 1986). However, many of the learning contexts that are created for young children act to *reduce*

this perceived similarity by presenting information in a fictional world that seamlessly interweaves fantasy and reality (Woolley & Cox, 2007). Even in explicitly pedagogical scenarios, teachers often embed their intended curriculum within a fantasy context. This decision is based on the assumption that fictional worlds are more engaging to the young child, and may therefore encourage increased sustained attention and learning of novel material (Harris, 2000; Renninger & Wozniak, 1985).

Previous research supports the proposal that fantasy contexts serve to improve children's performance on certain types of cognitive tasks, such as deductive and syllogistic reasoning and theory of mind (e.g., Dias & Harris, 1988; Dias, Roazzi, & Harris, 2005; Hawkins, Pea, Glick & Scribner, 1984; Richards & Sanderson, 1999; Lillard & Sobel, 1999; Sobel & Lillard, 2001). For example, according to Dias et al. (2005), placing an unfamiliar premise in a fantastical context – particularly when the premise directly contradicts a currently-held theory – allows children to override their natural empirical orientation, or bias to reason in line with their past experiences. It is unknown, however, how learning and generalization of novel causal information (which does not require the suspension of existing knowledge) is affected by the fantastical contexts of the fictional stories in which this information is embedded.

The ability to effectively process fictional information is dependent upon a variety of representational skills, including at least two major factors that are unique to learning from fictional material. The first includes the development of a mature concept about the boundary between the fictional and real world, as well as an understanding of what information is more appropriately quarantined to the fictional space. Second, it is necessary for children to develop an understanding of when it is appropriate to transfer information from the fictional to the real world, and what contextual cues should be considered in this decision. The current research explores the early development of each of these factors, and in particular, examines whether children's sensitivity to contextual cues in fictional worlds changes over the course of development.

Children's Beliefs about Fictional Worlds

There is a growing literature in developmental psychology regarding when and how children distinguish between fantasy and reality. Methods for testing this distinction vary

greatly, and include assessing children's beliefs about their imaginary companions (e.g., Taylor, 1999), their beliefs in magic (e.g., Rosengren Kalish, Hickling, & Gelman, 1994), and directly asking children about their beliefs in familiar and novel fantastical entities (e.g., Clark, 1995; Woolley & Van Reet, 2006). There has also been some work specifically aimed at assessing children's beliefs about the reality status of fictional content in storybooks (e.g., Morison & Gardner, 1978; Wellman & Estes, 1986; Woolley & Cox, 2006). Taken together, this research has shown that children do distinguish fantasy characters from real ones, and that (depending on the particular method and the nature of the task) this ability matures between 3- and 6-years of age.

Related research also indicates that children differentiate the particular contexts in which they encounter information in storybooks from a relatively young age. For example, Woolley & Cox (2006; 2007) presented preschoolers with realistic, fantastical, or religious stories in a variety of contexts and found that while 3-year-olds were more likely to judge characters as real than were 4- and 5-year-olds, most children accurately judged all characters as not real for all story types. They also found that children made more claims that the realistic story events "could happen in real life" than they did for fantastical story events, which indicates that context matters in the formation of these judgments. While this work explores children's willingness to believe that the story events themselves could happen in real life, the authors do not consider whether children learn and apply the information presented in the storybook to real world scenarios.

According to a study conducted by Skolnick & Bloom (2006), children conceptualize multiple fictional worlds as separate from one another, and separate from the real world. Given children's tendency to quarantine fictional worlds from the real world, it is possible that children also consider the content of these worlds to be distinct, regardless of the assessed possibility of the events themselves.

Learning from Stories

Despite the importance of understanding the distinction between fiction and reality, storybooks do often provide important opportunities for children to learn information about the real world that cannot be experienced directly (Ganea, Pickard, & DeLoache, 2007). There is currently a small, but growing number of researchers examining the development of children's ability to learn from picture books and the factors that affect their successful generalization of this newly learned information to the real world (e.g., Ganea, Pickard, & DeLoache, 2008; Ganea, Ma, & DeLoache, 2011; Simcock & Dooley, 2007; Walker, Walker, & Ganea, under review). To date, most of this work has focused primarily on transferring labels and simple concepts from a realistic or factual representation, rather than embedded in the context of a fictional story.

For example, Ganea, et al. (2008) demonstrated that 15- and 18-month-old infants are able to extend newly learned

labels both from picture books to real objects and from real objects to picture books. Additionally, they showed that performance was affected by the iconicity of the pictorial images, indicating that the nature of the represented content matters for transferring labels learned in the context of a picture book interaction. In related work, Ganea, et al. (2011) showed that 3- and 4-year-old children can also learn simple biological information about color camouflage in animals from a single picture book interaction, and apply this newly acquired knowledge to real world situations. These experiments indicate that from a very young age, children are able to incorporate factual information about the real world from minimal exposure to picture books, in certain highly realistic and pedagogical scenarios.

In an attempt to explore children's ability to learn from stories that include fantastical content, Richert, et al. (2009) conducted a series of studies looking at analogical reasoning from picture books to other stories and from picture books to the real world. In three experiments, 3½- to 5-year-old children were presented with analogical problems in the context of a short story which involved either real or fantasy characters. In the first experiment, children were tested on their ability to transfer a solution from a story about familiar fantasy characters to a story about realistic characters, and vice versa. In general, children were more likely to transfer the solution to the novel problem from the real source than from the fantasy source. In the second experiment, children were asked to generalize these same solutions to real world contexts (games that involved the manipulation of physical objects). Again, children were more likely to transfer the solution from the real source than from the fantasy source. Later, Richert and Smith (2011) replicated these findings using more complex stimuli that were introduced in a pedagogical context.

The results of these experiments indicate that the context of a story does affect children's ability to draw analogies between the story content and novel scenarios in the real world. One explanation for these results may be that children are sensitive to the *proximity* of the story world to reality, or the similarity of the causal structure of the fictional world to the real world.

Assessing Proximity of the Fictional World

Fictional worlds that are closer in possibility space (i.e., have higher proximity) share more of the causal structure with the real world, while those that are further away (i.e., have lower proximity) share less. In line with this idea, research with adult participants has demonstrated that the perceived proximity of the fictional world to reality influences participants' decisions to import facts about the real world in making inferences about fictional environments (Skolnick & Goodstein, 2009).

To test this, Skolnick and Goodstein (2009) presented adult participants with three stories that varied in their similarity to reality. They found that participants were more likely to import true facts from the real world to the fictional worlds that were more similar in underlying causal

structure. Adult participants were also more likely to import facts that were considered to be more causally central to the representation of reality (e.g., mathematical facts) to all worlds (regardless of their proximity) than facts that are less central (e.g., conventional or contingent facts). Thus, adults infer that fictional worlds that are more similar to the real world, or closer in possibility space, should contain more facts that are true of the real world. It is currently unknown whether children also display this sensitivity to the distance that a story world lies from reality, and to what extent (if any) this sensitivity to world proximity would affect children’s learning from fictional representations. Examining these issues will inform us about the nature of the mechanisms that underlie learning from fictional material and contribute to a more complete understanding of how causal knowledge is acquired more broadly.

Current Research

In the current research, we explore children’s causal inferences about fictional content and examine whether contextual information influences their subsequent generalization of novel causal properties to the real world. In particular, we examine whether the likelihood that children will generalize novel causal information varies based upon the perceived proximity of the fictional world (with far worlds generating a lower probability of generalization than close worlds), and whether sensitivity to the proximity of the fictional world changes over the course of development.

Participants

One hundred and eight preschoolers participated in the study, including 36 3-year-olds ($M = 43.7$, $SD = 3.9$, range = 37.2 – 48.0), 36 4-year-olds ($M = 54.9$ months, $SD = 3.2$, range = 49.8 – 59.9), and 36 5-year-olds ($M = 66.8$ months, $SD = 2.8$, range = 61.6 – 71.8). An approximately equal number of males and females were included at each age. Eight additional 3-year-olds and two 4-year-olds were tested, but excluded for failure on both memory questions or failure to complete the training for the sorting task. Although most children were from White, middle-class backgrounds, a range of ethnicities resembling the diversity of the local population was represented. All children were recruited from local preschools and museums.

Materials

Two 13-page illustrated storybooks were constructed for the experiment. Both stories depicted human protagonists who go on a family camping trip. One version of the story (the close world) was realistic, including no explicit violations of reality (i.e., all events could have easily taken place in the real world), and the other version of the story (the far world) was fantastical, including major violations of reality. Both stories shared the same general structure and the same number and type of events, but varied in the degree of proximity to the real world (see Table 1 for a list of all major story events and Figure 1 for sample pages).

Table 1: Close World and Far World Story Events.

Close World Events	Far World Events
Drive in car	Fly with magic cape
Find a ladybug	Find a fairy
Climb a tree	Talk with a tree
Raining raindrops	Raining stickers
Smell ‘Popple Flower’	Smell ‘Popple Flower’
Get Hiccups	Get Hiccups
Swim in pond	Swim in chocolate pond

In both stories, a novel (plausible) causal relationship was embedded within context of the other events – smelling a ‘Popple Flower’ causes the protagonist to get the hiccups (see Figure 1). This causal relationship was identical across both versions of the story.



Figure 1: Sample pages from *close world* (top left) and *far world* (top right) versions and the target causal relationship as it appears in both storybooks (bottom).

For the sorting task, eight training cards and two sets of six story event cards were constructed. The eight training cards depicted illustrations of real and fantastical versions of events that did not appear in the story (e.g., a boy eating spaghetti vs. a boy eating lightening). The two sets of story event cards depicted each of the individual story events (see Table 1). One set was constructed for children in the *close world* condition and the other set was constructed for children in the *far world* condition. One of the six cards in each set was an identical depiction of the target causal relationship (i.e., a boy smelling a ‘Popple Flower’ and getting the hiccups).

For the generalization task, we used a 5 x 7 color photograph of a real flower that was similar in shape and color to the illustrated ‘Popple Flower’ in the stories.

Procedure

In a between-subjects design, half of the children in each age group were randomly assigned to the *close world* or *far world* story condition. Children were tested individually, sitting next to the experimenter. The experimenter read one of the two books to the child, interacting naturally, pointing to illustrations, and asking questions in a manner that is typical of parent-child book interactions. The experimenter

introduced the story by saying, “This is a made-up story about a boy who goes on a camping trip.” While children were encouraged to engage with the content of the story, the experimenter provided no additional information over the course of the interaction.

Memory Assessment. Immediately after hearing the story, children were asked two memory questions intended to assess attention and recall. One question assessed recall of the novel causal relationship (“*What happened to the boy in the story when he smelled the Popple Flower?*”). The second question was open-ended, and intended to assess recall for other story events (“*What kinds of things did the boy do on his camping trip in the story?*”). Children were prompted to continue responding until they successfully recalled at least three story events. If children responded with fewer than three events, the experimenter would ask, “did anything else happen?” until the child could no longer recall any more story events. Children who failed both memory questions were excluded from the study.

Sorting task. Children were trained to sort picture cards into “real” and “pretend” piles. The eight training cards were presented, one at a time, and children were instructed to sort the cards into two piles: one pile for things that “can really happen” and one pile for things that “cannot really happen, and are just pretend.” This training was discontinued after children successfully sorted four cards in a row. Children who failed this training were excluded from analysis. Immediately following the training, children were asked to continue sorting, using the six test cards that depicted each of the events that took place in the story (including a card depicting the target causal relationship). As in the training, children were asked to sort each of the depicted events into the “real” pile or the “pretend” pile.

Generalization task. To assess generalization, children were presented with the target causal property that appeared in the story (*smelling ‘Popple Flowers’ causes hiccups*) in a real world context, and asked to judge whether this causal relationship would hold in the real world. To do so, the experimenter showed the child a realistic photograph depicting flowers that were similar in shape and color to the illustrated flowers in the story, saying, “On my way here today, I saw these. I didn’t know what kind of flowers they were, but I smelled them. What do you think happened to me, here in the real world? Do you think that I got the hiccups or that I did not get the hiccups?” The order of presentation of the potential outcomes was counterbalanced. The generalization question was presented in a forced choice format in order to eliminate a “yes” bias. Children received a score of “0” if they responded that the experimenter did not get the hiccups (no generalization) and a score of “1” if they responded that the experimenter did get the hiccups (generalization). The order of the sorting and generalization tasks was counterbalanced.

Results

Nearly all children who were included in the final analysis answered both memory questions correctly (97% of 3-year-olds, 97% of 4-year-olds, and 100% of 5-year-olds). There was no difference found between conditions on the memory assessment, $F(1, 106) = 1.86, p = .18$, indicating that children in both conditions were equally able to recall the content of the story.

Analysis of sorting judgments indicates that children were also sensitive to the presence of fantastical and realistic content in the story that they heard. There were a total of five contextual story events (not including the target causal relationship). Children in the *close world* condition correctly sorted the majority of the realistic story events to the “real pile” ($M = 4.43, SD = 0.93$), while children in the *far world* condition correctly sorted the majority of the fantastic story events to the “pretend pile” ($M = 4.33, SD = 1.06$). While the purpose of the sorting task was to assess whether children were capable of identifying the story events as real or pretend, children were also asked to sort a story event card depicting the target causal relationship (i.e., a boy smelling a ‘Popple Flower’ and getting the hiccups), which served as an additional measure of generalization. Although this story event card was identical in both conditions, children in the *close world* condition were more likely to sort this story event in the “real pile” ($M = .67, SD = .40$), while children in the *far world* condition more likely to sort this story event in the “pretend pile” ($M = .72, SD = .45$), with a significant difference between conditions $\chi^2(108, 1) = 9.69, p < .01$.

Loglinear analysis and chi squares were conducted to assess differences in children’s responses on the generalization task at each age and for each condition. Results appear in Figure 2 below. Results of loglinear analysis demonstrate an effect of condition on generalization, $\chi^2(108, 1) = 27.39, p < .001$, indicating that children successfully differentiated between *close worlds* and *far worlds* when selectively generalizing novel causal information from the story to the real world.

Overall, children in the *close world* condition chose to generalize the target causal information to the real world scenario, $\chi^2(54, 1) = 10.67, p < .01$, with no difference between age groups, $\chi^2(54, 2) = 0.45, p < .80$, indicating that preschoolers are able to generalize novel causal information from realistic stories. Children in the *far world* condition made the opposite inference, with the majority of children choosing not to generalize the target causal information to the real world scenario, $\chi^2(54, 1) = 14.42, p < .001$. While 3-, 4-, and 5-year-olds all generalized more often from the *close world* than from the *far world* ($\chi^2[36, 1] = 5.04, p < .05$; $\chi^2[36, 1] = 7.80, p < .01$; and $\chi^2[36, 1] = 14.57, p < .001$, respectively), our results also provide evidence for a developmental change: children’s willingness to generalize novel causal information from the *far world* decreased (marginally) with age, $\chi^2(54, 2) = 5.67, p = .059$, with 3-year-olds more likely to generalize the target causal relationship (39%) than 4-year-olds (28%) and 5-year-olds

(6%). There was a significant difference between 3- and 5-year-olds' willingness to generalize from the *far world*, $\chi^2(36, 1) = 5.79, p < .02$.

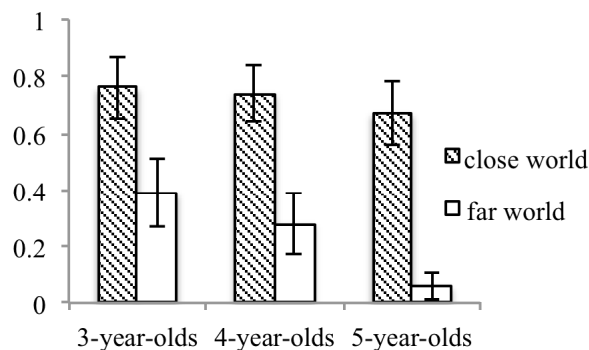


Figure 2. Percentage of 3-, 4-, and 5-year-old children who generalized the target causal relationship from the story to the real world in each condition.

Discussion

The current study examined children's generalization of novel causal information from fictional representations to the real world. Findings provide evidence that preschool-aged children are sensitive to the proximity of the fictional world when selectively learning and applying novel causal information from stories. While children in both *close world* and *far world* conditions were able to remember the target causal relationship embedded in the story, the proximity of the fictional world to reality influenced their subsequent generalization of this novel information. These results demonstrate that children begin to differentiate between close and far fictional worlds from a very early age, and that this sensitivity undergoes a process of developmental change, increasing between 3- and 5-years.

How might this sensitivity to the proximity of fictional worlds develop over time? The development of this ability requires the learner to successfully integrate the information provided in the story with their prior knowledge and beliefs about the causal structure of the real world. However, little was previously known about children's use of prior knowledge when evaluating the applicability of information learned in fictional representations, and how their reliance on this prior knowledge may change over the course of early development.

Recent probabilistic accounts of learning (e.g., Gopnik, Glymour, Sobel, Schulz, Kushnir, & Danks, 2004; Schulz, Bonowitz, & Griffiths, 2007) may provide a natural framework for addressing these questions. According to these accounts, a learner's background knowledge and prior beliefs are productively integrated with new data when forming novel inferences about the causal structure of the world. As prior knowledge increases over the course of development, children will become better able to approximate the true causal structure of the real world. As a result, children's ability to use contextual cues from the

story to inform their decision to generalize novel information should improve over time. For example, if story events are determined to have a high probability of occurring in the real world, children should be more likely to generalize novel causal information learned in this context than in cases in which the story events are determined to have a low probability of occurring in the real world. Therefore, as their prior knowledge about the causal structure of real world increases, children become better able to evaluate the information that they receive from fictional contexts to inform and structure their own learning.

Similarly, children's developing sensitivity to the proximity between fictional worlds and reality may be mediated by their increasing prior knowledge about the nature of fantastical representations. Previous research has shown that children who score higher on fantasy orientation scales (i.e., children who have more experience engaging with fantasy worlds) are less likely to transfer solutions to analogical problems from fantastical stories to real world scenarios (Richert & Smith, 2011). In other words, those children with the greatest amount of prior knowledge about fantastical representations are the least likely to draw analogies between worlds. One explanation for these findings is that children with more experience with fantastical representations have developed an increased appreciation of the distinction between the causal structure of *far worlds* and reality, which may lead to the sophisticated strategy of quarantining causal information acquired from these fantastical contexts. The developmental change that we document in the current study provides evidence for each of these related proposals. Future research should further explore the particular type of prior knowledge – knowledge about the true causal structure of the real world, knowledge about the nature of fictional representations, or some combination of the two – that is most relevant to developing this sensitivity during early childhood.

In sum, our findings demonstrate that by 3-years of age, children are already able to evaluate the data that they receive from fictional stories in order to inform their generalization of novel story content to the real world. Additionally, as children develop, they become better able to discriminate between close and far fictional worlds when assessing which stories are likely to provide relevant causal knowledge about the real world. These findings have important implications for educational contexts that rely upon children's literature to present intended curriculum. Storybooks provide rich opportunities for children to learn about aspects of the world that are otherwise inaccessible to them. However, because children's selective learning from storybooks is at least partly contingent upon the perceived proximity between worlds, the presence of fantastical events may inadvertently undermine educational goals. By explicitly directing children to the generalizable information in fictional stories, adults may help young learners to negotiate the complex relationship between fictional worlds and reality.

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