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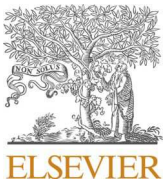

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Understanding pretense as causal inference☆

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ABSTRACT

There is a long-standing interest in the role that children's understanding of pretense plays in their more general theory of mind development. Some argue that children understand pretense as a mental state, and the capacity to pretend is indicative of children possessing the capacity for mental representations. Others argue that children understand pretense in terms of actions and appearances, and an understanding of the mental states involved in pretending has a prolonged developmental trajectory. The goal of this paper is to integrate these ideas by positing that children understand pretense as a form of causal inference, which is based on both their general causal reasoning capacities and specific knowledge of mental states. I will first review literature on children's understanding of pretense, and how such understanding can be conceptualized as integrating with children's causal reasoning ability. I will then consider how children's causal knowledge affects the ways they make inferences about others' pretense. Next, I will consider the role of causal knowledge more broadly in children's reasoning about pretense worlds, judgments of possibility, and counterfactual reasoning. Taken together the goal of this review is to synthesize how children understand pretending into a rational constructivist framework for understanding social cognitive development in a more integrative manner.

Researchers interested in theory of mind – the ways in which children understand their own and others' mental states – have often paid attention to the literature on children's pretending. In order to understand that others are pretending, children must reason about a representation of the world, which is in fact different from reality (Leslie, 1987; Lillard, 1993a). A block being 'fed' to a Teddy can represent a cake, and has particular cake-like qualities during this pretense (it's sweet, it's soft), even though there is no confusion on the part of the child that it is actually inedible and unfrosted. Such representational capacities are also necessary to reason successfully about others' false beliefs (e.g., Gopnik & Astington, 1988; Perner et al., 1987; Wimmer & Perner, 1983). In order to infer what another person will think is inside a deceptive container (that there are pencils in a candy box), children must put aside the container's actual contents in favor of a false representation. Children, however, understand others' pretense actions and engage in coherent social pretense with others at earlier ages (certainly by ~ 30 months, and possibly younger, see e.g., Harris & Kavanaugh, 1993) than they typically succeed on these standard measures of false belief performance (around age 4, see e.g., Wellman et al., 2001).

There have been two explanations for why children's understanding of others' pretense emerges earlier than their inferences about others' false beliefs. One possibility is that young children appreciate the representational nature of pretending before they understand the analogous representational nature of belief (e.g., Leslie, 1987, 1994). On this view, self-generated pretense is indicative that children have the representational capacity to understand that others are pretending (and is similar to, or used for, understanding

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others' belief states).

A second possibility is that before the age of 4, young children do not possess the representational capacities to understand either pretending or belief, and that their pretense behaviors do not indicate such capacity. This view suggests that although young children engage in pretend play at early ages, their appreciation of the representational nature of pretense (or even that it is a mental state) has a more prolonged developmental trajectory (Lillard, 1993a, 2001; Richert & Lillard, 2002). This hypothesis does not mean that children fail to appreciate or fail to engage with others during social pretense (e.g., Peterson & Wellman, 2009). Rather, it suggests that doing so does not indicate the same kind of representational capacities used in understanding others' false beliefs.

The goal of this paper is to consider a third account of children's understanding of pretense, which potentially reconciles the dialogue between these two views. Following the framework of rational constructivism, I posit that children represent their conceptual knowledge as a set of abstract, coherent networks of causal relations (Gopnik & Wellman, 2012; Xu & Kushnir, 2013). To apply this idea to children's pretending, understanding whether another person is pretending involves reasoning about one's representation of the causal relations among a set of mental states and behaviors.

To lay out this argument, I will first describe the empirical findings that suggest that young children have precocious and sophisticated representational abilities related to understanding others' pretense as well as other empirical findings that suggest that it is only at much older ages that children have such capacities. I will then consider ways of synthesizing these literatures by treating understanding others' pretense as a causal inference. I next consider the broader connections between pretense and causal knowledge. This includes how children discern fantasy from reality (a form of understanding what is uniquely pretense), how children understand fictional worlds (a form of appreciating what can and cannot happen when appreciating a pretense world created by another) and how children engage in counterfactual reasoning (a form of pretending about causal relations that will occur or could have occurred). In each case, I will consider how judgments about pretense are constrained by causal knoweldge. Finally, I examine the possibilty that the emergence of pretending is indicative of a broader imaginative system necessary for causal reasoning and learning.

Young children's understanding of pretense as mentalistic

Pretend actions involving object substitution (such as holding a banana up to one's ear and talking to it, like a telephone) could be seen as a mistake or a confusion about the objects' identity. That is, children who pretend bananas are telephones could be intepreted as indicating that children think something false about the world (i.e., that fruits are communication devices). Moreover, children who see others pretend in this way might become confused about the ontological structure of fruit. Attributing pretense representations allows children to not make this error.

How? One hypothesis, notably argued by Leslie (1987), suggests that the emergence of pretend play behaviors on the part of young children indicates that they possess the capacity to understand others' mental states as involving pretend representation different from the world (this will be referred to as the *mentalistic* hypothesis). Leslie observed that young children engage in spontaneous pretending at approximately 18 months of age (e.g., Fenson & Ramsay, 1980; Largo & Howard, 1979; Piaget, 1962). This behavior indicates children's ability to hold what he refers to as *M−representations*, which form the basis of their theory of mind understanding. Children possess the capacity to represent what they perceive in the world (what Leslie calls *primary* representations). For example, when they see a banana, their primary representation is that that object is *banana*, and that representation indicates the "direct semantic relation with the world" (Leslie, 1987, p. 414) that a banana would have (in all of its fruity glory, which does not include it being a communication device). The M−representations provide children with a relational structure between the primary representation of an object and a second, pretend representation, which is decoupled from the primary representation. So, when one talks into a banana and pretends it is a phone, the decoupled representation of phone is *quarantined* from the primary representation of banana. In this way, children do not suffer what Leslie (1987) calls *representational abuse* (i.e., thinking that one should talk into bananas into order to converse on the telephone, or put more simply, updating the primary representation of phones to include bananas[1]). Critically, engaging in pretend play also indicates that children can make the same kinds of inferences in the pretenses they observe.

Three lines of evidence support the hypothesis that young children's emerging capacity for pretense indicates broader meta-representational abilities related to their theory of mind development. First, there are several correlational studies demonstrating significant correlations between children's pretending or their understanding of pretense and their success on other tasks involving mental representation. For example, preschoolers' engagement in pretense predicts their success on standard false belief measures and other measures of their developing social cognition (e.g., Astington & Jenkins, 1995; Cutting and Dunn (1999); Hughes & Dunn, 1997; Lalonde & Chandler, 1995; Lillard, 2002; Schwebel et al., 1999; Youngblade & Dunn, 1995). Relatedly, the quality of that pretense, such as whether children have stable imaginary companions (e.g., Taylor & Carlson, 1997) also significantly correlates with children's early success on false belief measures.

Second, young preschoolers have some understanding of the mental states of pretenders. For instance, several studies have shown that 3-year-olds recognize that pretenders are thinking about what they are pretending to be (Bruell & Woolley, 1998; Custer, 1996; Hickling, Wellman, & Gottfried, 1997; Rosen, Schwebel, & Singer, 1997). Similarly, various studies have shown that 3-year-olds appreciate that pretenders are trying to act like what they are pretending to be (Joseph, 1998; Rakoczy et al., 2004). Still other studies suggest that preschoolers recognize that a pretender who acts in a manner consistent with two referents (e.g., jumping like a kangaroo or a rabbit), but only knows about one of those animals (i.e., knows about kangaroos but not rabbits) is thinking about what

[1] This example is one of object substitution, but such representational abuse can occur for object properties or imaginary objects as well, see Leslie (1987), for details.

s/he knows about and not what s/he does not know about (Aronson & Golomb, 1999; Davis et al., 2002). These investigations suggest that preschoolers have some understanding of the relation among pretending and other mental states, and specifically what the act of pretending indicates about pretenders' mental attitudes.

Third, using various looking-time techniques, infants appear capable of registering when others are acting under a false belief (e.g., Kovács et al., 2010; Onishi & Baillargeon, 2005; Scott & Baillargeon, 2009; Southgate et al., 2007; Surian et al., 2007). One could argue that these results indicate the emergence of the representational capacities Leslie (1987) suggested were necessary for pretending (what Scott & Baillargeon, 2009 called *Subsystem 2*).

In favor of this hypothesis, Onishi et al. (2007) found that 15-month-olds responded to violations in the coherence of pretense actions: When shown an actor pretend to pour water into one of two cups, infants stared longer when the actor then proceeded to pretend to drink out of the 'empty' cup than the 'full' one. Relatedly, Bosco et al. (2006) showed that toddlers make similar inferences about real actions as they do pretense ones; toddlers had no difficulty understanding coherent real actions (pouring water into a cup and drinking from the full cup) and understanding similar pretense actions (pretending to pour water into a cup and drinking from the 'full' cup). They also showed that with only a small amount of scaffolding, toddlers could appreciate a sequence of pretend actions (i.e., pretending to pour water into one of two "cups", which are really shoes, and drinking from the full one, see also Harris & Kavanaugh, 1993, for similar work on older children).

To summarize these arguments, children's ability to pretend and to understand others' pretending without confusing the identity of objects or situations begins during the second year of life. It is suggestive of the emergence of a capacity to separate pretense representations from primary ones. This capacity allows children to develop and articulate an understanding of the representational structure of pretense as well as other mental states.

Young children's understanding of pretense as *Acting-as-If*

Several researchers (e.g., Harris, 1994; Lillard, 1993a, 2001; Perner, 1991; Wellman, 1990) have challenged the view that children's early emerging ability to pretend indicates that they necessarily possess the representational capacities to understand others' minds. These researchers each offer slightly different theoertical accounts (see e.g., Perner et al., 1994), but the one I will probe in detail is that at young ages, children appreciate pretending as *acting-as-if*, and do not register anything about the pretender's mental states or attitudes.

Two lines of research are relevant here. The first has been to consider empirical findings that challenge data in support of the mentalistic account. But these data on their own do not support the acting-as-if hypothesis. The second has been to consider empirical work that supports the hypothesis that children interpret others' pretending as acting-as-if. I will consider these two arguments in detail in the next sections.

Empirical challenges to the mentalistic account

In his support of the mentalistic hypothesis, Leslie (1994) states the following question: "When the child first becomes able to pretend herself (solitary pretence), why does she also gain the ability to understand pretence-in-others?" (p. 216). Is this true? Does solitary pretense and understanding that others are pretending (or social pretense more generally construed) emerge at the same time?

Very young children do appear to appreciate behavioral cues that indicate pretense in others – ostensive *signs of pretense* that communicate the action being generated is not intended to be taken as real (e.g., Lillard et al., 2007; Lillard & Witherington, 2004; Richert & Lillard, 2004). These investigations typically examine toddlers' appreciation of the actions that adults show them, and find that toddlers react differently to adults' real and pretend actions. This suggests that toddlers might appreciate pretense acts. Observational studies, however, have suggested that children's social pretend play is typically observed after the emergence of their own solitary pretense (e.g., Howes, 1985; Rubin et al., 1983).

Moreover, at slightly older ages children seem to appreciate the causal ramifications of others' pretense actions. Harris and Kavanaugh (1993) showed that young 2-year-olds understand that if another person pretends to spill water on the table, children will appreciate that the table is now "wet". These results question whether children's solitary pretense (that emerges at younger ages) is necessarily related to their understanding that others are pretending. The signs of pretense findings can also be interpreted in two distinct ways. Children might use others' behavioral cues to indicate particular mental attitudes related to pretending, consistent with the mentalistic hypothesis.

Alternatively, children might interpret these behavioral cues as indicators of a different kind of action without appreciating any underlying mental states of the actor. For example, recall that Onishi et al. (2007) showed that 15-month-olds discriminated between actions that were consistent and inconsistent with a pretense representation. In a reproduction of this work, Tee and Dissanayake (2011) found that while 15-month-olds differentiated between expected and unexpected pretense actions, they also differentiated between the analogous expected and unexpected real action. Although Leslie and colleagues interpret these data as indicating that very young children appreciate pretense representations (and do so no differently than the primary representations inherent in understanding real actions), Tee and Dissanayake suggest that what infants are sensitive to is the coherence and incoherence of sequences of actions. That is, when an actor pretends to pour water into a cup and then reaches for the other cup, what children react to is the inconsistency in the action and not an understanding of pretense. Such a theoretical interpretaion relates to infants' capacity to sequence actions (e.g., Baldwin et al., 2001; Hespos et al., 2009; Saylor et al., 2007, see also Buchsbaum et al., 2012, for similar findings on older children), and indicates more of a behavioral understanding of pretense than a mentalistic one.

These findings suggest that young children might be interpreting others' pretense actions not in terms of their mental

representations, but rather just based on their observed behavior. But these findings only suggest the possibilty of an alternate account. They do not directly contradict the hypothesis that children have an understanding of others' minds when they view pretend play. Such data are considered in the next section.

Empirical support for "Acting as if" hypothesis

A different challenge to the mentalistic hypothesis comes from work that specifically posits an alternative interpretation to the mentalistic hypothesis: that pretending is "acting-as-if" – a set of behaviors no different from walking or moving, and interpreted by young children not in any mentalistic way. In these studies, researchers introduce children to a character and set up a conflict between the character's actions or appeareance, which is consistent with the character pretending, and the character's mental states, which indicate that the character is not pretending. For instance, Lillard (1993b) found that the 4-year-olds she tested would state that a character who lacks knowledge of an animal, but is nonetheless acting like that animal, is pretending to be that animal. For example, children are introduced to Moe the Troll, who is hopping up and down, and looks like a kangaroo. But in the Land of the Trolls, there are no kangaroos, and Moe does not know about them, nor that they hop. Across several studies, the children Lillard tested nevertheless stated that Moe is pretending to be a kangaroo. Moreover, these same children pass standard false belief measures, suggesting that their understanding that others are pretending is not linked to their more general capacities for mental representation. Using this paradigm (which I will refer to as *The Moe Task*), an understanding of pretense based on children using the character's mental states as opposed to their actions, develops around age 7 (Richert & Lillard, 2002).

These findings extend to other mental states besides knowledge. Across various studies, 4-year-olds who typically succeed on standard false belief measures also fail to understand the role of intentional action or that one must be aware that one is pretending. For example, Moe the Troll could be hopping up and down like a kangaroo, but not trying to be one. Four-year-olds who were read a story about such characters stated that they are pretending to be a kangaroo roughly 60–65 % of the time (e.g., Ganea et al., 2004; Lillard, 1998; Sobel, 2007). Similarly, a character could fall in the mud and emerge with muddy stripes on his clothes, giving him the appearance of a tiger, but not know about his appearance; four-year-olds who were read a story about such a character stated that they were pretending to be a tiger, again ~ 65 % of the time (Sobel, 2004a).

There is much debate over whether these kind of studies – studies that present a conflict between characters' mental states and their actions or appearance – accurately test children's understanding of pretense (see e.g., Aronson & Golomb, 1999; Hickling, Wellman, & Gottfried, 1997; Rosen, Schwebel, & Singer, 1997; Woolley, 1995, although see Lillard, 2001). But also consistent with the acting-as-if hypothesis are studies that suggest children do not understand that pretense itself involves mental states or the brain. For example, in studies where preschoolers are asked whether mental states involve the brain, the children only state that a person needs their brain to pretend 35 % of the time (Lillard, 1996; Sobel & Lillard, 2002). Similarly, in studies where Moe is replaced by an inanimate object that acts like the object of a pretense, children state that the object is pretending (e.g., children claim that a spinning top that "looks like a ballerina" is pretending to be a ballerina, see Lillard et al., 2000). These data suggest that young children do not appreciate the mentalistic nature of pretending.

Understanding pretense as causal reasoning

The main hypothesis of this paper is that children make judgments about others' pretending as a set of causal inferences. This hypothesis relates to a broader framework of rational constructivism, which suggests that children represent others' mental states in terms of the causal relations among those states (Campbell, 2007; Gopnik & Wellman, 1994; Wellman, 2014). Typically, this has been studied in the form of belief-desire reasoning, as indicated by the idea that children come to learn that both beliefs and desires motivate human action (see e.g., Wellman, 1990). When applied to pretending, the hypothesis is that children must come to recognize a number of causal relations among pretending, other mental states, and the actions or appearance of the individual. Critically, children have access to their causal reasoning capacities and domain-specific conceptual knowledge, which is represented as (among other things) a set of causal relations among events to facilitate their causal inference.

"Acting-as-if" as causal inference

Consider the causal relations necessary to appreciate the Moe Task. Moe the troll is engaging in an action that gives him the appearance of another entity (i.e., hopping like a kangaroo). However, because there are no kangaroos in the land of the Trolls, Moe is ignorant of this animal, and thus cannot be pretending to be one, even though the action is representative of having that appearance. The causal structure of these relations is shown in Fig. 1.[2] The model shows three variables: (1) the intention to pretend to be an entity (represented by the middle node), (2) knowledge of that pretense entity (the leftmost node), and (3) whether the actions of the potential pretender are consistent with the pretense entity (the rightmost node).

What is important to understand is that the causal relation between intention and action is different from the causal relation between knowledge and intention. The causal relation between the intention to pretend and the potential pretender's actions is

[2] Note that we are using the nodes and arrows notation of the causal graphical model framework, but as will be obvious below, this figure is not intended to represent such a causal model. My goal is simply to illustrate the causal relations among mental states, pretense, and behavior; success on the Moe task requires children to infer this model.

generative. If one has the intention to pretend to be a particular entity, one will act like that entity (unless particular circumstances prevent this[3]).

The causal relation between knowledge and intention, however, is not generative; it is an enabling condition. Knowing about an entity does not cause one to pretend to be it, but rather enables such pretense to take place. To apply this to the Moe task, if children do not understand that the lack of knowledge of an entity indicates one cannot intend to pretend to be that entity, then they might be more swayed by the other information available to them. In this case, because Moe's actions are diagnostic of an intention to pretend, their inability to understand the enabling condition might cause them to be more swayed by the actions. In the absence of explicitly knowing that Moe's ignorance cannot enable the pretense, they struggle with the task. This might also explain why young children struggle with similar measures of pretense that require appreciating a particular mental state that enables pretending to occur (such as intention or awareness of pretense), and that performance on these tasks correlate with one another (Sobel & Letourneau, 2019).

But there are some reasons to suggest that this understanding of enabling conditions is available to very young children. Toddlers, for example, remember sequences of events better if those events build on each other – if, for example an early event enables a later event to occur – than if the events occur in an arbitrary order (e.g., Barr & Hayne, 1996; Bauer, 1992; Mandler & McDonough, 1995; Wenner & Bauer, 1999). Better memory for sequences of events, however, does not show that children understand *why* certain sequences are easier to remember than others, nor does it show a specific understanding that one event must have been in place for a second event (the enabled event) to be present. Moreover, there is evidence that children struggle when faced with many events of this type; preschoolers' ability to plan and enact events was limited when faced with many enabling conditions within a sequence (Shapiro & Hudson, 2004). More generally, Siegler (1976) showed that 5-year-olds had difficulty understanding the necessity and sufficiency among causal events. Given that enabling conditions are necessary, but not sufficient for a generative causal relation to be present, these data suggest that young children might have difficulty reasoning about this kind of causal relation.

More recently, Nyhout and Ganea (2020) asked 3- to 8-year-olds causal and counterfactual questions about events with generative causes and enabling conditions, which were controllable or uncontrollable. They found that even the youngest children they investigated indicated generative causes in response to diagnostic questions about what caused the outcome. What developed was children's responses about controllable enabling conditions. Children did not use such factors in responses to counterfactual questions (e.g., how an effect could have been prevented) until approximately age 5. For example, when told about a character who left drawings outside, which resulted in the wind blowing the drawings away, children showed a developmental trajectory through the preschool years in stating that to prevent this from happening, the character could have not left her drawings outside (instead of stating a change to a more uncontrollable generative cause – that the wind could not have blown).

One way of interpreting these data is that young children might appreciate some aspects of enabling, simply from the contextual cues in their everyday life. An example is the associative relation between batteries and electronics. That is, by the age of 4, children understand that objects' causal properties are related to their insides (Gottfried & Gelman, 2005; Sobel et al. 2007; see also Gelman & Wellman, 1991), and preschoolers often explain artifact motion by appealing to those objects' batteries (Gelman & Gottfried, 1996). They recognize that batteries are associated with objects functioning. Moreover, they also generate and hear the word "battery" in everyday conversation.[4] What is unlikely is that children at this age understand how batteries actually function (it seems unlikely that adults know how batteries function). Instead they might simply appreciate that batteries are an enabling condition in making electronics to work. They might not understand enabling generally, but they could understand enabling in this specific context. This proposal would be consistent with the illusion of explanatory depth (Rozenblit & Keil, 2002), which is also observed in elementary-school aged children (Mills & Keil 2004). That is, children (and possibly adults) might appreciate an associative relation between batteries being present and electronics being functional, and (falsely) interpret this as understanding the mechanism – how batteries work beyond that they enable electronics to function.

Why would understanding batteries be relevant for success on the Moe task? Sobel (2009) presented 4-year-olds with a novel version of the Moe task. Children were introduced to Moe, and told that Moe was "from the land of the trolls." In the land of the trolls, there were certain kinds of animals, but not others. For example, in the land of the trolls, there were rabbits, but not kangaroos. Pictures of these animals were placed on AA batteries or on wooden dowels of the same size. The battery/dowel with the picture of the

[3] I am not displaying such a possibility in Fig. 1. Given that this particular arrow is designed to represent a generative causal relation, one could imagine using algorithms to instantiate such a preventer if necessary (e.g., Buchanan & Sobel, 2014). I would refer the reader to that citation if interested, but the absence of representing such a preventer does not affect the argument made in the text.

[4] Sobel (2009) presented a brief CHILDES analysis (MacWhinney, 2000) on children's use of this word. He examined transcripts of five children between the ages of 2;6 and 5;0. All children generated the word *battery* in their spontaneous speech in relation to making toys or other electronic devices work. All of the children also heard at least one of their parents talk about batteries, also in this context. As an example:Abe (at 3;4, taken from Kuczaj & Maratsos, 1975):

CHI: like this # hey the light is burned off the light bulb is burned off.
FAT: really?
CHI: yeah.
FAT: maybe we can fix it.
CHI: I have another battery we could Daddy # I bought two batteries home.
FAT: Abe # I don't think it's the battery it's probably the light bulb.This example suggests that when Abe observes a familiar causal relation fail to be effective, he appeals to the battery as a possible enabling mechanism that is not in place. The parental feedback gives the child confirmation that batteries could be a causal factor, but probably is not in this case.

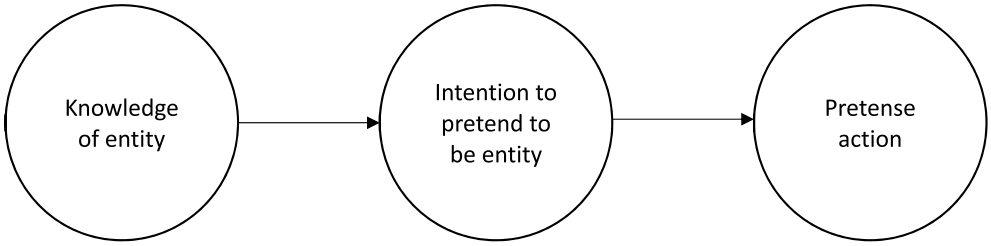

Fig. 1. Causal relations involved in appreciating the Moe task.

animal Moe knew was inserted into a backpack he wore, so that it was connected to him. The other battery/dowel was placed on the table next to the troll doll. The doll was then made to act consistently with both animals (e.g., he hopped up and down, and when he did so he looked like both a kangaroo and a rabbit). Children were asked specifically whether the troll doll was pretending to the kangaroo (the animal that he did not know about).

When the pictures were placed on the dowels, children's responses were not different from previous results by Lillard (1993b) – they made the correct "no" response only 35 % of the time. In contrast, when the pictures were attached to batteries, children responded correctly ~70 % of the time, significantly greater, and significant more likely than chance. When the enabling condition relation between knowledge and pretending was made more accessible to the children, they displayed a better understanding of the relation between these mental states.

To summarize this argument: Young children might understand that the intention to pretend causes one to act in certain ways. However, in order to respond correctly on procedures like the Moe task, children must integrate that knowledge with other mental states involved in pretending (e.g., Lillard, 2001; Richert & Lillard, 2002). A way of resolving these findings might be that what is developing during the preschool years is an understanding of the explicit causal structure (and the nature of those causal relations) among mental states like pretense and knowledge. A way of reformulating the mentalistic and acting-as-if hypotheses is that although young children engage in pretense, and thus understand that the intention to pretend relates to their overt actions, the explicit understanding of how other mental states are causally related to the intention to pretend develops later on.

This hypothesis allows us to explain a contrast in the literature on children's understanding of pretense, pointed out by Lillard (2001). Many of the findings that are consistent with the acting-as-if hypothesis involve child participants inferring whether one is pretending, given a contrast between that individual's actions and mental states. Leaving aside the lack of ecological validity of these experiments (i.e., how often are you told about another's mental states), the question asked of child participants in these studies is whether a character is pretending. In contrast, many studies that report data consistent with the mentalistic hypothesis tell child participants that a character is pretending, and then ask about other mental states the character might have (e.g., Bruell and Woolley, 1998; Custer, 1996). These studies are all consistent with the possibility that preschoolers understand the generative causality that relates certain mental states (i.e., if one is pretending, then their actions are intended to be pretense); they all test the facets of the causal model that involve generative causality.

Benefits of fantasy as faciliating diagnostic causal inferences

There are several domains of reasoning in which placing an inference into a fantasy context affects the way children respond (e.g., Dias & Harris, 1988, Hawkins et al., 1984; White & Carlson, 2016). For example, White and Carlson (2016) found that having 5-year-olds pretend to be a fantasy character – and they specifically used exemplary fantasy characters, such as Batman – improved children's performance on measures of executive function. Such a difference between fantasy and ordinary events is also present when children are asked whether others are pretending and whether pretending requires mental states. Lillard and Sobel (1999) found that children were more likely to state that pretending to be a fantasy character involved the mind and mental states than pretending to be more mundane entities. For instance, children were ~15 % more likely to claim that one needed their brain to pretend to be the Lion King than to pretend to be a cat. Sobel and Lillard (2001) replicated this finding and extended it to the Moe task; children were more likely to say correctly that Moe was not pretending to be the Lion King than a cat when Moe had the appearance of that entity, but no knowledge.

On the surface, these findings might seem inconsistent with the hypothesis that pretense is a causal inference. After all, the causal inference involved in judging whether Moe is pretending to be the Lion King or a Cat seems to be the same; the inference about the enabling condition between knowledge and the intention to pretend is the same. But in this section, I want to argue that there is a critical difference between the two situations.

In particular, one interpretation of these findings is that there are individual differences among young children's consumption and understanding of fantasy, such that children with high interest in fantasy (or a high fantasy orientation) engage in more mental state reasoning because of the complexity of their imaginations (e.g., Taylor, 1999; Taylor & Carlson, 1997). Consistent with this possiblity, Lillard (2002) found that the extent to which children engaged in spontaneous pretend play predicted whether they would succeed on a standard version of the Moe task. Similarly, Woolley et al. (2004) suggested that such fantasy orientation mediated beliefs in a novel fantastical entity (the Candy Witch), particularly in children who did not have more direct (testimonial) evidence of the entity's existence.

Individual differences in children's fantasy orientation potentially play a role in the extent to which they might be more engaged when participating in these studies; it is certainly possible that children who have higher fantasy orientations might be more interested in the fantasy nature of certain stimuli, and bring more cognitive resources to bear on these trials. However, consider that the child participant must recover the intention to pretend to be that character from the action or appearance of the character in the story. This diagnostic causal inference differs between fantasy and ordinary characters. To illustrate this with a (hopefully) straightforward example, when children pretend to be Superman, they might pretend to fly, pretend to shoot lasers from their eyes, pretend to help people or pretend to defeat bad guys (actions that are diagnostically indicative of Superman); they do not simply walk around (an action that Superman surely does, but one that does not represent his unique identity). This might suggest that an ordinary action (e.g., running) is more diagnostic of a ordinary animal (e.g., a cat) than of a fantasy character (e.g., the Lion King). This might make it easier for children to recognize that the generative causal relation is absent.

Sobel (2006) introduced 4-year-olds to a fantasy character (Zoltron from the planet Zolnar) in a storybook. Zoltron was described as "being from another planet" – a manipulation usually used to establish the fantastical nature of a fictional character (see Dias & Harris, 1988). In one story, Zoltron engaged in a set of completely ordinary actions; in the other condition, Zoltron engaged in mostly fantastic actions (i.e., actions that violated real-world causal structure), although one of his actions was ordinary, and identical to one of the actions of the Zoltron character in the ordinary story (i.e., the same picture was used). After being read the story, children were introduced to Moe the Troll, who was acting in an identical manner to that one ordinary action that was common across both Zoltron stories. Children were then told that Moe had no knowledge of Zoltron and had never read the story. They were asked whether Moe was pretending to be Zoltron. Children were more successful on this test question when Zoltron engaged in mostly fantastical actions as opposed to ordinary ones.

To determine whether Moe is pretending to be Zoltron (and indeed, to succeed on the Moe task in general, as well as most other measures consistent with the acting-as-if hypothesis), children must reason about a particular kind of counterfactual: They must compare whether the action/appearance of Moe (i.e., the potential pretender) is representative of the action/appearance of Zoltron (i.e., the potential pretense). The more they believe that Moe's action/appearance indicates Zoltron's, the more they should be likely to say that Moe is pretending to be Zoltron. Fantasy itself might not motivate any benefit in performance. Rather, children must infer whether the ordinary action performed by Moe is representative of the intention to pretend to be Zoltron. If Zoltron mostly performs fantastical actions, engaging in the one ordinary action Zoltron does perform seems less representative than when Zoltron only performs ordinary actions.

This hypothesis suggests a slightly modified interpretation to other studies that suggest the importance of fantasy in affecting children's cognition. Consider again the White and Carlson (2016) findings: They suggested that what motivates older preschoolers is "psychological distancing" from the self – that is, pretending to be an exemplary fantasy character causes children to think about what others would do, as opposed to themselves (and importantly, they suggest that pretense is not the mechanism of such distancing; simply considering the measures from a third-person perspective is sufficient).

The present discussion instead posits that engaging in the pretense (or using the imaginative capacities necessary to simulate a third-person perspective) creates a causal reasoning problem for the child participant. Taking on that pretense and then engaging in the executive function measure (or other such measures, such as measures of persistence in problem solving, see White et al., 2017), requires inferring what that character would do in that situation. Given the exemplary nature of the pretense, children might infer that they have to hold those positive attributes in order to successfully pretend. For example, Wansink et al. (2012) demonstrated that posing lunch choices to children in the form of what an exemplary character would eat (i.e., "What would Batman eat?") correlated with children being more likely to choose a healthier option (apple slices) over a less healthy option (french fries). It's likely, however, that asking children about a character with even greater psychological distance from them (Cookie Monster) might result in children not being more likely to choose the healthier option.[5]

Influences of causal knowledge on children's pretense

The previous section suggested that children's ability to understand pretending in others, particularly the distinction between the role of mental state knowledge and one's actions or appearance, is a function of children's developing causal inference. If understanding pretense is a form of causal inference, then children's causal knowledge might constrain not only how they pretend, but also how they understand pretense in other ways.

Discerning fantasy from reality

Preschoolers are often characterized as being in the "high season of imaginative play" (Singer & Singer 2009). Young children can create highly fantastic imaginary companions, who remain as stable presences in their lives (Taylor, 1999). During the preschool years, pretending can influence ways in which children act on the world. For example, when told to pretend a monster is in an empty box, young children were less likely to approach that box when left alone with it than when guided to pretend a bunny rabbit was inside

[5] Of importance is that White and Carlson also suggested that taking a third-person perspective also caused children to have psychological distance from the inference. This is certainly possible. However, if one knows nothing about a third-person other, one might interpret that other person in a positive manner (following e.g., Boseovski, 2010), which would suggest that one might place more exemplary characteristics on the person, resulting in a similar effect to that of the distancing they propose.

(Harris et al., 1991). Even though children know the box is empty and the pretense has concluded, children react differently to the real object based on the emotional valence of the pretense.

That said, young children do distinguish between real events and fantastical ones; that is, they recognize what can only be pretense from what can be real. They recognize that characters and events depicted in fictional stories are not real (e.g., Golomb & Galasso, 1995; Morison & Gardner, 1978; Samuels & Taylor, 1994) and that fictional characters live in different pretense worlds (Skolnick & Bloom, 2006). Sharon and Woolley (2004) also found evidence that young children reason differently about different kinds of real and fictional entities. They introduced 3- to 5-year-olds to pictures of real individuals (Michael Jordan), specific fantasy entities (Santa), and generic fantasy entities (Monsters), and asked whether that entity had a property that was biological (e.g., Does X need to sleep sometimes?), social (e.g., Can X have a pet?), physical (e.g., Can someone touch X?) and mental (e.g., Can X know what we're thinking?). They found that the 5-year-olds in their study, like adults, judged that real entities were more likely to obey causal laws in each domain (i.e., Michael Jordan needed to sleep and can't know what we're thinking). Four-year-olds showed this sensitivity for the physical and social characteristics, but did not differ in their judgments about biological or mental properties. Three-year-olds showed no domain differences at all. Critically, this pattern of performance reflects children's developing understanding of causal structure across these domains (i.e., physical and social characteristics of entities are understood before mental or biological knowledge; see also Cook & Sobel, 2011).

Conceptions about fictional worlds

By the age of 4, children engage in various forms of magical thinking. They appeal to magic as a causal force (e.g., Johnson & Harris, 1994; Rosengren et al., 1994; Rosengren & Hickling, 2000). They infer the presence of fantastical agents, often based only on the others' testimony (Woolley et al., 2004; see Woolley and Ghossainy, 2013, for a review). They often describe the mechanism of causal relations they do not understand as magic (e.g., Subbotsky, 2010).

One could interpret this description of children's propensities for the fantastical as indicating certain beliefs about the nature of fiction. In contemporary middle-class WEIRD cultures (Henrich et al., 2010), young children are often exposed to stories and books almost from birth, and it is difficult to conceptualize children in these cultures being raised without some form of media exposure. One important question, then, is how children conceptualize the fictional worlds they are exposed to.

Following Leslie's (1987) initial argument (and indeed, consistent with many of the conclusions reviewed in the previous section), once children possess the capacity to represent a pretense representation separate from a primary one, they might generalize such inferences to representing multiple possible worlds. They potentially quarantine states of reality from one another. Both children and adults recognize boundaries among fictions worlds. Superman and Batman co-exist in a fictional world and conceptualize each other as real. The DC Universe is different from Narnia, which is considered a fictional world to Batman and Superman, even though Batman conceptualizes Superman as a real entity (Skolnick & Bloom, 2006). In explicit measures of children's pretending, even preschoolers keep their own pretenses separate from one another (specifically object mappings, such as using a block for a pillow, see Skolnick Weisberg & Bloom, 2009).

These findings suggest that children construct distinct representations of fictional worlds, but how do they construct these representations in the first place? Stories themselves provide children with information necessary to construct parts of the fictional world. But how do children fill in the gaps? On *Star Trek*, technology allows the characters to travel at speeds faster than light, transport matter from one location to another, and diagnose diseases without physical contact, but we (the consumers of this fiction) assume that the human beings on the show have the same biological constraints as human beings in the real world (e.g., they need to sleep, breath, and go to the bathroom, even if this is rarely considered on the show). And critically, it would be strange if Captain Stubing from *The Love Boat* pulled out a phaser in the middle of an episode. Some fictional worlds license novel violations and others do not. How are children constructing the rest of a fictional world, beyond the information inherent in the story itself?

Adults potentially use their knowledge of the real world to supplement whatever information is not in a story, a heuristic known as the *Principle of Minimal Departure* (Ryan, 1980; see also Lewis, 1978; Walton, 1990). Their knowledge of a fictional world is based on their real-world causal knowledge when violations of real-world knowledge are not specified by the story. Both children and adults apply this principle when they construct fictional characters (e.g., Brédart et al., 1998; Ward, 1994; Ward & Sifonis, 1997). In a direct test of adults' inferences about fictional stories, Weisberg and Goodstein (2009) showed that adults predicted that certain real-world laws would be true in each of the different fictional worlds they investigated. For example, adults judged that mathematical principles are true regardless of the nature of the fictional world; $2 + 2 = 4$ on both *Star Trek* and *The Love Boat*.

Do children understand these constraints on fictional worlds in the same way that adults do? Weisberg et al. (2013) examined how young children extended fictional worlds, based on the content of the story they had already observed. They read 4-year-olds stories that contained only ordinary events or contained only fantastical elements (i.e., impossible, real-world causal violations), and then asked children to extend each kind of story with either a novel realistic or fantastical event. They found that children extended these stories with novel realistic events in both cases. Critically, this was not because of children's poor categorization abilities. In a follow-up study, they demonstrated that 4-year-olds would categorize impossible events together – when told four impossible events were examples of something that was "daxy", children would choose another impossible event as opposed to a realistic event to extend that label.

Sobel and Weisberg (2014) extended these findings by asking children to construct stories out of pairs of pictures. Both pictures depicted the same end goal, but one did so by including a violation of real-world causality while the other was simply an ordinary action. They found that 4-year-olds mostly constructed stories out of completely ordinary pictures. In contrast, in pretesting (and in several experiments detailed in Weisberg et al., 2013), when children were asked which picture they liked the best, choices were at

chance; children do not inherently prefer the real or the fantastic events, but they treat them differently when constructing stories.

Psychologically, the principle of minimal departure might derive from children's cognitive capacities, particularly their causal knowledge. In trying to explain how young children generated pretend actions in response to a play partner, Bretherton (1984) argued that their imaginative activities were "script-based" and limited to their knowledge of the world. Children's pretending was full of real-world actions because they relied on their knowledge of event structures (e.g., Nelson & Seidman, 1984). She further suggested a distinction "between the enactment of fairly realist scripts in which the agents and objects are not what they purport to be (low-level "what-if" play) and fantasy scripts (high-level "what-if" play)" (p. 36), and argued that young children's pretend play is typically based on this lower-level understanding. Applying this logic to how children construct fictional worlds (as opposed to engage in pretend acts), children might rely on similar scripts and construct the fictional world from the same knowledge. This might lead them to reasoning about more ordinary facets of fictional worlds; after all, their own engagement with the world is what we would consider 'ordinary' and not fantastical.[6]

Counterfactuals and reasoning about possibility

An important relation between causal knowledge and pretense comes from considering children's ability to engage in counterfactual reasoning. Counterfactuals – or reasoning about what might have been – have been thought to underlie representations of causal structure. Understanding that event A caused (generatively) event B typically indicates that (all other things being equal), the absence of A would result in the absence of B (Hume, 1739/1978). Some have argued, following Mackie (1974), that children might infer causal relations among events if they can infer this particular counterfactual: the absence of the cause would have resulted in the absence of the effect. Harris and colleagues (Harris, 2000; Harris et al., 1996) suggested that children learn new causal relations from their ability reason counterfactually, and that children's pretending presents them with their capacity to represent and reason about the hypothetical world.

In contrast to these initial findings, a number of studies suggest that causal reasoning about future hypotheticals emerges before children's ability to engage in counterfactual inferences about the same content (e.g., Riggs et al., 1998) or that these capacities are similar, but other, more open-ended counterfactual inferences about multiple possibilities might be more complex (Beck et al., 2006). Beck and colleagues suggest that where children might struggle is with a more general, explicit concept of possibility. They suggested that preschoolers might make future hypothetical and counterfactual inferences "by thinking about the counterfactual event in isolation, without recognizing its temporal relationship to the actual event." (p. 423), but where they struggle is preparing for the possible outcomes of a particular set of antecedent events. That is, when given a set of potential causes, preschoolers can reason about the resulting effect. Alternatively, when given causes and effects, preschoolers can reason about how effects would be different had causes changed (although see Rafetseder et al., 2010, for an alternate interpretation). But where preschoolers struggle is with an explicit understanding that events could possibly be a cause.

Interestingly, there is a parallel argument in young children's understanding of explicit probability. Many studies suggest that infants and toddlers implicitly understand probabilistic relations among events and make probabilistic inferences (e.g., Kirkham et al., 2002; Kushnir et al., 2010; Téglás et al., 2007; Xu & Garcia, 2008). However, their explicit understanding of probability has a prolonged developmental trajectory. For example, Hoemann and Ross (1971) showed 4–10-year-olds spinners divided into different sections of black and white. Children were asked about the size of the areas or to make a probability judgment about where the spinner would land. At all ages, children could make magnitude differences, but they chose randomly when asked about probability until after age 6. These findings echo several classic studies showing a prolonged developmental trajectory in making explicit inferences about probabilities (e.g., Fischbein, 1975; Hoemann & Ross, 1982; Perner, 1979; Piaget & Inhelder, 1951).

Children develop an explicit understanding of possibility. Preschoolers (and even infants) make clear diagnostic inferences (i.e., inferring the cause of an event) when data are deterministic and the specific, individual efficacy of each potential cause is known (e.g., Gopnik et al., 2001; Schulz & Gopnik, 2004; Sobel & Kirkham, 2006). However, when potential causes act stochastically or are not known (or inferable), children show a lag in their reasoning. As an example, Fernbach et al., (2012) showed preschoolers three objects (A, B, and C) and a novel machine. Across two conditions, one object activated the machine (which I will refer to as A+) and one object did not activate the machine (B-). What differed between the conditions was the third object. In one condition, the third object activated the machine (C+); in the other, it was never placed on the machine, so its efficacy was unknown (C?). The machine and objects were then occluded from the children, and the experimenter activated the machine with one of the objects. The child was asked which object had just been used to activate the machine. Regardless of the object children chose, they were told they were incorrect and asked to make a second choice.

In both conditions, children should avoid choosing the object that had previously failed to activate the machine (B-) in response to the two test questions. When the efficacy of the three objects was known, children had no trouble with this. But when the third object was not demonstrated (C?), 3-year-olds responded on these questions at chance, and 4-year-olds responded accurately only 45 % of the time. Erb and Sobel (2014) showed that children's ability to recognize that they should avoid choosing the object that failed to activate the machine, instead of the object they know nothing about developed between the ages of 4 and 7. Younger children, instead, decide that the object they know nothing about either is or is not a cause, as opposed to being uncertain about its efficacy.

[6] An important caveat to this argument is that I interpret "scripts" here in a causal manner (in an analogous way that very young children interpret sequences of events in terms of their causal or enabling relations). That is, when children are told about a sequence of events, they interpret those events in terms of the causal relations among them.

Such protracted developmental effects are consistent with developmental differences in children's reasoning about randomness and the distinction between what is impossible and improbable. Regarding randomness, Kuzmak and Gelman (1986) presented 3-, 4-, and 5-year-olds with two machines. One randomly spit out marbles of different colors; the other did so in a predictable sequence. Children were shown the mechanisms underlying each machine and were asked whether they could predict the color of the next marble. Only the oldest children in the sample were able to distinguish between the deterministic and random machine. Children's reasoning here seemed to be aided by the mechanistic information they were presented; between the ages of 3–5, children begin to clearly understand the relation between the internal properties of objects and their causal efficacy (Gelman & Wellman, 1991; Sobel et al., 2007). This allows them to interpret the machines differently.

And regarding improbability, Shtulman and Carey (2007) showed that while 4- to 8-year-olds easily judged that possible events were possible and impossible events were impossible, their judgments about improbable events developed. Between these ages, children moved from judging improbable events as impossible to judging them as possible. They interpret this development as indicative of older children understanding that "judgments of impossibility are based on ignorance of how an event could occur rather than knowledge of why the event could not occur." (p. 1030). An interpretation of these findings is that because younger children cannot imagine a world in which the improbable event occurs, they treat the improbable event as impossible. Older children, in contrast, have more experience, which allows them to recognize ways to imagine the improbable event as possible.

An alternative interpretation of these findings is that children must possess more causal knowledge about the entity in question; and that causal knowledge constrains children's imagination. A 4-year-old might not recognize that onions can be juiced, whereas an 8-year-old might have a better understanding of the causal structure of vegetables, making "drinking onion juice" an improbable but possible event. Such an interpretation is supported by studies that ask children about improbable events, but which do not require them to use the relation between their experience and an understanding of possibility; in these cases, younger children often suggest that improbable events are indeed possible. For example, introducing psychological distance (e.g., by saying that the event happens in a land far away), allows children to say that improbable events are possible at slightly younger ages (e.g., Bowman-Smith et al., 2019; see also Goulding & Friedman, 2020), although the mechanism here might be similar to what I described above in the section on fantasy.

Similarly, Weisberg and Sobel (2012) found that 4-year-olds treated improbable events differently from impossible events (and equivalently to ordinary events) when asked to categorize them in a story, but not when simply asked if they were possible outside of a story context (a replication of the Shtulman & Carey, 2007 procedure). The story context implies to children that they do not have to rely on their real-world experience, but the fictional world is obviously different. More generally, the individual differences in children's causal knowledge underlie how children make specific inferences about the possibility of particular improbable items (Shtulman & Yoo, 2015). These findings together suggest that judging that improbable events are possible requires the causal knowledge necessary to appreciate how something can be possible, which constraints children's pretense and imagination.

These findings all suggest that the ability to pretend – that is, to imagine hypothetical events – might be related to the child's capacity for reasoning about future hypotheticals and counterfactual pasts. But there might also be more metacognitive development that emerges later on: An explicit understanding of what pretending is might relate to children's understanding that there are multiple possibilities in the world (Sobel & Letourneau, 2019). Such an account is actually consistent with mentalizing theories of pretense as well. German and Leslie (2001), for example, suggest that children's understanding of pretense involves a specialized mechanism that "…introduces the concept 'pretend', allowing the child to decide to pretend and to infer from another person's behaviour that that person is pretending" (p. 80). But later in the same paper, they also suggest that "this does not mean that the child is endowed with knowledge of a theory about what pretending really is" (p. 80). On this view, theory of mind knowledge - particularly developing a representational understanding of false belief - might be the more metacognitive understanding that develops, related to their understanding of multiple possibilities in the world. Consistent with the main hypothesis of this paper, children's pretense (along with their causal knowledge) may be an enabling condition for their counterfactual reasoning, but the ability to pretend itself does not indicate that children understand that they are reasoning about explicit possibilities at early ages.

On this view, children's ability to engage in pretense is the hallmark of a representational capacity that they use in their causal inference. Buchsbaum et al. (2012) suggest that pretending allows children to simulate the data required for learning a causal model.[7] They showed that children's ability to simulate the results of a pretense about the causal properties of objects related to their counterfactual reasoning about those causal relations. Children's causal knowledge relates to their counterfactual reasoning, but also their ability to engage in pretense serves as a mechanism for causal learning (see also Weisberg & Gopnik, 2013, for similar arguments).

More generally, in a review of the role of imagination in children's reasoning, Harris (2021) argues that "children's imagination helps them to anticipate reality and its close alternatives." He suggests that the development of many facets of cognition related to children's pretense and imagination, such as that counterfactual reasoning emerges from the development of imaginative capacities. Following this view, pretense – or more generally, the ability to imagine alternate possibilities – is what allows children to interpret the world in a counterfactual manner. This early-emerging capacity fundamentally changes children's causal reasoning. In the final

[7] Many formal causal learning algorithms, particularly those interested in learning all possible dependence and independence relations among events (e.g., Gopnik et al., 2004; Pearl, 2000) require large amount of data in order to come to viable conclusions. One way to apply such models to children's learning is to infer that they either observe sufficient data, or are able to simulate multiple instances of a relation from a single observation and a parametric assumption, such as determinism. Other learning algorithms – particularly those based on Bayesian inference (e.g., Goodman et al., 2011; Griffiths et al., 2011; Tenenbaum et al., 2011) – do not have this limitation, but still can benefit from such simulation capacities.

section, I want to speculate on the implications of the development of such a reasoning capacity.

Pretense as part of causal reasoning

Despite the fact that traditional cognitive development research has suggested that young children are "precausal" (e.g., Piaget, 1929), young children do have sophisticated causal reasoning capacities. Even infants interpret displays differently based on their causal perception (e.g., Kominsky et al., 2017; Muentener & Carey, 2010; Oakes & Cohen, 1990) and make different kinds of causal inferences regarding agency and mechanistic relations (Saxe et al., 2005, 2007; Sobel & Kirkham, 2006). These findings have been taken to suggest that understanding causality is part of "core cognition" (Carey, 2009) or fundamental to the way in which children's conceptual knowledge develops (Gopnik & Wellman, 2012). Both of these theoretical approaches posit that causal reasoning emerges early, and its reasoning systems do not change.

Others (Weisberg & Sobel, 2022) have argued that children's causal reasoning capacities undergo developmental change in the first year of life, primary based on the hypothesis that many of the causal perception and inference studies in infants show developmental differences between infants in the first and second half of the first year of life (e.g., Cohen & Amsel, 1998; Denison et al., 2013; Sobel & Kirkham, 2007). This view suggests that children have early-emerging capacities for statistical reasoning, but that more associative representation becomes more causal as infants develop motor capacities to act on the world – recognizing the importance of their own interventions beyond just passively observing data.

One could suggest that the emergence of pretend play during the second year of life might spark a similar change in children's causal reasoning, a point generally consistent with the arguments made by Harris (2021). Not only is pretense indicative of the representational capacity to simulate data or hypothetical interventions to reason counterfactually, but it allows children to represent what does not happen in addition to what does. Such representational capacities might underlie certain kinds of pedagogical inferences, which seem to be in place by 12- to 15-months-old (around the time, or just before children begin to engage in pretense, see e.g., Gergely et al., 2002; Csibra et al., 2003; Yang et al, 2013). Interestingly, younger infants seem to not make such inferences, which is interpereted as infants developing "the ability to infer hypothetical (unseen) states of affairs in teleological action representations" (Csibra et al., 2003, p. 111).

But a more speculative hypothesis is that it is not pretend play behaviors that indicate children have these representational abilities. Instead, the representational capacity indicated by pretend play might be present much earlier than when children begin to engage in pretense. For instance, a strong interpretation of the violation of expectation paradigm is that infants represent an expectation of what will happen, and then react to the difference between what actually happens and the hypothetical (i.e., pretense) expectation. Infants might react differently when their expectations are violated because they have quarantined the representation of the expectation from reality, much in the same way that they do not think that bananas are now telephones when engaging in pretense. It may be that pretense actions, which emerge around 15–18-months old, are just a behavioral manifestation of that representational capacity, but the capacity itself for pretense (or imagination, as this hypothesis suggests that this capacity does not necessarily involve actions) is available to infants even earlier (Kushnir, 2022; Wellman & Liu, 2007).

On this view, one then might ask a question: Why do children pretend? Certainly, one possibilty is that pretending allows children to explore the affordances of objects and situations without much risk. And there are social processes that are at play in pretense. That is, pretense can be a shared activity and a form of cultural transmission. But it is also possible that pretense is a manifestation of a more promiscuous causal reasoning capacity (Gopnik, 1998). At young ages we can't stop ourselves from imagining what if and what else (see also Walker & Nyhout, 2020).

Conclusions

I have argued that understanding whether others are pretending is an act of causal inference. Doing so resolves some of the theoretical tension between mentalistic and acting-as-if interpretations of the role of pretend play in children's developing theory of mind. Doing so also posits that pretending (and pretense representations more generally construed) might be part of children's causal reasoning capacities, and the ways in which they change might faciliate children's developing capacity for causal reasoning and diagnostic inference. The representational capacity indicated by pretending is the same as one in which actual representations are separated from hypothetical ones (i.e., Leslie's (1987) "quarantining"). In contrast, the development of children's explicit knowledge of pretense or their understanding of the relation between pretense and other mental states proceeds like the acquisition of any other form of causal knowledge – through observation and interaction with the world and reflection on those data. Experience with social pretense provides much information about others' pretense actions and appearances. Only later do children recognize the enabling role of mental states when judging whether others are pretending, as they have less explicit experience with others' belief states or intentions.

In this way, the idea that understanding pretense as causal inference is similar to the hypothesis argued by Stich and Tarzia's (2015), who suggest pretense is not mentalistic, but rather a game. In the game, children "create a sequence of events that is saliently similar to events represented in the PWB" (p. 6; PWB is a *Possible World Box*, which is similar to what Leslie refers to as the quarantined representation of the actual world). Observers judge whether others are pretending by constructing the content of their representation of the pretend world from their actions. But inferring the contents of that representation and translating pretense representations into action requires causal knowledge and reasoning abilities. As children's causal knowledge changes, their ability to know what one represents from one's actions also changes.

But the development of domain-specific causal knowledge is not the mechanism for children's developing understanding of the

relations between pretense and other mental states. Children are potentially coming to represent an explicit concept of possibility – that uncertain information does not have to be collapsed to a certainty, but rather can be represented in multiple ways. That relation between making an inference about what is in the "possible world box" and one's causal knowledge is mediated by children's appreciation of possibility in general. The ability to engage in pretense, therefore, might indicate the child's ability to represent those initial possibilities – to construct the possible world box they use in their game. Only then do children come to appreciate more subtle facets of others' pretense including what mental states and behaviors are involved in pretense, and how pretense can facilitate learning about the real world.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

References

Aronson, J. N., & Golomb, C. (1999). Preschoolers' understanding of pretense and presumption of congruity between action and representation. *Developmental Psychology, 35*(6), 1414–1425. https://doi.org/10.1037/0012-1649.35.6.1414

Astington, J. W., & Jenkins, J. M. (1995). Theory of mind development and social understanding. *Cognition and Emotion, 9*(2–3), 151–165. https://doi.org/10.1080/02699939508409006

Baldwin, D. A., Baird, J. A., Saylor, M. M., & Clark, M. A. (2001). Infants parse dynamic action. *Child Development, 72*, 708–717. https://doi.org/10.1111/1467-8624.00310

Barr, R., & Hayne, H. (1996). The effect of event structure on imitation in infancy: Practice makes perfect? *Infant Behavior & Development, 19*(2), 253–257. https://doi.org/10.1016/S0163-6383(96)90024-7

Bauer, P. J. (1992). Holding it all together: How enabling relations facilitate young children's event recall. *Cognitive Development, 7*(1), 1–28. https://doi.org/10.1016/0885-2014(92)90002-9

Beck, S. R., Robinson, E. J., Carroll, D. J., & Apperly, I. A. (2006). Children's thinking about counterfactuals and future hypotheticals as possibilities. *Child Development, 77*(2), 413–426.

Bosco, F. M., Friedman, O., & Leslie, A. M. (2006). Recognition of pretend and real actions in play by 1-and 2-year-olds: Early success and why they fail. *Cognitive Development, 21*(1), 3–10.

Brédart, S., Ward, T. B., & Marczewski, P. (1998). Structured imagination of novel creatures' faces. *The American Journal of Psychology, 111*(4), 607.

Bretherton, I. (1984). Representing the social world in symbolic play: Reality and fantasy. In *Symbolic play* (pp. 3–41). Academic Press.

Boseovski, J. J. (2010). Evidence for "rose-colored glasses": An examination of the positivity bias in young children's personality judgments. *Child Development Perspectives, 4*(3), 212–218.

Bowman-Smith, C. K., Shtulman, A., & Friedman, O. (2019). Distant lands make for distant possibilities: Children view improbable events as more possible in far-away locations. *Developmental Psychology, 55*(4), 722.

Bruell, & Woolley, J. D. (1998). Young children's understanding of diversity in pretense. *Cognitive Development, 13*(3), 257–277. https://doi.org/10.1016/S0885-2014(98)90011-9

Buchanan, D. W., & Sobel, D. M. (2014). Edge Replacement and Minimality as Models of Causal Inference in Children. In O. Saccaro (Ed.), *Advances in Child Development and Behavior* (Vol. 46, pp. 183-213).

Buchsbaum, D., Bridgers, S., Skolnick Weisberg, D., & Gopnik, A. (2012). The power of possibility: Causal learning, counterfactual reasoning, and pretend play. *Philosophical Transactions of the Royal Society B: Biological Sciences, 367*(1599), 2202–2212.

Campbell, J. (2007). *An interventionist approach to causation in psychology* (pp. 58–66). Causal learning: Psychology, philosophy and computation.

Carey, S. (2009). *The origin of concepts*. New York: Oxford University Press.

Cohen, L. B., & Amsel, G. (1998). Precursors to infants' perception of the causality of a simple event. *Infant behavior and development, 21*(4), 713–731.

Cook, C., & Sobel, D. M. (2011). Children's beliefs about the fantasy/reality status of hypothesized machines. *Developmental Science, 14*(1), 1–8.

Csibra, G., Bíró, S., Koós, O., & Gergely, G. (2003). One-year-old infants use teleological representations of actions productively. *Cognitive Science, 27*(1), 111–133.

Custer, W. (1996). A comparison of young children's understanding of contradictory representations in pretense, memory, and belief. *Child Development, 67*(2), 678–688. https://doi.org/10.1111/j.1467-8624.1996.tb01759.x

Davis, D. L., Woolley, J. D., & Bruell, M. J. (2002). Young children's understanding of the roles of knowledge and thinking in pretense. *British Journal of Developmental Psychology, 20*, 25–45. https://doi.org/10.1348/026151002166307

Denison, S., Reed, C., & Xu, F. (2013). The emergence of probabilistic reasoning in very young infants: Evidence from 4.5-and 6-month-olds. *Developmental psychology, 49*(2), 243.

Dias, M. D. G., & Harris, P. L. (1988). The effect of make-believe play on deductive reasoning. *British Journal of Developmental Psychology, 6*(3), 207–221.

Cutting, A. L., & Dunn, J. (1999). Theory of mind, emotion understanding, language, and family background: Individual differences and interrelations. *Child Development, 70*(4), 853–865.

Erb, C. D., & Sobel, D. M. (2014). The development of diagnostic reasoning about uncertain events between ages 4–7. *PLoS One1, 9*(3), e92285.

Fenson, & Ramsay, D. S. (1980). Decentration and integration of the child's play in the second year. *Child Development, 51*(1), 171–178. https://doi.org/10.1111/j.1467-8624.1980.tb02523.x

Fernbach, P. M., Macris, D. M., & Sobel, D. M. (2012). Which one made it go? The emergence of diagnostic reasoning in preschoolers. *Cognitive Development, 27*(1), 39–53.

Fischbein, H. (1975). *The intuitive sources of probabilistic thinking in children* (Vol. 85). Springer Science & Business Media.

Ganea, P. A., Lillard, A. S., & Turkheimer, E. (2004). Preschooler's understanding of the role of mental states and action in pretense. *Journal of Cognition and Development, 5*(2), 213–238. https://doi.org/10.1207/s15327647jcd0502_3

Gelman, S. A., & Gottfried, G. M. (1996). Children's causal explanations of animate and inanimate motion. *Child Development, 67*(5), 1970–1987.

Gelman, S. A., & Wellman, H. M. (1991). Insides and essences: Early understandings of the non-obvious. *Cognition, 38*(3), 213–244.

Gergely, G., Bekkering, H., & Király, I. (2002). Rational imitation in preverbal infants. *Nature, 415*(6873), 755.

German, T. P., & Leslie, A. M. (2001). Children's inferences from 'knowing' to 'pretending' and 'believing'. *British Journal of Developmental Psychology, 19*(1), 59–83.

Golomb, C., & Galasso, L. (1995). Make believe and reality: Explorations of the imaginary realm. *Developmental Psychology, 31*(5), 800.

Goodman, N. D., Ullman, T. D., & Tenenbaum, J. B. (2011). Learning a theory of causality. *Psychological Review, 118*(1), 110.

Gopnik, A. (1998). Explanation as orgasm. *Minds and Machines, 8*(1), 101–118.

Gopnik, A., & Astington, J. W. (1988). Children's understanding of representational change and its relation to the understanding of false belief and the appearance-reality distinction. *Child Development, 59*(1), 26–37. https://doi.org/10.2307/1130386
Gopnik, A., Glymour, C., Sobel, D. M., Schulz, L. E., Kushnir, T., & Danks, D. (2004). A theory of causal learning in children: Causal maps and Bayes nets. *Psychological Review, 111*(1), 3–32.
Gopnik, A., Sobel, D. M., Schulz, L. E., & Glymour, C. (2001). Causal learning mechanisms in very young children: Two-, three-, and four-year-olds infer causal relations from patterns of variation and covariation. *Developmental Psychology, 37*(5), 620.
Gopnik, A., & Wellman, H. M. (1994). The theory theory. In L. A. Hirschfeld, & S. A. Gelman (Eds.), *Mapping the mind: Domain specificity in cognition and culture* (pp. 257–293). New York: Cambridge University Press. https://doi.org/10.1017/CBO9780511752902.011.
Gopnik, A., & Wellman, H. M. (2012). Reconstructing constructivism: Causal models, Bayesian learning mechanisms, and the theory theory. *Psychological Bulletin, 138*(6), 1085–1108. https://doi.org/10.1037/a0028044
Gottfried, G. M., & Gelman, S. A. (2005). Developing domain-specific causal-explanatory frameworks: The role of insides and immanence. *Cognitive Development, 20*(1), 137–158.
Goulding, B. W., & Friedman, O. (2020). Children's beliefs about possibility differ across dreams, stories, and reality. *Child Development, 91*(6), 1843–1853.
Griffiths, T. L., Sobel, D. M., Tenenbaum, J. B., & Gopnik, A. (2011). Bayes and blickets: Effects of knowledge on causal induction in children and adults. *Cognitive Science, 35*(8), 1407–1455.
Harris, P. L. (1994). Understanding pretense. In C. Lewis, & P. Mitchell (Eds.), *Children's early understanding of mind: Origins and development* (pp. 235–259). East Sussex: Lawrence Erlbaum Associates.
Harris, P. L. (2000). *The work of the imagination*. Blackwell Publishing.
Harris, P. L. (2021). Early constraints on the imagination: The realism of young children. *Child Development, 92*(2), 466–483.
Harris, P. L., Brown, E., Marriott, C., Whittall, S., & Harmer, S. (1991). Monsters, ghosts and witches: Testing the limits of the fantasy—reality distinction in young children. *British Journal of Developmental Psychology, 9*(1), 105–123.
Harris, P. L., German, T., & Mills, P. (1996). Children's use of counterfactual thinking in causal reasoning. *Cognition, 61*(3), 233–259.
Harris, P. L., & Kavanaugh, R. D. (1993). Young children's understanding of pretense. *Monographs of the Society for Research in Child Development, 58*(1), 1–92. https://doi.org/10.2307/1166074
Hawkins, J., Pea, R. D., Glick, J., & Scribner, S. (1984). " Merds that laugh don't like mushrooms": Evidence for deductive reasoning by preschoolers. *Developmental Psychology, 20*(4), 584.
Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world? *Behavioral and Brain Sciences, 33*(2–3), 61–83.
Hespos, S. J., Saylor, M. M., & Grossman, S. R. (2009). Infants' ability to parse continuous actions. *Developmental Psychology, 45*(2), 575.
Hickling, A. K., Wellman, H. M., & Gottfried, G. M. (1997). Preschoolers' understanding of others' mental attitudes towards pretend happenings. *British Journal of Developmental Psychology, 15*(3), 339–354.
Hoemann, H. W., & Ross, B. M. (1971). Children's understanding of probability concepts. *Child Development*, 221–236.
Hoemann, H. W., & Ross, B. M. (1982). Children's concepts of chance and probability. In *Children's logical and mathematical cognition* (pp. 93–121). New York, NY: Springer.
Howes, C. (1985). Sharing fantasy: Social pretend play in toddlers. *Child Development, 56*(5), 1253–1258. https://doi.org/10.2307/1130240
Hughes, C., & Dunn, J. (1997). "Pretend you didn't know": Preschoolers' talk about mental states in pretend play. *Cognitive Development, 12*(4), 381–403. https://doi.org/10.1016/S0885-2014(97)90019-8
Johnson, C. N., & Harris, P. L. (1994). Magic: Special but not excluded. *British Journal of Developmental Psychology, 12*(1), 35–51.
Joseph, R. M. (1998). Intention and knowledge in preschoolers' conception of pretend. *Child Development, 69*(4), 966–980. https://doi.org/10.1111/j.1467-8624.1998.tb06154.x
Kirkham, N. Z., Slemmer, J. A., & Johnson, S. P. (2002). Visual statistical learning in infancy: Evidence for a domain general learning mechanism. *Cognition, 83*(2), B35–B42.
Kominsky, J. F., Strickland, B., Wertz, A. E., Elsner, C., Wynn, K., & Keil, F. C. (2017). Categories and constraints in causal perception. *Psychological Science, 28*(11), 1649–1662.
Kovács, Á. M., Téglás, E., & Endress, A. D. (2010). The social sense: Susceptibility to others' beliefs in human infants and adults. *Science, 330*(6012), 1830–1834. https://doi.org/10.1126/science.1190792
Kuczaj, S. A., & Maratsos, M. P. (1975). What children can say before they will. *Merrill-Palmer Quarterly of Behavior and Development, 21*(2), 89–111.
Kuzmak, S. D., & Gelman, R. (1986). Young children's understanding of random phenomena. *Child Development*, 559–566.
Kushnir, T. (2022). Imagination and social cognition in childhood. *Wiley Interdisciplinary Reviews: Cognitive Science*, Article e1603.
Kushnir, T., Xu, F., & Wellman, H. M. (2010). Young children use statistical sampling to infer the preferences of other people. *Psychological Science, 21*(8), 1134–1140.
Lalonde, C. E., & Chandler, M. J. (1995). False belief understanding goes to school: On the social-emotional consequences of coming early or late to a first theory of mind. *Cognition and Emotion, 9*(2–3), 167–185. https://doi.org/10.1080/02699939508409007
Largo, R. H., & Howard, J. A. (1979). Developmental progression in play behavior of children between nine and thirty months. I: Spontaneous play and imitation. *Developmental Medicine and Child Neurology, 21*(3), 299–310. https://doi.org/10.1111/j.1469-8749.1979.tb01622.x
Leslie, A. M. (1987). Pretense and representation: The origins of "theory of mind.". *Psychological Review, 94*(4), 412–426. https://doi.org/10.1037/0033-295X.94.4.412
Leslie, A. M. (1994). Pretending and believing: Issues in the theory of ToMM. *Cognition, 50*(1–3), 211–238. https://doi.org/10.1016/0010-0277(94)90029-9
Lewis, D. (1978). Truth in fiction. *American Philosophical Quarterly, 15*(1), 37–46.
Lillard, A. S. (1993a). Pretend play skills and the child's theory of mind. *Child Development, 64*(2), 348–371. https://doi.org/10.2307/1131255
Lillard, A. S. (1993b). Young children's conceptualization of pretense: Action or mental representational state? *Child Development, 64*, 372–386. https://doi.org/10.1111/j.1467-8624.1993.tb02915.x
Lillard, A. S. (1996). Body or mind: Children's categorizing of pretense. *Child Development, 67*, 1717–1734. https://doi.org/10.1111/j.1467-8624.1996.tb01823.x
Lillard, A. S. (1998). Wanting to be it: Children's understanding of intentions underlying pretense. *Child Development, 69*(4), 981–993. https://doi.org/10.2307/1132357
Lillard, A. S. (2001). Pretend play as twin earth. *Developmental Review, 21*, 1–33. https://doi.org/10.1006/drev.2001.0532
Lillard, A. (2002). Pretend play and cognitive development. In U. Goswami (Ed.), *Blackwell handbook of childhood cognitive development* (pp. 189–205). Blackwell Publishing. https://doi.org/10.1002/9780470996652.ch9.
Lillard, A., Nishida, T., Massaro, D., Vaish, A., Ma, L., & McRoberts, G. (2007). Signs of pretense across age and scenario. *Infancy, 11*(1), 1–30. https://doi.org/10.1207/s15327078in1101_1
Lillard, A. S., & Sobel, D. M. (1999). Lion Kings or puppies: The influence of fantasy on children's understanding of pretense. *Developmental Science, 2*(1), 75–80. https://doi.org/10.1111/1467-7687.00057
Lillard, A. S., & Witherington, D. C. (2004). Mothers' behavior modifications during pretense and their possible signal value for toddlers. *Developmental Psychology, 40*(1), 95–113. https://doi.org/10.1037/0012-1649.40.1.95
Lillard, A. S., Zeljo, A., Curenton, S., & Kaugars, A. S. (2000). Children's understanding of the animacy constraint on pretense. *Merrill-Palmer Quarterly, 46*(1), 21–44.
Mackie, J. L. (1974). *The cement of the universe: A study of causation*. Oxford: Oxford University Press.
MacWhinney, B. (2000). *The CHILDES project: The database* (Vol. 2). Psychology Press.
Mandler, J. M., & McDonough, L. (1995). Long-term recall of event sequences in infancy. *Journal of Experimental Child Psychology, 59*(3), 457–474.
Mills, C. M., & Keil, F. C. (2004). Knowing the limits of one's understanding: The development of an awareness of an illusion of explanatory depth. *Journal of Experimental Child Psychology, 87*(1), 1–32. https://doi.org/10.1016/j.jecp.2003.09.003

Morison, P., & Gardner, H. (1978). Dragons and dinosaurs: The child's capacity to differentiate fantasy from reality. *Child Development, 49*(3), 642. https://doi.org/10.2307/1128231
Muentener, P., & Carey, S. (2010). Infants' causal representations of state change events. *Cognitive Psychology, 61*(2), 63–86. https://doi.org/10.1016/j.cogpsych.2010.02.001
Nelson, K., & Seidman, S. (1984). Playing with scripts. In *Symbolic play* (pp. 45–71). Academic Press.
Nyhout, A., & Ganea, P. A. (2020). What is and what never should have been: Children's causal and counterfactual judgments about the same events. *Journal of Experimental Child Psychology, 192*, 104773.
Oakes, L. M., & Cohen, L. B. (1990). Infant perception of a causal event. *Cognitive Development, 5*(2), 193–207. https://doi.org/10.1016/0885-2014(90)90026-P
Onishi, K. H., & Baillargeon, R. (2005). Do 15-month-old infants understand false beliefs? *Science (New York, N.Y.), 308*(5719), 255–258. https://doi.org/10.1126/science.1107621
Onishi, K. H., Baillargeon, R., & Leslie, A. M. (2007). 15-month-old infants detect violations in pretend scenarios. *Acta Psychologica, 124*(1), 106–128.
Pearl, J. (2000). *Causality: Models, reasoning, and inference*. Cambridge, UK: Cambridge University Press.
Perner, J. (1979). Discrepant results in experimental studies of young children's understanding of probability. *Child Development*, 1121–1127.
Perner, J. (1991). *Understanding the representational mind: Learning, development, and conceptual change*. Cambridge, MA: MIT Press.
Perner, J., Baker, S., & Hutton, D. (1994). Prelief: The conceptual origins of belief and pretence. In C. Lewis, & P. Mitchell (Eds.), *Children's early understanding of mind: Origins and development* (pp. 261–286). Lawrence Erlbaum Associates, Inc.
Perner, J., Leekam, S. R., & Wimmer, H. (1987). Three-year-olds' difficulty with false belief: The case for a conceptual deficit. *British Journal of Developmental Psychology, 5*(2), 125–137. https://doi.org/10.1111/j.2044-835X.1987.tb01048.x
Peterson, C. C., & Wellman, H. M. (2009). From fancy to reason: Scaling deaf and hearing children's understanding of theory of mind and pretence. *British Journal of Developmental Psychology, 27*(2), 297–310.
Piaget, J. (1929). *The child's conception of the world*. London: Kegan Paul, Trench & Trubner.
Piaget, J. (1962). *Play, dreams, and imitation in childhood*. New York: Norton.
Piaget, J., & Inhelder, B. (1951). *The origin of the idea of chance in children*. New York: Psychology Press.
Rafetseder, E., Cristi-Vargas, R., & Perner, J. (2010). Counterfactual reasoning: Developing a sense of "nearest possible world". *Child Development, 81*(1), 376–389.
Rakoczy, H., Tomasello, M., & Striano, T. (2004). Young children know that trying Is not pretending: A test of the "behaving-as-if" construal of children's early concept of pretense. *Developmental Psychology, 40*(3), 388–399. https://doi.org/10.1037/0012-1649.40.3.388
Richert, R. A., & Lillard, A. S. (2002). Children's understanding of the knowledge prerequisites of drawing and pretending. *Developmental Psychology, 38*(6), 1004–1015. https://doi.org/10.1037/0012-1649.38.6.1004
Richert, R. A., & Lillard, A. S. (2004). Observers' proficiency at identifying pretense acts based on behavioral cues. *Cognitive Development, 19*(2), 223 240. https://doi.org/10.1016/j.cogdev.2004.01.001
Riggs, K. J., Peterson, D. M., Robinson, E. J., & Mitchell, P. (1998). Are errors in false belief tasks symptomatic of a broader difficulty with counterfactuality? *Cognitive Development, 13*, 73–90. https://doi.org/10.1016/S0885-2014(98)90021-1
Rosen, C. S., Schwebel, D. C., & Singer, J. L. (1997). Preschoolers' attributions of mental states in pretense. *Child Development, 68*(6), 1133–1142.
Rosengren, K. S., & Hickling, A. K. (2000). 3 Metamorphosis and Magic. *Imagining the impossible: magical, scientific, and religious thinking in children*, 75.
Rosengren, K. S., Kalish, C. W., Hickling, A. K., & Gelman, S. A. (1994). Exploring the relation between preschool children's magical beliefs and causal thinking. *British Journal of Developmental Psychology, 12*(1), 69–82.
Rozenblit, L., & Keil, F. C. (2002). The misunderstood limits of folk science: An illusion of explanatory depth. *Cognitive Science, 26*(5), 521–562. https://doi.org/10.1016/S0364-0213(02)00078-2
Rubin, K.H., Fein, G.G., & Vandenberg, B. (1983). Play. In: P. Mussen & E. M. Hetherington (Eds.), Handbook of child psychology, Volume 4: Socialization, personality, and social development (pp. 693–774). New York: Wiley.
Ryan, M. L. (1980). Fiction, non-factuals, and the principle of minimal departure. *Poetics, 9*(4), 403–422.
Samuels, A., & Taylor, M. (1994). Children's ability to distinguish fantasy events from real-life events. *British Journal of Developmental Psychology, 12*(4), 417–427.
Saxe, R., Tenenbaum, J. B., & Carey, S. (2005). Secret agents: Inferences about hidden causes by 10- and 12-month-old infants. *Psychological Science, 16*(12), 995–1001. https://doi.org/10.1111/j.1467-9280.2005.01649.x
Saxe, R., Tzelnic, T., & Carey, S. (2007). Knowing who dunnit: Infants identify the causal agent in an unseen causal interaction. *Developmental Psychology, 43*(1), 149–158. https://doi.org/10.1037/0012-1649.43.1.149
Saylor, M. M., Baldwin, D. A., Baird, J. A., & LaBounty, J. (2007). Infants' on-line segmentation of dynamic human action. *Journal of Cognition and Development, 8*(1), 113–128.
Schwebel, D. C., Rosen, C. S., & Singer, J. L. (1999). Preschoolers' pretend play and theory of mind: The role of jointly constructed pretence. *British Journal of Developmental Psychology, 17*(3), 333–348.
Schulz, L. E., & Gopnik, A. (2004). Causal learning across domains. *Developmental Psychology, 40*(2), 162–176. https://doi.org/10.1037/0012-1649.40.2.162
Scott, R. M., & Baillargeon, R. (2009). Which penguin is this? Attributing false beliefs about object identity at 18 months. *Child Development, 80*, 1172–1196. https://doi.org/10.1111/j.1467-8624.2009.01324.x
Shapiro, L. R., & Hudson, J. A. (2004). Effects of internal and external supports on preschool children's event planning. *Journal of Applied Developmental Psychology, 25*(1), 49–73.
Sharon, T., & Woolley, J. D. (2004). Do monsters dream? Young children's understanding of the fantasy/reality distinction. *British Journal of Developmental Psychology, 22*(2), 293–310.
Shtulman, A., & Carey, S. (2007). Improbable or impossible? How children reason about the possibility of extraordinary events. *Child Development, 78*(3), 1015–1032. https://doi.org/10.1111/j.1467-8624.2007.01047.x
Shtulman, A., & Yoo, R. I. (2015). Children's understanding of physical possibility constrains their belief in Santa Claus. *Cognitive Development, 34*, 51–62.
Skolnick, D., & Bloom, P. (2006). What does Batman think about SpongeBob? Children's understanding of the fantasy/fantasy distinction. *Cognition, 101*(1), B9–B18.
Skolnick Weisberg, D., & Bloom, P. (2009). Young children separate multiple pretend worlds. *Developmental Science, 12*(5), 699–705.
Siegler, R. S. (1976). The effects of simple necessity and sufficiency relationships on children's causal inferences. *Child Development*, 1058–1063.
Singer, D. G., & Singer, J. L. (2009). *The house of make-believe: Children's play and the developing imagination*. Harvard University Press.
Sobel, D. M. (2004a). Children's developing knowledge of the relationship between mental awareness and pretense. *Child Development, 75*(3), 704–729. https://doi.org/10.1111/j.1467-8624.2004.00702.x
Sobel, D. M. (2006). How fantasy benefits young children's understanding of pretense. *Developmental Science, 9*(1), 63–75.
Sobel, D. M. (2007). Children's knowledge of the relation between intentional action and pretending. *Cognitive Development, 22*(1), 130–141. https://doi.org/10.1016/j.cogdev.2006.06.002
Sobel, D. M. (2009). Enabling conditions and children's understanding of pretense. *Cognition, 113*(2), 177–188. https://doi.org/10.1016/j.cognition.2009.08.002
Sobel, D. M., & Kirkham, N. Z. (2006). Blickets and babies: The development of causal reasoning in toddlers and infants. *Developmental Psychology, 42*(6), 1103–1115. https://doi.org/10.1037/0012-1649.42.6.1103
Sobel, D. M., & Kirkham, N. Z. (2007). Bayes nets and babies: Infants' developing statistical reasoning abilities and their representation of causal knowledge. *Developmental Science, 10*(3), 298–306. https://doi.org/10.1111/j.1467-7687.2007.00589.x
Sobel, D. M., & Letourneau, S. M. (2019). Children's developing descriptions and judgments of pretending. *Child Development, 90*(5), 1817–1831. https://doi.org/10.1111/cdev.13099
Sobel, D. M., & Lillard, A. S. (2001). The impact of fantasy and action on young children's understanding of pretence. *British Journal of Developmental Psychology, 19*(1), 85–98. https://doi.org/10.1348/026151001165976
Sobel, D. M., & Lillard, A. S. (2002). Children's understanding of the mind's involvement in pretense: Do words bend the truth? *Developmental Science, 5*, 87–97.

Sobel, D. M., & Weisberg, D. S. (2014). Tell me a story: How children's developing domain knowledge affects their story construction. *Journal of Cognition and Development, 15*(3), 465–478. https://doi.org/10.1080/15248372.2012.736111
Sobel, D. M., Yoachim, C. M., Gopnik, A., Meltzoff, A. N., & Blumenthal, E. J. (2007). The blicket within: Preschoolers' inferences about insides and causes. *Journal of Cognition and Development, 8*(2), 159–182. https://doi.org/10.1080/15248370701202356
Southgate, V., Senju, A., & Csibra, G. (2007). Action anticipation through attribution of false belief by 2-year-olds. *Psychological Science, 18*(7), 587–592. https://doi.org/10.1111/j.1467-9280.2007.01944.x
Stich, S., & Tarzia, J. (2015). The pretense debate. *Cognition, 143*, 1–12. https://doi.org/10.1016/j.cognition.2015.06.007
Subbotsky, E. (2010). *Magic and the mind: Mechanisms, functions, and development of magical thinking and behavior*. Oxford University Press.
Surian, L., Caldi, S., & Sperber, D. (2007). Attribution of beliefs by 13-month-old infants. *Psychological Science, 18*(7), 580–586.
Taylor, M. (1999). *Imaginary companions and the children who create them*. Oxford University Press on Demand.
Taylor, M., & Carlson, S. M. (1997). The relation between individual differences in fantasy and theory of mind. *Child Development, 68*(3), 436–455. https://doi.org/10.2307/1131670
Tee, J., & Dissanayake, C. (2011). Can 15-month-old infants understand pretence? An investigation using the 'violation-of-expectation' paradigm. *Acta Psychologica, 138*(2), 316–321. https://doi.org/10.1016/j.actpsy.2011.07.006
Téglás, E., Girotto, V., Gonzalez, M., & Bonatti, L. L. (2007). Intuitions of probabilities shape expectations about the future at 12 months and beyond. *Proceedings of the National Academy of Sciences, 104*(48), 19156–19159.
Tenenbaum, J. B., Kemp, C., Griffiths, T. L., & Goodman, N. D. (2011). How to grow a mind: Statistics, structure, and abstraction. *Science, 331*(6022), 1279–1285.
Walker, C. M., & Nyhout, A. (2020). Asking "why?" and "what if?": The influence of questions on children's inferences. In L. P. Butler, S. Ronfard, & K. H. Corriveau (Eds.), *The questioning child: Insights from psychology and education* (pp. 252–280). New York: Cambridge University Press.
Walton, K. L. (1990). *Mimesis as make-believe: On the foundations of the representational arts*. Harvard University Press.
Wansink, B., Shimizu, M., & Camps, G. (2012). What would Batman eat?: priming children to make healthier fast food choices. *Pediatric Obesity, 7*(2), 121–123.
Ward, T. B. (1994). Structured imagination: The role of category structure in exemplar generation. *Cognitive Psychology, 27*(1), 1–40.
Ward, T. B., & Sifonis, C. M. (1997). Tosh demands and generative thinking: What changes and what remains the same? *The Journal of Creative Behavior, 31*(4), 245–259.
Weisberg, D. S., & Goodstein, J. (2009). What belongs in a fictional world? *Journal of Cognition and Culture, 9*(1), 69–78. https://doi.org/10.1163/156853709X414647
Weisberg, D. S., & Gopnik, A. (2013). Pretense, counterfactuals, and Bayesian causal models: Why what is not real really matters. *Cognitive science, 37*(7), 1368–1381.
Weisberg, D. S., & Sobel, D. M. (2012). Young children discriminate improbable from impossible events in fiction. *Cognitive Development, 27*(1), 90–98. https://doi.org/10.1016/j.cogdev.2011.08.001
Weisberg, D. S., & Sobel, D. M. (2022). *Constructing science: Connecting causal reasoning to scientific thinking in young children*. MIT Press.
Weisberg, D. S., Sobel, D. M., Goodstein, J., & Bloom, P. (2013). Young children are reality-prone when thinking about stories. *Journal of Cognition and Culture, 13*(3–4), 383–407. https://doi.org/10.1163/15685373-12342100
Wellman, H. M. (1990). *The child's theory of mind*. Cambridge, MA: MIT Press.
Wellman, H. M. (2014). *Making minds: How theory of mind develops*. New York: Oxford University Press.
Wellman, H. M., Cross, D., & Watson, J. (2001). Meta-analysis of theory-of-mind development: The truth about false belief. *Child Development, 72*(3), 655–684. https://doi.org/10.1111/1467-8624.00304
Wellman, H. M., & Liu, D. (2007). Causal reasoning as informed by the early development of explanations. In A. Gopnik, & L. Schulz (Eds.), *Causal learning: Psychology, philosophy, and computation* (pp. 261–279). Oxford: Oxford University Press.
Wenner, J. A., & Bauer, P. J. (1999). Bringing order to the arbitrary: One-to two-year-olds' recall of event sequences. *Infant Behavior and Development, 22*(4), 585–590.
White, R. E., & Carlson, S. M. (2016). What would Batman do? Self-distancing improves executive function in young children. *Developmental Science, 19*(3), 419–426. https://doi.org/10.1111/desc.12314
White, R. E., Prager, E. O., Schaefer, C., Kross, E., Duckworth, A. L., & Carlson, S. M. (2017). The "Batman Effect": Improving perseverance in young children. *Child development, 88*(5), 1563–1571.
Wimmer, H., & Perner, J. (1983). Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition, 13*(1), 103–128. https://doi.org/10.1016/0010-0277(83)90004-5
Woolley, J. D. (1995). The fictional mind: Young children's understanding of imagination, pretense, and dreams. *Developmental Review, 15*(2), 172–211. https://doi.org/10.1006/drev.1995.1008
Woolley, J. D., Boerger, E. A., & Markman, A. B. (2004). A visit from the Candy Witch: Factors influencing young children's belief in a novel fantastical being. *Developmental Science, 7*(4), 456–468.
Woolley, J. D., & Ghossainy M, E. (2013). Revisiting the fantasy–reality distinction: Children as naïve skeptics. *Child Development, 84*(5), 1496–1510.
Xu, F., & Garcia, V. (2008). Intuitive statistics by 8-month-old infants. *Proceedings of the National Academy of Sciences, 105*(13), 5012–5015.
Xu, F., & Kushnir, T. (2013). Infants are rational constructivist learners. *Current Directions in Psychological Science, 22*(1), 28–32. https://doi.org/10.1177/0963721412469396
Yang, D. J., Bushnell, E. W., Buchanan, D. W., & Sobel, D. M. (2013). Infants' use of contextual cues in the generalization of effective actions from imitation. *Journal of Experimental Child Psychology, 116*(2), 510–531. https://doi.org/10.1016/j.jecp.2012.09.013
Youngblade, L. M., & Dunn, J. (1995). Individual differences in young children's pretend play with mother and sibling: Links to relationships and understanding of other people's feelings and beliefs. *Child Development, 66*(5), 1472–1492.

Further reading

Leslie, A. M., German, T. P., & Polizzi, P. (2005). Belief-desire reasoning as a process of selection. *Cognitive Psychology, 50*(1), 45–85.
Sobel, D. M. (2004b). Exploring the coherence of young children's explanatory abilities: Evidence from generating counterfactuals. *British Journal of Developmental Psychology, 22*(1), 37–58. https://doi.org/10.1348/026151004772901104