Imagining the Impossible
Magical, Scientific, and Religious Thinking in Children

Edited by
Karl S. Rosengren
University of Illinois
Carl N. Johnson
University of Pittsburgh
Paul L. Harris
Oxford University
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The Development of Children’s Thinking About Possible Events and Plausible Mechanisms

KARL S. ROSENGREN AND ANNE K. HICKLING

The world is filled with wonderful, fantastic, and even miraculous events. Animals change color, providing natural camouflage as part of seasonal variations. Tadpoles and caterpillars metamorphose into frogs and butterflies as part of their natural growth and development. Amazing events are not limited to living things. From the startling beauty of the motion of waves, rainbows, or sunsets to the tremendous destructive powers of volcanoes and hurricanes, nature is filled with awesome events and surprising phenomena. Changes in technology have also made wonderful events commonplace in our homes and offices. At the touch of a button or remote control, lights, televisions, computers, and all sorts of machines come to life. Adults in many cultures generally accept all of these events without question. We view these events as possible and governed by natural causes or ordinary human agencies.

At the same time, we do not always agree about the possibility of events or causal mechanisms that stretch or violate scientific principles. If asked about the possibility of life on Mars, time travel, fish that change from male to female, carnivorous mushrooms that devour worms, the existence of ghosts or angels, the efficacy of prayer, or the likelihood that certain individuals have telepathic powers, many adults are not quite sure what to think.1 Most adults routinely place

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1 As an aside, some of these events are actually possible. For example, a number of species of fish change sex as a function of environmental pressures (Crews, 1994) and some mushrooms trap and eat worms (Thorn & Barron, 1984). Even scientists disagree about the possibility of some events. Although the scientific community does not widely hold these beliefs, some physicists do question the impossibility of time travel (Deutsch & Lockwood, 1994) and other scientists cite recent meteor findings as suggestive of Martian life.
still other events in the realm of pure fantasy (e.g., visits by the Tooth Fairy, wishes granted by genies). This boundary between fantasy and reality or possible and impossible is not impermeable or unchanging. It varies according to age, knowledge level, context, and culture.

Given the prevalence of amazing events in everyday life, observations of relatively routine phenomena such as rainbows and sunsets could plausibly lead to the expectation that anything is possible. Indeed, if caterpillars can turn into butterflies, why can’t butterflies turn into birds and frogs into princes? Although traditional views of early childhood have implied just that, characterizing young children as engaged in a magical, fantasy world (e.g., Piaget, 1930), current research in developmental psychology suggests that even very young children competently draw boundaries between reality and its alternatives. Although we accept this view for the most part, we suggest that children differ importantly from adults in how they view the possibility of events and the plausibility of various mechanisms.

In this chapter we examine the origins and development of thinking about possible and impossible events. We address how children come to construct boundaries between what is possible in the world by ordinary means and what is impossible. We also focus on how children’s preferred explanations shift with context and development. We emphasize throughout that children’s causal judgments and explanations, although sometimes different from adults’, are quite sensitive in light of information provided by direct experience, parents, and culture. Although young children do seem quite skilled at maintaining boundaries between reality and fantasy or magical and real, they also may rely on explanations that adults would reserve for different classes of events. Specifically, in this chapter we examine children’s use of magic, an explanation that children come to use to describe certain real-world phenomena but that adults routinely reserve for the world of fantasy, imagination, or pretense.

**Defining Magic**

Establishing the place and function of magic in the everyday thought of young children first requires sorting out definitions emerging from diverse social science traditions. We contrast two distinct senses of magic pertinent to children’s thinking. One concerns magical thinking, the focus of many anthropological and psychological accounts characterizing thoughts of exotic populations (young children or adults in preindustrial cultures) as illogical or irrational. The other encompasses magical explanations and beliefs, a topic of growing interest within recent psychological models of the causal reasoning systems that children recruit to make sense of ordinary experiences. Although both senses of magic describe aspects of cognitive functioning, magical explanations more directly reveal the nature of magic from the child’s point of view.

Magical thinking encompasses errors in everyday causal attribution. For example, Piaget (1929, 1930) observed several apparent confusions in children’s understanding of cause-effect relations and characterized these as “magical.” Following this tradition, phenomena such as realism, inappropriate causal inferences between the mind and the world (e.g., explaining illness in terms of immoral thoughts), or participation, unwarranted causal inferences linking merely coincidental events, contribute to a picture of childhood thought as perversely immature and rigid.

In contrast, magical explanations, that is, “thinking about magic” (Chandler & Lalande, 1994), reveal children’s flexibility in selecting among several candidate belief systems to make sense of real-world events. We argue that children’s use of the term “magic” appeals to a legitimate and relatively coherent system of causal beliefs. Far from reflecting a fragile understanding of cause-effect relations, “magic” may provide considerable explanatory power.

We view magic as one of several alternative causal models. We use the term “alternative” to set these causal beliefs apart from foundational (Wellman & Gelman, 1997) or primary theories (Horton, 1993). Throughout our discussion we will refer to causal belief systems or models rather than to theories. This terminology highlights less well-

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2 We focus on issues of possibility in part because our initial investigations have explored this issue. At the same time, we realize that our findings should be considered with respect to children’s views of probability rather than possibility. Our focus on possibility may create a somewhat artificial dichotomy of possible/impossible events when, in fact, children and adults may make judgments based on probability. At present very little is known about children’s understanding of chance and probability. Interestingly, Lesser and Palfner (1985) suggested that concepts of chance and probability are central to adults’ views of reality. Although Piaget (1930) did investigate children’s understanding of chance to some extent, this is an area where more research is sorely needed.
developed forms of reasoning and avoids some of the intellectual baggage that comes with the use of the term “theory” to describe everyday thinking.3

Like more foundational domains of thought (see Wellman & Gelman, 1997), magic provides a causal-explanatory system specifying a unique set of relevant mechanisms and agents. We argue that a belief in extraordinary, perhaps even supernatural, forces defines the causal core of this domain. In this way, magic contrasts with ordinary physical, biological, and psychological reasoning. We believe that it is also important to distinguish magic from other types of alternative causal models that children and adults treat as distinct and that may have independent developmental trajectories. For example, we view religion as a distinct reasoning system involving a unique set of causal principles, not as an extension of magic. Beliefs in magic, religion, and extrasensory perception may each form distinct causal models. Because research directly supporting this view has not yet been conducted, we present suggestive data from our own research and point out where more research is needed.

The Origins of Magical Beliefs

A central issue in characterizing the role of magical explanations in children’s developing an understanding of everyday events concerns when and how magical beliefs originate: Do magical beliefs inform thinking from the very beginning, and then gradually decline in explanatory power across early childhood with the construction of causal-explanatory beliefs in other “scientific” domains (i.e., naive physics, biology, and psychology), or do they emerge somewhat later, as afforded by the consolidation of core conceptual domains? We argue that the ability to make sense of ordinary events through core “theories” actually sets the stage for the consideration of extraordinary events through alternative causal models like magical beliefs. In this way, the emergence of magical explanations reflects a degree of cognitive sophistication, with the underlying magical beliefs arising out of the interaction between knowledge acquisition and cultural support.

Although especially congenial with contemporary views of cognitive development as a process of constructing conceptual understanding in collaboration with more knowledgeable members of one’s culture (Rogoff, 1990; Vygotsky, 1978; 1986), the notion of magical beliefs arising through interaction between the individual and the social context finds roots even in earlier accounts. Classic developmental theories primarily focused on “magical causality” (Piaget, 1930), young children’s belief in their own ability to control events in the world through the power of thought alone. Within this framework, young children’s belief in the principle of efficacy at a distance leads to faulty reasoning about the causal links between thought or desire and action. Accordingly, toddlers and preschoolers might view wishing as a productive way to obtain an attractive new toy, whereas only older children would know to rely on more direct means (see Woolley, this volume).

In spite of this emphasis on magical thinking as a developmental precursor to scientific and systematic causal reasoning, Piaget (1929) also recognized a class of “social magical beliefs” of a more enduring and stable nature than causal understandings that children construct purely on their own. These social magical beliefs resemble many commonsense cultural views of magic, in which certain individuals, such as fantastic beings (e.g., fairies, wizards, Santa Claus), are endowed with extraordinary powers or capabilities (Rosengren, Kalish, Hickling, & Gelman, 1994). However, Piaget addressed neither the origins of magical beliefs nor their relationship to developments in causal reasoning skills. These unresolved issues gain renewed interest in the context of recent theories of knowledge development as instantiated within distinct domains of thought (for reviews, see Wellman & Gelman, 1992, 1998). This attention to multiple belief systems informing early causal-explanatory reasoning provides an arena for fresh consideration of the origins and developmental trajectory of magical beliefs and their place in children’s everyday world views.

Despite widespread agreement about the active role that young children play in creating their own everyday knowledge systems, the role of knowledge acquisition in the construction of magical beliefs in particular remains controversial. Whereas classic constructivist accounts support an early, perhaps innate set of quasi-magical beliefs
that are reflected in a global “magical” orientation in young children, ample evidence points to an alternative developmental story. We argue that young children’s growing understanding of causal mechanisms and principles, supported by socio-cultural input, provides the foundation and motivation for the development of magical beliefs and explanations (see also Chandler & Lalonde, 1994; Harris, 1994; Johnson & Harris, 1994). In other words, the very processes of knowledge acquisition long thought to replace a “magical” world view actually encourage its development. With respect to the origins and developmental role of magical explanation, Chandler and Lalonde (1994) propose that “… children’s thoughts about magic are sometimes meant to help preserve rather than undermine their commitment to systems of natural law” (p. 84). Thus, magical beliefs emerge as young children come to recognize shortcomings in their more conventional belief systems.

Several phenomena central to the emergence of everyday concepts eventually lead children to actively, even consciously, entertain notions of magic. Broadly speaking, magical beliefs may originate from children’s developing abilities to consider both possible events and plausible mechanisms. How do these competencies arise? One important foundation for this development may lie in an innate (or very early learned) disposition to expect causal regularity. During the first months and years of life, children show an impressive ability to interpret events in terms of diverse, domain-specific causal mechanisms (Hickling, 1996; Wellman & Gelman, 1998). The speed and apparent ease with which these early causal understandings emerge have led to speculation that causality comprises a developmental primitive (Wellman & Gelman, 1998). Causal determinism, a presumption that knowable (even if unknown) mechanisms underlie events, may guide the search for explanation and understanding (Gelman & Kalish, 1993). Evidence for this strong propensity to view events as caused comes from research suggesting that preschoolers sometimes refuse to accept the possibility of random (i.e., acausal) events and draw causal inferences between unrelated states of affairs (Piaget, 1930). Still more compellingly, preverbal infants show a similar drive to explain by using spatio-temporal cues to resolve physical anomalies (i.e., seemingly impossible displays) intended to violate their expectations (Bailargeon, 1994). Therefore, a causal presumption may operate from the beginning of life in a framework fashion, directing attention to and thinking about events even before learning about relevant domain-
specific causes takes place (Wellman & Gelman, 1998). This bias may so powerfully compel young children to search for causes that they eventually must recruit a broad repertoire of specific causal factors to make sense of the diverse and increasingly complex events they observe and experience. Preschoolers may begin to recruit alternative causal models, especially magical beliefs, for those circumstances that violate their now rich causal-explanatory beliefs provided by more ordinary domains of thought.

In light of their overwhelming orientation to seek out causes of everyday events, what guides children to begin appealing to magical explanations in particular? Another early conceptual achievement, the ability to categorize events as impossible, sets the stage for the consideration of unconventional causal factors. Distinguishing impossible events from possible ones allows children to recognize a special class of magical occurrences (Harris, 1994). The possible-impossible distinction, which is evident from the first months of life (Baillargeon & Devos, 1991), suggests an appreciation that causal principles constrain what can take place rather than just what usually or typically happens (Harris, 1994; Rosengren & Hickling, 1994). Thus, events that defy expectations do so because they contradict well-established causal beliefs, not merely because they involve rare or unfamiliar outcomes. This growing understanding of what is ordinarily impossible in the physical, biological, or psychological domains helps young children define boundaries between the magical and the commonplace. Preschoolers’ emerging ability to think about fictional events in the contexts of fantasy, imagination, pretense, and dreams (see Taylor & Carlson, this volume; Woolley & Phelps, 1994) enriches and expands how they conceptualize possibility and, therefore, impossibility. Early in the preschool period, children come to view fictional contexts as free-wheeling and unconstrained. For example, children as young as three years appreciate the possibility of imagining an entity (e.g., a purple cow) having no real-world referent (Woolley & Wellman, 1993) and of pretending a state of affairs in direct conflict with the pretense of one’s playmate (e.g., same glass simultaneously holds both pretend “orange juice” and “coke”) (Hickling, Wellman, & Gottfried, 1997).

This growing experience with thinking about both real and fictional possibilities makes impossible events increasingly more salient and, therefore, especially demanding of explanation.

Once the normal processes of cognitive development enable young children to notice this class of special, seemingly impossible events,
how do they come to see magic as a plausible mechanism? In short, culture invites young children to embrace magical beliefs. Cultural or social support of magical beliefs takes several forms. Most generally, a wealth of cultural practices and materials introduce young children to extraordinary or supernatural entities and mechanisms. Books and movies designed for preschoolers expose them to both (seemingly ordinary) human and (obviously) fantastic beings capable of bringing about events deemed impossible in the real world. As portrayed in many classic fairy tales, as well as in their animated adaptations, a variety of trappings accompany magical feats. Common types of cues signaling magical events include special clothing, objects with unusual properties, or incantations and spells. Furthermore, ritual practices such as hanging stockings or donning Halloween disguises help children find a place for magic in the real world, at least on special occasions. All of these activities, along with imaginary and pretend play, give young children experience integrating the magical into everyday life.

Nonetheless, interactions within children’s close relationships exert more immediate influence than broader forms of cultural support. Parental input may play an especially powerful role in the development and maintenance of young children’s magical beliefs. What form might such encouragement take? One crucial source may come from parent-child conversations regarding magical events. Instances in which an adult labels an event as “magic” provide a direct source of input. Although many parents surveyed about their responses to preschoolers’ causal questions reported a preference for “scientific” (i.e., mechanical or technical) explanations, some admitted to resorting to magical explanations when asked about especially unusual events (Rosengren & Hickling, 1994). These magical markers may well occur more commonly than parents report. Informal observations in preschool classrooms reveal that teachers and other adults often describe events as “magic” (Rosengren & Hickling, 1994). Similarly, parents’ use of magical explanations to highlight interesting events (e.g., “It’s the magic of the season.”) or to explain an anomalous event of interest to the child could spark the construction or elaboration of magical beliefs. The impact of parental input may prove substantial until children eventually orient more to the wider culture of peer group and school.

To summarize, we suggest that magical reasoning stems from an interaction of knowledge acquisition (learning the limits of possibil-

ity), the emergence of pretense and imagination (opening up the realm of possibility), a search for causality (and a desire to categorize entities or events by domain), and cultural support for the existence of magical phenomena and mechanisms. These factors set the stage for a special developmental window within which magical explanation rises and falls.

Age-Related Changes in Magical Beliefs

When do children’s magical beliefs first emerge? Figure 3.1 shows one possible developmental trajectory. Based on Piaget’s account of magical thinking, this depiction shows a stagelike increase in logical thought, accompanied by a complementary age-related decrease in illogical or magical thinking. Figure 3.2 shows a contrasting developmental story (for a third perspective, see Subbotsky, 1993; this volume). Based on our experimental work, we argue that children’s magical beliefs emerge some time around the beginning of the fourth year of life, peak during the preschool years, and then decline as children enter school.

Several research findings support our claim that magical beliefs emerge during but not prior to the preschool period. First, toddlers and young preschoolers show little if any familiarity with magic. In a pilot study of preschoolers’ magical explanations for physical events,
we found that children younger than age four did not know or use the term “magic.” A longitudinal analysis of children’s natural language supports this finding (Hickling, 1996). Children’s first use of magical explanation in everyday conversation occurred on average at forty-two months, six to twelve months later than initial uses of physical, biological, psychological, or social explanations. Thus, magical reasoning emerges later than the more foundational forms of causal explanation.

Even if children do not commonly use magical words or explanations, they may still treat magical entities as belonging to a distinct category (or domain) from an early age. Determining whether children have a distinct magical domain of thought prior to the development of relevant language skills and vocabulary requires a method of tapping children’s implicit magical knowledge. As a starting point, we investigated whether toddlers constrain the types of events they will attribute to different causal agents. Do toddlers associate magical events with specific sorts of causal agents (e.g., magicians), or do they think that anyone can perform magical events? In an exploratory study, we presented 2½-year-olds ($N = 11$) with a series of events (commonplace and magical ones) and then asked whether their teachers and parents could perform each one.4 Ten of the eleven children judged that both the teacher and their parents could perform the commonplace events (blowing up a balloon, drawing a happy face, and cutting a triangle out of a paper circle). Six of the eleven children responded that they themselves would be unable to perform these commonplace events. This is not too surprising, because most of the commonplace events were beyond the motor skills of most children of this age.

More centrally, how did the children respond to the magical events? Seven of the eleven children judged that both the teacher and their parents could perform these events – and also responded that they themselves could not perform the events. Although preliminary, this finding suggests that toddlers may not restrict the causal agency of magical events. Some of these younger children appear to view all adults as equally capable of performing both commonplace and magical events. In contrast, we have found that somewhat older children are highly restrictive in who they believe capable of performing magic (Rosengren & Hickling, 1994). If this result holds up under more detailed exploration, it will provide greater evidence that young children do not start with a distinctly magical category.

When do children begin to embrace magic as a real, possible, explanation? We have found that preschoolers use magical explanations to explain impossible physical events. For example, in one study we presented four- and five-year-olds with a set of hypothetical object transformations (Rosengren & Hickling, 1994). These events included similar commonplace and magical events as in the study described earlier. In this study, however, we first showed specific objects (e.g., a piece of string, a coloring book with black and white line drawings) and then suggested hypothetical mechanisms for changing the object’s appearance (i.e., making the string two pieces by cutting it with scissors, coloring the pages simply by flipping them). If the children said that the action we described could not cause the event to occur, we

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4 It is important with children of this age to spend a significant amount of time building rapport and to include questions to control for yes or no response biases. In this study, the head preschool teacher aided with both rapport and interpreting the children’s responses. This was necessary because such young children often have idiosyncratic pronunciations that are understood only by familiar adults.
asked them to describe an action that would be successful. If the children accepted our action, we asked them for additional means for bringing about the event.

Children of both ages overwhelmingly judged the commonplace events to be possible and the magical ones to be impossible given the mechanisms we described. After actually viewing the events, most of the four-year-olds responded that the experimenter had performed magic. Children reserved magical explanations only for the events that they had previously described as impossible. The children did not generalize magical explanations to all of the events performed by the experimenter. In follow-up questions, the children of this age responded that the experimenter was in fact a magician, that magic can only be performed by certain individuals (i.e., magicians, and not teachers or parents), and that magic involves special powers.

These data also revealed striking age differences in the children's explanations. Most five-year-olds explained "impossible" events in terms of tricks (in contrast to real magic) and described magic as something that anyone may learn from experts or books. Although most four-year-olds embraced magic as a legitimate form of causal explanation and held a coherent set of magical beliefs, five-year-olds incorporated magical occurrences into their natural models of the world. Phelps and Woolley (1994) suggested a slightly older age for this decline in magical explanation (~ age 6). We suggest that timing will vary from one group to another depending on the level of support for magical beliefs in a given community. It is likely that this decline in magical beliefs coincides with the onset of formal schooling and a wider exposure to peer culture.

As mentioned earlier, we believe that changes in support provided by parents and the larger community in part account for age differences in magical explanations and beliefs. For the past few years we have collected a number of examples where parents or teachers use the term "magic." Although fairly rare in everyday speech, these instances seem to be associated with particular kinds of entities or events. For example, we have heard teachers of preschool and kindergarten children refer to magnets as "magic wands," chemical indicators as "magic potions," and color-changing paper as "magic." We have also found preschoolers' chemistry sets labeled as "mysterious or magical," science kits labeled as "Science Magic Tricks," or books that combine learning science with magic (see, for example, Ladizinsky, 1994). Although these examples are compelling, anecdotal evidence alone cannot reveal how widespread this phenomenon might be. Thus, to explore this issue more systematically, we conducted a number of questionnaire studies and experimental manipulations.

The survey responses suggest age-related changes in parental perceptions and encouragement of preschoolers' magical beliefs. In one study (Rosengren et al., 1994), the parents of four-to six-year-olds (N = 70) reported relatively low levels of support for beliefs in various "magical" characters (e.g., magicians, witches) other than event-related figures such as Santa, the Easter Bunny, and the Tooth Fairy. Parents' reports of their children's beliefs significantly correlated with parental encouragement, especially for the event-related characters. A survey of parents whose children (ages four and five) participated in experimental research on preschoolers' magical explanations (Rosengren & Hickling, 1994) revealed similar results. These parents, however, received an additional set of questions that asked how they would respond if their children asked them about the reality status of certain figures (i.e., "is Santa real?"). Most parents responded that they would describe ghosts and magicians as not real, but would describe Santa, the Easter Bunny, and the Tooth Fairy as real. Most importantly, the parents also responded that their answers would change as their children grew older. The parents said that they would provide increasingly evasive answers (i.e., "what do you think?"); alternative responses (i.e., "Santa is real in the spirit"); or definite denials of reality status (i.e., "there really is no Santa").

Although anecdotal evidence and parents' own reports provide a starting point for examining parental encouragement of magical beliefs, we have also examined this issue in experimental work (Rosengren, Hickling, Jurist, & Burger, in preparation). In one study, parents and their four- or seven-year-old children (ten families per age group) watched a live magic show. The magician performed a series of magic tricks (e.g., making a rabbit appear in an empty box) as well as some commonplace events (e.g., blowing up a balloon, removing a ketchup bottle from a bag). For a week following the show, the parents kept a diary of their responses to the children's questions about the events performed by the magician. We coded the contents of the parents' explanations according to reasoning system (physical/natural, magic, or trick) and degree of encouragement in magic (affirm, evade, disconfirm). The parents of preschoolers generally provided magical explanations (of tricks) and affirmed the existence of magic.
When asked, “How did the man fold the money? Was it magic?” the parent of a preschooler responded, “Yes, it was!” The parents of the older children more often responded to the children’s questions about the magic tricks by explicitly describing the event as a “trick” or by providing a physical/natural explanation. For example, when asked, “How did the magician make the bird come out of the balloon?” the parent of an elementary school age child replied, “I’m not sure. Sometimes magicians keep things up their sleeves and slip them down when you’re not looking, but this takes a lot of practice.” The parents of the older children generally disconfirmed the existence of magic.

How do parents explain magical events at the time they first observe them? In a second study, we examined the conversations between three- and five-year-old children and their parents watching a televised “magic show.” A magician performed magical (i.e., our magic coloring book), commonplace (i.e., blowing up a balloon), and other extraordinary transformations (i.e., possible but dramatic events like mixing two colorless liquids to get a dark liquid). We recorded the parents’ and children’s spontaneous comments while watching the magic show. Here again we looked at the types of causal explanations given by the parents with a particular focus on whether the parents differentiated between the three types of events in their causal comments. The parents generally provided physical or natural explanations for the commonplace events, saying things like, “Hey that wasn’t magic!” or “He’s not a very good magician.” The parents of the younger children (three-year-olds) often provided magical explanations for the magical events. For example, the following dialogue presents a conversation about a trick in which a brightly colored scarf vanished:

CHILD: “It disappeared!”
MOTHER: “It disappeared! That was pretty neat! He made the scarf disappear.”
CHILD: “How’d he do that?”
MOTHER: “I don’t know, it must be magic.”
CHILD: “Yeah!”

A number of parents engaged their children in explicit discussions regarding the nature of magic. For example, one mother walked her child through a number of events and evaluated whether each counted as magic.

CHILD: “You know I think he’s doing different things, where some things look like magic and some don’t. Like blowing up a balloon, is that magic?”
MOTHER: “No.”
CHILD: “I don’t think so.”
MOTHER: “Blowing up a balloon is not magic.”
CHILD: “Yeah... when he drew the happy face was that magic?”
MOTHER: “NOOOOO!!!”
MOTHER: “Then he made the scarves change colors, was that magic?”
CHILD: “Yeah, that was magic!”

The parents of the older children in this study (five-year-olds) usually provided physical or natural mechanisms to explain magic tricks (“He put it [the scarf] in his pocket”) or explicitly described the event in terms of trickery or deception.

Although the parents’ comments clearly distinguished between the commonplace and magical events, we were particularly interested in how they talked about extraordinary events. Based on our anecdotal evidence we expected that the parents would describe these events as magic, especially in the context of a “magic show.” Instead, we found that the parents talked about these events primarily by describing the event or using physical or scientific explanations. For example, the following dialogue presents a conversation about an event that involved mixing two colorless liquids together resulting in a dark liquid:

(Magician holds two glasses containing colorless liquid.)
MOTHER: “What’s he have in his hands?”
CHILD: “Water.”
(Magician mixes liquids)
MOTHER: “Oh, cool, it turned black! Is it bubbling?”
CHILD: “Yeah.”
MOTHER: “That’s strange.”
CHILD: “Ooh, right?”
MOTHER: “Yes, I think so.”
MOTHER: “It’s kind of mysterious... That’s chemistry you know, when you combine liquids, different liquids.”

The parents rarely explained extraordinary events as magic or tricks (an average of less 0.3 utterances per parent). The parents of the older
children provided significantly more physical or scientific explanations than the parents of the younger children.

Taken together, these studies suggest that parents clearly distinguish between magical and nonmagical events in both their spontaneous comments and responses to causal questions. In addition, parents of younger children (three- and four-year-olds) tended to provide encouragement of magical beliefs, whereas parents of older children (five- and seven-year-olds) tended to treat magic merely as clever trickery. This research suggests that parents support magical beliefs selectively. They and, most likely, the culture at large reserve magical explanations for particular situations, contexts, and events. This targeting of certain events as special or magical provides children with a structure to construct a unique causal belief model that applies to a constrained set of entities and events. Interestingly, soon after children construct this system of beliefs, parents begin to withdraw their support, providing less explicit encouragement and more evasive statements about the existence of magic. This raises an intriguing question. That is, if parents’ ultimate goal is for children to have a clear understanding of the difference between magic or, more generally, fantasy and reality, why do they invest any energy in encouraging magical and fantasy beliefs? Several hypotheses for further consideration include that parents encourage such beliefs for fun, to support cultural rituals, or to recapture their own childhood.

Contextual Issues

We do not view the developmental progression that we have just articulated as completely uniform or universal. We view this process as strongly influenced by the characteristics of the child, significant older individuals (specifically parents, teachers, and most likely older siblings), and the wider culture. Thus, we expect wide individual variation in the adherence to magical beliefs (see Johnson, this volume). We also suggest that young children do not show a generally magical orientation to events they confront in everyday life. Magical beliefs and explanations appear to arise in particular situations. In this section we explore the contexts that may elicit magical explanations.

In a series of studies of children’s reasoning about the possibility of various biological and physical events (Rosengren et al., 1991, 1993, 1994; Rosengren & Hickling, 1994) we have found that: (1) young children are generally less accepting than older children and adults of events leading to dramatic changes in the appearance of an animal (i.e., metamorphosis) or object (i.e., changing from wood to metal); and (2) young children rarely provide spontaneous statements referring to magical means or entities. For example, of some 300 preschool children that we have interviewed in a variety of settings, only 3 have spontaneously provided any form of magical reasoning (DeHart, Rosengren, & Protska, under review; Rosengren et al., 1991, 1994). Therefore, children ordinarily do not rely on magic as a default explanation. However, a number of situations may elicit children’s magical beliefs. These include, but may not be restricted to: (1) situations violating children’s causal expectations; and (2) special events explicitly labeled by parents and the culture as magical (i.e., magic shows).

It is important to point out that a violation of expectations alone is probably not sufficient for children to draw on magical beliefs. Two conditions must prevail as well. First, children must have experienced similar violations in the past where the event (or one highly similar to it) was explicitly labeled as magic. We expect that a few salient examples of parents or other adults labeling a dramatic event as magical may be enough to create this “magical category.” Second, other alternative explanations cannot be readily available. Indeed, one reason that magicians perform each trick once per magic show and quickly move from one trick to the next is that these techniques do not enable the observer to spend any time pondering how any particular event was performed. Chandler and Lalonde (1994) showed that if children are allowed to repeatedly view an event, they rapidly give up their magical explanation in favor of a more mundane mechanism. Likewise, we have found that if children are provided with an alternative mechanism, even one that adults find highly implausible, they are less likely to resort to magical explanations. For example, in one study we presented children with a scenario where a machine would shrink and enlarge a room (DeLoache, Miller, & Rosengren, 1997). Although originally designed to examine children’s symbolic understanding, this study also sheds light on situations that may violate children’s expectations but not elicit magical explanations. In this study, the children were first introduced to “Terry the Troll,” who was then shrunk by a “special machine.” After successfully shrinking Terry, we enlarged him to his initial size and then hid him in a particular place in a larger room. We then turned the machine toward the room, activated it, and rendered the room approximately one-tenth of its previous size. The children were then asked to find Terry. During the actual shrinking
or enlarging the children were in an adjoining room (for "safety") and the machine generated noises indicating the shrinking or enlarging of Terry or the room. Two-and-a-half-year-old children, who typically fail to find an object hidden in one space when it is hidden in an analogous space (such as a scale model), successfully find it in the shrinking room condition. This result suggests that toddlers accepted our transformation and viewed the room as the same room after it had been shrunk. We have found that children under the age of five are quite accepting of our transformation — with many four-year-olds even refusing to accept our debriefing about the machine. The children would often ask us to "shrink" something else and would describe the machine to the parent who had not come into the laboratory as a "machine that can really shrink things." In only one case (out of approximately forty children) did we have a child describe the shrinking machine using magical terms. The few older participants (six-seven-year-olds) who completed this task began immediately looking for an alternative explanation and rapidly uncovered the real mechanism behind the transformation.

Overall, we interpret these findings as suggesting that young children are quite accepting that a machine can bring about an amazing transformation, one that they would normally view as impossible (see Rosengren et al., 1991, 1993). Given the prevalence of amazing machines such as televisions, CD players, and remote controls that have permeated most homes, it is not altogether surprising that children might believe that a shrinking machine was in the realm of possibility. This study also provides further evidence that children are not uniformly magical in their orientation to real-world events.

Magical Beliefs and Other Forms of Causal Reasoning

How do magical beliefs and explanations relate to other forms of causal reasoning? Specifically, we return to the issue of whether magical reasoning should be considered as a distinct causal model.

We suggest that it might be useful to consider how different forms of causal reasoning are related by thinking of different causal models as separate attractor states. In this view, the state of the system (here the possible causal reasoning systems that children may use) is modeled as a surface representing all possible states of the system (an attractor landscape). Depressions in the surface represent attractor states or regions where the system is likely to move under different conditions. The current state of the system can be represented in terms of a ball that rolls around on this surface. If the ball lands in one of the depressions in the surface, it will tend to remain in that location as long as the attractor well is sufficiently deep or the walls of the attractor region are sufficiently steep (symbolizing a strong attractor) and the conditions of the system remain relatively stable. However, if greater energy enters into the system, the ball will become more active and the likelihood that the system will move to a different attractor state will increase according to the overall characteristics of the attractor landscape.

Neither the attractor landscape nor the ball (the current state of the system) should be viewed as static. Rather, because biological systems are in constant flux, the ball should be viewed as constantly moving (similar in some regards to Piaget's view of dynamic equilibrium). These movements can be relatively small fluctuations or vibrations or be more vigorous in nature, depending on the level of energy or excitement in the system. Likewise with development, greater experience, or changes in context, new attractor states (new forms of causal reasoning) may emerge, while others deepen or become more shallow and still others may disappear completely.

Why adopt this metaphor for children's causal reasoning? One advantage of this type of description of cognitive development is that it provides a way of thinking about how different causal reasoning systems might relate and how children might shift from one form to another given different situations. This issue has been ignored for the most part as researchers have scrambled to describe domain-specific aspects of cognition and its early development (for a variety of views, see Hirschfeld & Gelman, 1994). This trend has been driven in part from the failure to find coherence in reasoning across domains and a general dissatisfaction with global descriptions of cognition (such as that proposed by Piaget). This approach enables us to think constructively about the variability in children's reasoning, an issue that has most recently been emphasized by dynamic systems theorists (see Thelen & Smith, 1994). However, other researchers in cognitive devel-
opment have begun to examine more fully the nature of variability in children’s thinking within particular domains (see Siegler, 1996; Rosengren, Taylor & DeHart, 1997). Few researchers or theorists have examined how domains might relate (but, see Hirschfeld, 1994; Taylor, Gerow, & Carlson, 1993).

From this perspective, each depression in the surface of the landscape, or attractor well, could represent one of the three foundational reasoning systems: physics, biology, and psychology. The exact shape and orientation of these domains (attractors) are yet to be determined (and in fact are most likely indeterminate). We view these wells as varying in depth to indicate that certain forms of causal reasoning may be more attractive than others. For example, the attractor state for physical reasoning would be relatively deep, indicating an “entrenched” causal model. In our view, an attractor landscape with three separate attractor wells representing naive physics, biology, and psychology would capture young children’s default causal reasoning systems. That is, children primarily rely on one of these three causal models. If the event involves mechanical force, the attractor state for physical reasoning would deepen, and that form of explanation would become increasingly likely. Likewise, if the event involves mental states, the well corresponding to psychology would deepen, and the likelihood that children would reason about the event in psychological terms would increase.

At the boundary regions between attractor states the system may change in one direction or another, depending on the steepness or attractiveness of the different causal reasoning systems. Other attractor states may emerge in these boundary regions when more entrenched causal belief models fail to provide explanatory power (or when cultural support for a particular form of reasoning changes). For example, Hirschfeld (1995) suggested that reasoning about social phenomena (labeled as a Theory of Society) should be viewed as a distinct causal model (see also Hickling, 1996). This causal model may develop at the boundary between naive biology and naive psychology. Likewise, we suggest a causal model for magic emerging at the boundaries of physics and psychology. This attractor state deepens during the preschool period and then shrinks as children enter school. We view this causal reasoning system as distinct (and deserving of a separate attractor state) based on criteria articulated by Wellman and Gelman (1997). Specifically, magical reasoning involves a unique mode of causality (i.e., magic), nonobvious constructs (i.e., magical powers cannot be seen), and a relatively coherent set of interrelated concepts (i.e., magicians, magic wands, potions, special hats, etc.).

As magical explanation emerges and then declines, a religious causal reasoning system may form (see Wooley, this volume). Given developmental accounts of religious thinking, this attractor state may continue to deepen as children age (see Boyer & Walker, this volume). We suggest that these alternative causal models (i.e., magic or religion) will for the most part never become more attractive than the foundational domains for most individuals. The foundational reasoning systems will predominate in part because of greater experiential and cultural support. Cultural support for magical or religious reasoning (except in the case of isolated religious groups) may never be uniform enough, so that these causal models may become as entrenched or coherent as those for the foundational domains. Likewise, differing inclinations toward or support for magic or religion may influence whether either of these causal models emerge in the first place.

What causes a shift from one mode to another? Shifts in causal reasoning may occur due to changes in the entities involved in an event (i.e., objects, animals, or people), changes in context (i.e., home, school, farm or zoo, church or religious ceremony), heightened interest or curiosity about some type of phenomena (i.e., a child’s fascination about magic leading to learning about the actual tricks), acquisition of new knowledge (i.e., learning why the sun appears to move), and changes in mood or emotional factors (i.e., hopelessness in one’s current situation leading to the individual to turn toward religion). The nature of the attractor landscape is likely to vary across children as well. Children certainly vary with respect to their fantasy proneness (Taylor, Cartwright, & Carlson, 1993). Individuals also vary with respect to their beliefs in religion. Thus, the depth of particular attractor states, their location with respect to other causal reasoning systems, and the developmental course of attractors is likely to vary greatly across individuals.

**Conclusion**

In this chapter we have outlined the development of children’s beliefs and explanations about magic. Our view of the development of magical reasoning differs in two important ways from other accounts. First, we treat magical reasoning as carving out a distinct domain. In this
view, magical reasoning represents an alternative form of causal reasoning that is distinct from both foundational forms of reasoning (i.e., physics, biology, and psychology) and other alternative forms of reasoning, such as religion. Traditionally, magic has primarily been viewed as an error in children's (or adult's) reasoning, and used to label any explanation that varied from the accepted logic. While we agree that children may sometimes make errors of logic and reasoning, we suggest that it is more fruitful to label these as just that, causal errors, and reserve the term magic for situations where individuals apply a specific type of causal reasoning, one that involves reference to specific supernatural powers.

We also differ from other researchers and theorists in that we view magical reasoning as emerging during the preschool years, rather than being present from the start. We have provided evidence that magical reasoning emerges in the fourth year of life, peaks sometime within in the next year or two, and then shows a relatively rapid decline as children enter formal schooling. This developmental trajectory is driven by a search for causal understanding, the acquisition of new knowledge, and changing cultural support. Like other contributors to this volume (most notably Woolley) we argue that it is important to consider how parents and culture provide support and encouragement for children's cognitive development.

Although we have argued that children's reasoning about magic should be viewed as distinct from other forms of causal reasoning, few researchers have explicitly addressed the relation between different causal modes of reasoning. Future research should examine more closely how magical reasoning relates to other types of reasoning, whether it truly represents a distinct form of reasoning, and the factors that cause children to switch from one mode of explanation to another.

References

*Metamorphosis and Magic*

4 The Development of Beliefs About Direct Mental-Physical Causality in Imagination, Magic, and Religion

JACQUELINE D. WOOLLEY

A fundamental ontological distinction that governs much of human behavior is that between the realms of the mental and the physical. An awareness of this distinction informs most, if not all, of adults' predictions for and explanations of events in the world. Thus, an important developmental question arises: When do children become aware of this distinction? Recent research has documented that, in their early years, children in Western cultures are acquiring considerable knowledge about how the mind and reality are both distinct and related. For example, children know that mental entities have very different properties from physical things (Estes, Wellman, & Woolley, 1989; Wellman & Estes, 1986). They also understand that mental states are related to the world in important ways, in particular in the form of beliefs and knowledge (Aasting, 1993; Bartsch & Wellman, 1995; Perner, 1991; Aasting, 1993). These pieces of knowledge are part of what many have called a "theory of mind" and arguably represent one of children's earliest bodies of knowledge to be used in understanding the world (Wellman, 1990).

Yet a consideration of certain cultural practices in Western society

As there is very little data on the development of a "theory of mind" in other cultures, the universality of early beliefs about the mind is as yet unknown. Although a "theory of mind" could be considered a cultural construct, I have chosen to speak of it here more as a body of knowledge that children acquire somewhat spontaneously, and to contrast it with particular constructs that are passed down more explicitly from generation to generation. I view the very early understandings and distinctions that children acquire about the mind as primarily untutored and implicit, and, as such, I think of their development as proceeding more similarly to development of knowledge about the natural world than to the acquisition of cultural constructs, such as magic and religion, which I expect to vary more between cultures. Of course this is still an open question (see, e.g., Lillard, 1997).