

The Coexistence of Natural and Supernatural Explanations Across Cultures and Development

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Although often conceptualized in contradictory terms, the common assumption that natural and supernatural explanations are incompatible is psychologically inaccurate. Instead, there is considerable evidence that the same individuals use both natural and supernatural explanations to interpret the very same events and that there are multiple ways in which both kinds of explanations coexist in individual minds. Converging developmental research from diverse cultural contexts in 3 areas of biological thought (i.e., the origin of species, illness, and death) is reviewed to support this claim. Contrary to traditional accounts of cognitive development, new evidence indicates that supernatural explanations often increase rather than decrease with age and supports the proposal that reasoning about supernatural phenomena is an integral and enduring aspect of human cognition.

In Zandeland sometimes an old granary collapses. There is nothing remarkable in this. Every Zande knows that termites eat the supports in [the] course of time and that even the hardest woods decay after years of service. Now a granary is the summerhouse of a Zande homestead and people sit beneath it in the heat of the day and chat or play the African hole-game or work at some craft. Consequently it may happen that there are people sitting beneath the granary when it collapses and they are injured, for it is a heavy structure made of beams and clay and may be stored with millet as well. Now why should these particular people have been sitting under this particular granary at the particular moment when it collapsed? That it should collapse is easily intelligible, but why should it have collapsed at the particular moment when these particular people were sitting beneath it? (Evans-Pritchard, 1937, p. 69)

As Evans-Pritchard (1937) observed, the Azande fully understand that termite damage combined with the granary's own weight caused the structure

to collapse, and that on a hot day people might well be sitting beneath it and be hurt or killed. One could say that it was a coincidence of events, two chains of causation intersected at a certain time and in a certain place (Evans-Pritchard, 1937). Yet for the Azande, the question of multiple causality remains: Why these people at this moment and at this place? The question is not simply one of "how" but of "why." To answer the question of "why," the Azande supplement their naturalistic explanation of the collapse of the granary by invoking supernatural forces: Witchcraft is used to explain the unfortunate presence of the victims.

Access to natural as well as supernatural explanations is not confined to the Azande. It is a pervasive experience across different cultures (Astuti, Solomon, & Carey, 2004; Campbell, 1972; Evans, Legare, & Rosengren, 2011). For example, with regard to the origin of species Americans and Europeans are exposed to a creationist account on the one hand (i.e., God placed humans on earth) and an evolutionary account on the other (i.e., humans evolved from different kinds of living things; Evans, 2001). Similarly, both biological and supernatural explanations for the transmission and cure

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of serious illnesses are prevalent. In the developing world, although information about the transmission of the AIDS virus is widely available via health and education programs (Legare & Gelman, 2009), supernatural accounts of infection based on witchcraft are promulgated (Ashforth, 2001; Farmer, 1999; Legare & Gelman, 2008). Finally, although people must confront the biological inevitability and finality of death for all living creatures, in many religious traditions they are also invited to believe in the prospect of an afterlife—at least, for human beings (Astuti & Harris, 2008; Harris & Giménez, 2005; Talwar, Harris, & Schleifer, 2011).

In spite of their dual prevalence, little is known about how natural and supernatural explanations codevelop or the extent to which children and adults recruit and accommodate both to explain the same events. We propose that understanding the coexistence of natural and supernatural explanations is fundamentally a cognitive developmental endeavor and speaks to general questions of knowledge acquisition, socialization, and the interaction of cognition and culture. We review research demonstrating that the coexistence of natural and supernatural explanations is not a short-lived, transitional phenomenon that wanes in the course of development but instead that coexistence thinking is also evident and indeed widespread among adults. Before proceeding further, we will frame our discussion with working definitions of natural and supernatural phenomena. For the most part, we borrow from standard psychological usage. We define *natural* as (in principle) observable and empirically verifiable phenomena of the physical or material world. We define *supernatural* as phenomena that violate, operate outside of, or are distinct from the realm of the natural world or known natural law. Even when a particular cause is unknown, natural or physical mechanisms are assumed to exist in the case of natural explanations and supernatural mechanisms are assumed to exist in the case of supernatural explanations. Rather than making strong definitional claims about the distinction between natural and supernatural phenomena, we focus on the kinds of causes and practices that are generally regarded as belonging to natural (e.g., science, medicine, and biology) versus supernatural (e.g., religion, divination, and witchcraft) kinds from an intuitive, psychological perspective.

In both lay and scientific writing, natural or scientific explanations on the one hand and supernatural or religious explanations on the other are often pitted against each other (Bloom, 1992; Dawkins, 2006; Preston & Epley, 2009) with the assumption

that scientific explanations may eventually prevail due to their superiority at providing empirically testable explanations. This view is also implied by the secularization hypothesis, which states that as science and technology advance they will increasingly displace religious explanations (Norris & Inglehart, 2004). An alternative to this displacement account is that natural and supernatural explanations do not overlap because they are used to explain different types of phenomena (Biema, 2006; Gould, 1997). However, contrary to the displacement account and in contrast to nonoverlap, we propose that these two explanatory frameworks often coexist within the same individual, and may both be recruited even with respect to the same phenomenon.

In this review, we examine how children and adults respond to distinct natural and supernatural explanatory accounts of the world around them. We propose that although in some contemporary cases they are represented as competing and mutually exclusive accounts (e.g., Biblical literalist accounts of God creating the world in 7 days vs. evolutionary accounts of the diversity of life evolving over millions of years), natural and supernatural explanations are frequently used by both children and adults in a complementary rather than an exclusive manner.

In this respect, we propose a different stance from long traditions of thinking and research in developmental and cultural psychology. In developmental psychology, it has been claimed that young children gradually abandon a belief in supernatural causation and instead acquire a more objective, rational, or scientific appreciation of cause and effect (Harris, 2009; Piaget, 1928). In cultural psychology, a classic body of early research was taken to show that the twin engines of education and modernization accelerate various aspects of cognitive development (Luria, 1934, 1971, 1976; Vygotsky, 1978). In combination, these two lines of developmental research point to the possibility that, in the course of history, with more widespread access to education and modernity, a focus on natural explanations will increasingly compete with, and even displace, adherence to supernatural explanations, consistent with the secularization hypothesis. However, relatively few adults, across a wide range of cultural backgrounds, endorse an exclusively natural stance, stripped of all references to the supernatural (Campbell, 1972; Misztal & Shupe, 1992; Raman & Winer, 2004; Tambiah, 1990). How can the traditional view of cognitive development be reconciled with the fact that

supernatural explanations are present in many cultural contexts and are a pervasive feature of cognition for most adults?

An intuitively plausible psychological explanation for this paradox is that these distinct explanatory frameworks operate differently in different individuals (i.e., some individuals are more scientific or religious than others) or at least over different domains or contexts (i.e., an individual may hold scientific explanations for certain phenomena, and supernatural explanations for other phenomena). However, the proposal discussed in this article is that both natural and supernatural explanations frequently operate within the same mind to explain the very same event or phenomenon. We argue that supernatural explanations do not always appear early in development; nor are they primitive or immature ways of thinking that are suppressed over the course of development. Instead, like natural explanations, they are constructed and elaborated through socialization and cultural learning and may be founded on earlier intuitive explanations.

In contrast to the developmental pattern described by Piaget, we will propose that in certain domains, the tendency to invoke supernatural explanations increases with age rather than decreases (Astuti & Harris, 2008; Evans, 2001; Harris & Giménez, 2005; Legare & Gelman, 2008; Mead, 1940; Raman & Gelman, 2004; Woolley, Cornelius, & Lacy, 2011). Indeed, in line with sociocultural perspectives on development (Cole, 2005; Rogoff, 2003; Vygotsky, 1978), we argue that the development of both natural and supernatural explanatory systems requires a considerable amount of cultural experience and participation in dynamic aspects of the social learning process, in which children seek out and actively construct information in collaboration with others (Callanan, 2006; Harris & Koenig, 2006). Consequently, both natural and supernatural explanations can operate within the same mind (Subbotsky, 2001), and crucially, for the same to-be-explained phenomena. For example, a person might explain AIDS using witchcraft in one instance, biology in another, or combine the two in a third instance. Similarly, a person might explain the sequelae of death using a religious framework in one instance, a biological framework in another, or combine the two frameworks in a third instance. Thus, when faced with different explanatory frameworks—including those that are potentially in conflict with one another—adults and children might endorse both, either by recruiting them in different contexts, by ignoring potential contradictions, or by finding

ways to combine and coordinate them. In the final discussion, we return to the question of when and to what extent such strategies are adopted.

Exploring Functional Similarities

One reason to posit that people may use both natural and supernatural explanations to explain the same events is that they can serve a similar function. Each offers an “attempt to explain and influence the working of one’s everyday world by discovering the constant principles that underlie the apparent chaos and flux of sensory experience” (Horton, 1979, p. 355). Both natural and supernatural explanatory frameworks can provide answers to the same core questions of fundamental interest to humans. For example, both evolution and creationism explain the origin of human beings, both biomedicine and witchcraft explain the causes of serious illness, and both biology and religion explain what happens when we die. Given the shared objectives of natural and supernatural cognition—that is, to enable us to explain, understand, and intervene in the world—there is much to be gained by investigating whether and how far a single cognitive system can entertain both kinds of thinking, even with respect to the same phenomenon.

Exploring the interplay between natural and supernatural explanations offers a new perspective on the question of how humans represent knowledge. The development of organized, explanatory systems of knowledge is an integral part of human cognition and a fundamental developmental task. Although a well-established, wide-ranging, and influential body of research exists on the development of reasoning in natural domains (Carey, 2009; Gopnik & Schulz, 2007; Keil, 1992; Kuhn, 1989; Wellman & Gelman, 1992) and on the development of causal explanatory reasoning in particular (Chi, DeLeeuw, Chiu, & LaVancher, 1994; Crowley & Siegler, 1999; Frazier, Gelman, & Wellman, 2009; Gopnik, 2000; Keil, 2006; Keil & Wilson, 2000; Legare, 2012; Legare, Gelman, & Wellman, 2010; Legare, Wellman, & Gelman, 2009; Lombrozo, 2006; Wellman, 2012; Wellman, Hickling, & Schult, 1997) there has been less sustained and systematic research on the development of thinking about supernatural or divine powers (but see recent findings by Barrett, 2000; Barrett, Richert, & Driesenga, 2001; Bering, 2006; Harris & Koenig, 2006; Lane, Wellman, & Evans, 2010; McCauley, 2000; Rosengren, Johnson,

& Harris, 2000; Woolley, 2000). In particular, investigators have rarely asked whether, and more importantly, *how* these different forms of thinking coexist in the minds of children and adults. Possible explanations for the dearth of research on this pervasive feature of human cognition is that supernatural thinking was traditionally viewed as not amenable to empirical investigation (Rosengren et al., 2000) and that much of the conventional research in developmental psychology decontextualized the study of cognitive development (Callanan, 2006; Cole, 2005; Rogoff, 2003).

Our rationale for discussing the prevalence of coexisting explanatory frameworks for human origins, illness, and death is that both natural and supernatural explanations are highly salient in each, arguably because the three domains share a number of properties. First, each phenomenon can be attributed to hidden or unobservable causal agents. Second, each is associated with strong emotions. With respect to illness and death these emotions arise from the loss or potential loss of loved ones. With respect to human origins, the emotions surround the belief that humans are somehow special and different from other organisms (Evans, 2001) or that acceptance of evolution implies a range of negative outcomes (e.g., Brem, Ranney, & Schindel, 2003; Evans, 2008) including the possible extinction of the human species (Poling & Evans, 2004). Finally, human origins, illness, and death are embedded in specific cultural practices and narratives that predate our current scientific understanding of these concepts and continue to coexist alongside our scientific knowledge.

In each of these three domains, supernatural agency is frequently invoked—either a unique special being (God) or a set of special beings (witches, ancestors). Like ordinary humans, these beings have the capacity to observe, make decisions, and act but unlike ordinary humans, they are also believed to possess unusual causal powers that can bring about extraordinary or otherwise impossible outcomes.

Although we focus on three examples of coexistence thinking, we anticipate that coexistence thinking is a pervasive feature of human cognition. We acknowledge that the question of which particular domains motivate such thinking is an empirical one and that the kind of data that might provide a definitive answer to this question are not currently available. Nevertheless, we note that several other domains appear to be characterized by the same kinds of coexistence thinking. For example, within the domain of biology, the phenomenon of procreation is often framed in terms of both natural and

supernatural factors (Emmons, 2010). More specifically, from the moment of conception, the development of the fetus is widely believed in many cultural contexts to have both biological (body) and supernatural (soul) properties. Moreover, prevention or termination of that developmental process is often seen as having supernatural or religious as well as natural consequences.

Parallel examples can also be identified outside of the domain of biology. For example, in the eyes of believers, special beings play a major role in the designation, punishment, and absolution of human wrongdoing. Perpetrators and their accusers often conceive of wrongdoing in terms of a supernatural as well as a natural or secular framework. Thus, wrongdoing is analyzed in ordinary psychological or judicial terms but it can also be analyzed in light of the capacity of special beings to exercise their extraordinary powers. Special beings are thought to punish or absolve wrongdoing in ways that no human being is capable of. Indeed, such powers are central to the belief systems of those who believe in the existence of God, witches, or the ancestors. Marriage is another domain that appears to motivate coexistence thinking. In many cultural contexts, marriage is conceptualized both in secular terms (i.e., the joining of two individuals in a legal union) and in supernatural terms (i.e., the union of two souls under God). Sanctions for maintaining and protecting this institution are also both secular and supernatural in nature (infidelity is conceptualized in natural terms as disloyalty and in supernatural terms as a sin).

In the next section, we review developmental and cross-cultural data showing that the use of natural and supernatural explanations to explain the same events is pervasive and that supernatural explanations often increase rather than decline with age. We also illustrate how these explanations are accommodated, integrated, and reconciled by reviewing explanations for biological origins among Christian fundamentalist groups in the United States (Evans, 2001); explanations for illness in South Africa (Legare & Gelman, 2008), India (Raman & Gelman, 2004), and Vietnamese- and Euro-American populations in the United States (Nguyen & Rosengren, 2004); as well as explanations for death in Madagascar (Astuti & Harris, 2008), Spain (Harris & Giménez, 2005), China (Brent, Speece, Lin, Dong, & Yang, 1996), and Mexico (Rosengren et al., 2009). Next, we first briefly outline three different ways in which natural and supernatural explanatory frameworks are brought to bear on a single phenomenon.

Explanatory Coexistence Across Diverse Cultural Contexts and Domains

In response to a question about a single event or object of explanation, individuals might recruit different explanatory frameworks in various ways (Table 1). One possibility is that natural and supernatural domains remain alternative views of the world. Even if both are recruited in order to provide a coherent explanation of a given phenomenon, they are used to explain distinct aspects of that phenomenon, depending on the particular mode of response or kind of causal attribution. We label this *target-dependent thinking* (Table 1). For example, a natural framework might be used to explain the breakdown of all bodily processes at death whereas a supernatural framework might be used to explain the continued existence of the spirit or soul after death. The subsequent analysis of death concepts in Spain, Mexico, and Madagascar provides evidence for the use of such target-dependent thinking. Supernatural or religious explanations are more likely to be offered for the continuation of the soul or spirit whereas biological explanations are more likely to be offered for the cessation of bodily processes (Astuti & Harris, 2008; Harris, 2011; Harris & Giménez, 2005). Similarly, in the case of reasoning about the origin of

diverse species, an evolutionary framework might be recruited to explain the origin of nonhuman species whereas a theistic framework might be recruited to explain the creation of human beings.

A second possibility is that natural and supernatural frameworks are brought together to explain a given phenomenon. In this type of thinking, two different forms of explanation are invoked. Such dual explanations may involve a loose integration of natural and supernatural frameworks but without any detailed consideration of how they would interact. We refer to this as *synthetic thinking* (Vosniadou, Vamvakoussi, & Skopeliti, 2008, Table 1). For example, in the domains of serious illness and death, synthetic reasoning acknowledges distinct explanatory frameworks, but not in a clearly integrated manner. Thus, one might invoke both witchcraft and unsafe sexual practices to explain contracting AIDS (Legare & Gelman, 2008) or biological decay and spiritual metamorphosis to explain what happens after death (Harris & Giménez, 2005) without specifying how the two forms of explanation fit together.

A third possibility is that explanations of a single phenomenon are combined in a more precise fashion; we refer to cases of such well-coordinated explanations as *integrated thinking* (Table 1). Integration can be achieved by using natural and supernatural

Table 1
Examples of Coexistence Thinking

Label	Integrative thinking	Synthetic thinking	Target-dependent thinking
Definition	Two different explanations are integrated into a single explanation	Two different explanations are combined into a single explanation without explicit integration	Two different explanations remain alternative views of the world, recruited to explain distinct aspects of a given phenomenon, depending on the target or context
Origins	"[Humans] got here from gorillas and monkeys, cause they're intelligent creatures if you really look at them . . . The first monkeys probably evolved from something else or got put here as an individual . . . God could have put them [the monkeys] here" (Evans, 2000)	"Well, again, evolution with the environment, but I am also a religious person, so that's a difficult question. I think a bit of both perhaps . . ." (Adult: Evans et al., 2010)	"Man is created with a soul, which makes him different from an animal—that can be found in the book of Genesis. And um, so I would consider a monkey an animal without an eternal soul . . ." (Adult: Evans et al., 2010)
Illness	"A witch can put you in the way of viruses and germs" (Legare & Gelman, 2008)	"It might be witchcraft and having unprotected sex" (Legare & Gelman, 2008)	"Witchcraft can cause a disease that looks like AIDS" (Legare & Gelman, 2008)
Death	"If she is in Heaven she will be with other people and she will communicate with them. It is as if you are brought back to life because God bring you back to life to be with him" (Harris & Giménez, 2005)	"Even if she doesn't use her heart, up in Heaven there is something special that makes the rest of your body work; it is like magic" (Harris & Giménez, 2005)	"Because if she is with God I guess she could see and hear. Her soul is alive even if her body is buried" (Harris & Giménez, 2005)

explanations for different levels of analysis. For example, a natural cause can be regarded as proximate, and a supernatural cause as ultimate. Thus, in the case of theistic evolution, Darwinian natural selection is regarded as proximate whereas the Creator is regarded as ultimate. Similarly, in the case of AIDS, unprotected sex is regarded as a proximate cause whereas witchcraft is regarded as the ultimate cause (e.g., witches are believed to be capable of distorting your sense of good judgment or putting an AIDS-infected person in your path; Legare & Gelman, 2008).

Next, we systematically examine explanatory coexistence in the domains of origins, illness, and death. We then consider what conclusions can be drawn across these three different domains and discuss directions for future research.

Using Multiple Epistemologies to Reason About the Origin of Species

Explanations for the origin of species provide an instructive context for studying the coexistence of natural and supernatural explanatory frameworks. In a 2007 Gallup Poll, 24% of the U.S. public endorsed the idea that “humans evolved from earlier forms of life” but those same respondents also endorsed the idea “that humans were created in their present form . . . within the past 10,000 years.” How could such apparently contradictory explanations be entertained by the same people (Evans et al., 2011)?

Theologians have been wrestling with these questions ever since Darwin introduced his theory of evolution, which contradicted the prevailing and apparently self-evident view that living kinds were designed and created by God (Miller, 1999; Scott, 2004). Nevertheless, as evolutionary ideas have seeped into the broader cultural milieu, individuals from a variety of religious contexts have found ways of accommodating such contradictory ideas (e.g., Numbers, 1992). Members of the general public, for example, often adopt target-dependent thinking, in which humans were created, while other species evolved, a pattern found in about 30% of adolescents and adults (Evans, 2000, 2001). Moreover, explanations of evolutionary origins are more likely to be assigned to animals that are taxonomically distant from humans, particularly animals that undergo metamorphosis (Evans, 2008).

Typically, in these studies, the term *evolution* was not used, because children (who would not have heard of the term), as well as adults, were

participants; moreover, the focus was on the more controversial evolutionary theory, that of common descent, which holds that one kind of animal descended from a completely different kind and that all living creatures have an ancestor in common. For example, in a study of over 100 elementary school children and their parents from diverse (Midwestern) Christian religions, participants were asked how much they agreed with an evolutionary explanation that humans, other mammals, frogs and butterflies: “changed from a different kind of animal that used to live on earth” (Evans, 2008). Overall, there were developmental changes, with older children (8- to 10-year-olds) and adults from nonfundamentalist Christian families more likely to agree with “evolutionary” change than younger children (5- to 7-year-olds). Nevertheless, all age groups, regardless of religious background, were more likely to agree that mammals “evolved” than that humans evolved, and more likely to agree that butterflies and frogs evolved than that mammals evolved. The reverse pattern was found for the creationist explanation that “Somebody made X . . .,” with creationism more likely to be applied to humans and least likely to be applied to insects (Evans, 2008). Religious affiliation was also critical, with members of Christian Fundamentalist families more likely to endorse creationism and much less likely to endorse common descent, a position consistent with their theological stance.

Thus, with increasing experience of the relevant cultural stances, children and adults identify more nuanced targets, in line with changes in both their natural and supernatural explanatory frameworks. In the case of the creationist framework, the early developing idea that people (but not necessarily other animals) were created, may eventually cede to a fine-grained distinction, consistent with target-dependent thinking, in which the human soul is created, whereas the body evolved (see Table 1). In the case of the evolutionary framework, a common-sense early understanding is that evolutionary change is like developmental change, with animals that undergo radical developmental change, such as metamorphosis, more likely to have evolved. This (often) cedes to the more scientifically valid explanation that natural selection explains evolutionary change in all living things (Evans, 2008). Pope John Paul II (1997) articulated a version of this target-dependent model, in which the human soul was created, while the human body evolved.

Even among populations who are the most resistant to theories of evolution there is evidence for explanatory coexistence. Creationists, who comprise

roughly 30% of the U.S. population (Doyle, 2003), endorse a literal interpretation of the Bible in which each kind of animal owes its origins and its essential nature to God. However, some creationists agree with biologists that natural selection is a key mechanism of evolutionary change, provided it is used to explain change within a species, not their origins. Again, this is an example of target-dependent thinking because within-species variation and the origins of any given species are treated as separate phenomena (Darwin was the first to link them; Evans, 2008). This accommodation is most often voiced by Christian Fundamentalist scholars, as in the following example: “. . . The only complaint that creationists have . . . is the confusing use of the term ‘‘evolution’’ to describe both variation within a species and the origins of new kinds of life. . . . The fact that one can mix existing genes to get some variation in species doesn’t prove that genes arise naturally to create new kinds of creatures’’ (Jones, 2005).

Further examples of coexistence thinking amongst creationist members of the public were found in a study of highly educated adult visitors (more than 60% had a college degree) to Midwestern natural history museums. In this sample, 22% were creationist for humans only, with a further 6% consistently creationist, regardless of species. The latter group, the consistent creationists argued that by building diversity into the genes of each living kind, God designed the conditions whereby each pair of animals placed on Noah’s Ark had the capacity to change in response to local contingencies via natural selection. Thus, the original wolf-dog pair on the Ark eventually gave rise to all the dogs on earth, from dachshunds to dingoes (Evans et al., 2010). In this nuanced stance, naturalistic and supernatural explanations were explicitly integrated to explain a single phenomenon, within-species diversity. In contrast, examples of the less well-integrated reasoning pattern, *synthetic thinking* (see Table 1) were more likely to be found among those visitors who were not consistently creationist, suggesting that this reasoning pattern represents a less coherent framework.

One of the more enduring ways that individuals reconcile naturalistic and supernatural explanations for the origins of species is to combine these explanatory systems into a causal chain, as in theistic evolution (Evans, 2008). In this example of integrated thinking, common among nonfundamentalist theologians (Ruse, 2005; Scott, 2004), God becomes the distal or ultimate cause of evolutionary change by setting in motion the natural laws that govern the

origins of living kinds. This contrasts with the creationism of some Christian Fundamentalists in which God is the proximate cause of these events—a grand designer who directly creates the essential nature (the DNA) of each kind of animal found on earth, as described above. Children may express less complex versions of integrated thinking (see Table 1); younger children (5- to 7-year-olds) tend to focus on the proximate causes of events, while older children (8- to 10-year-olds) combine distal and proximate causes into a causal chain (Evans, 2000, 2001). For example, when asked ‘‘How do you think the very first chair got here on earth?’’ 5- to 7-year-olds from mixed religious communities in the Midwest responded with: ‘‘from the store’’ and ‘‘God made it,’’ whereas 8- to 12-year-olds, from the same communities, responded: ‘‘God makes trees so we can cut the trees down and make chairs out of wood’’ and ‘‘God gave people the idea to make a chair’’ (Evans, 2008). In this developmental trajectory, the links of the causal chain appear to become more numerous, more interconnected, and more complex, with increasing age (cf. Mull & Evans, 2010). It may well be that an increasing grasp of the fundamentals of both natural and supernatural explanatory frameworks sets the stage for changes in the developmental trajectories of target-dependent and integrated thinking, whereas synthetic thinking appears to be symptomatic of a less reflective form of coexistence thinking.

Using Multiple Epistemologies to Reason About Illness

The potential coexistence of natural and supernatural explanatory systems within the same individual can be fruitfully investigated in cultural settings where both kinds of explanations are prevalent. The AIDS crisis in South Africa provides such a context. In South Africa, multiple approaches to illness are available, including traditional folk medicine, faith healing, and modern biomedical services (Ashforth, 2001). Perhaps the most prominent supernatural explanation for AIDS in South Africa is that of witchcraft, or the practices of persons with malicious intent to cause harm through the use of harmful substances and invisible supernatural forces (Ashforth, 2001). Witchcraft is used as an explanatory framework for dealing with ill will, envy, suspicion, and other universal, human feelings and behaviors (Evans-Pritchard, 1937). Witchcraft is often associated with *muthi* (*sejeso* in Sesotho), or the malicious manipulation of herbs

and other substances, and is believed to cause a wide variety of misfortunes ranging from unemployment and interpersonal discord to illness and death.

To investigate age differences in the coexistence of natural and supernatural explanations for illness, Legare and Gelman (2008) examined biological and witchcraft explanations for AIDS in South Africa. Although traditional accounts of young children's explanations of illness described children as appealing to immanent justice explanations and therefore lacking a biological framework for interpreting illness (Kister & Patterson, 1980), more recent research has demonstrated that even young children have complex and often elaborate beliefs about biological processes (Inagaki & Hatano, 2002; Keil, 1992; Legare et al., 2009; Wellman et al., 1997). Given that children have access to biological explanations at young ages, how do they reason about and accommodate seemingly inconsistent nonbiological (supernatural) explanations?

One possibility is that children will become more biologically accurate with age: Biological explanations may increase, and witchcraft explanations may decrease as participants gain knowledge and experience. This first possibility would be consistent with most standard theories of development (and the secularization hypothesis mentioned earlier) that predict increasing biological knowledge and accuracy with age. In contrast, a second possibility is that young children may actually provide *more* biological explanations and *fewer* witchcraft explanations than older children and adults, consistent with the idea that biological explanations may be a default or early emerging explanation for illness that is gradually supplemented or replaced by other kinds of explanations as children acquire culturally specific explanatory models (Harris & Giménez, 2005; Nguyen & Rosengren, 2004; Raman & Gelman, 2004; Raman & Winer, 2004). The data support a third possibility and more complex interaction: Witchcraft explanations for AIDS may decrease with age (due to direct educational programs in school) but then rise again as participants are further removed from their years in school (Legare & Gelman, 2008). This would result in a U-shaped curve (Raman & Winer, 2004), with witchcraft explanations decreasing among older children and adolescents and increasing again among adults.

In two studies, participants (5-, 7-, 11-, and 15-year-olds and adults; $N = 366$) were drawn from two Sesotho-speaking, South African communities

where Western biomedical and traditional healing frameworks are both widely available (Legare & Gelman, 2008). Participants were given a variety of vignettes describing characters diagnosed with AIDS and then provided with a variety of different biological and supernatural explanations for why they had been infected, explanations that they could individually endorse or reject. A strength of this design was that participants could reject or endorse all or none of the explanations, or reject some and endorse others. Results indicated that biological explanations were endorsed at high levels (i.e., participants of all age groups agreed with biological explanations for at least one vignette). Nevertheless, witchcraft explanations were also frequently supported among children and adolescents, and universally among adults. Bewitchment explanations for at least one vignette were endorsed by 47% of 5-year-olds, 59% of 7-year-olds, 47% of 11-year-olds, 34% of 15-year-olds, and 100% of adults. Importantly, bewitchment explanations were not the result of ignorance of biological causes. Thus, they existed alongside and were not replaced by biological explanations.

In a third study on the effects of contextual priming on the recruitment of natural and supernatural explanations to explain the same outcome or event, adolescent and adult participants provided explanations for vignettes in which the type of contextual information about the characters who had been afflicted by AIDS was systematically varied (Legare & Gelman, 2008). There were four conditions that differed in the kind of explanatory system that was primed: biological only, bewitchment only, both biological and bewitchment, and neither. Importantly, participants were sensitive to the narrative context of the illness in question, recruiting one or both kinds of explanation in their responses to open-ended questions, depending on whether biological or witchcraft explanations were primed. Biological explanations were the default explanatory system for interpreting AIDS when neither system was primed. However, when attention was drawn to socially risky behaviors (e.g., lack of generosity or jealousy) believed to put someone at risk for witchcraft attacks, participants gave primarily witchcraft explanations for AIDS.

This research provided evidence for each kind of coexistence thinking. Evidence for target-dependent thinking was found in explanations indicating that different forms of the same illness could have either natural or supernatural origins. More specifically, although certain forms of AIDS may have a biological explanation, witchcraft can cause an equally

deadly disease that mimics AIDS. For example, participants stated, "Witchcraft can cause a disease that looks like AIDS" or "To medical doctors it seems like AIDS but it is not. The spell was supposed to look like AIDS." The notion of "supernatural AIDS" is arguably a reaction to the information people receive from AIDS education programs indicating explicitly that witchcraft does not cause AIDS, enabling them to maintain witchcraft as an explanatory system for illness and misfortune generally (Ashforth, 2001). Twenty-six percent of participants provided such a target-dependent explanation at least once (Legare & Gelman, 2008).

Evidence for synthetic thinking was found in additive explanations indicating that both biological risk factors and witchcraft could explain AIDS, but not in a clearly integrated manner. For example, "Witchcraft, which is mixed with evil spirits, and having unprotected sex caused AIDS." Fifty-seven percent of participants provided a synthetic explanation at least once (Legare & Gelman, 2008). Finally, there was also evidence for integrated thinking. Most typically, in explanations of this kind, the proximate cause was identified as unprotected sex, whereas the final cause is believed to be witchcraft. For example, witches are believed to be capable of distorting your sense of good judgment or putting an AIDS-infected person in your path (Legare & Gelman, 2008). Thirty-eight percent of participants provided an integrated explanation at least once (Legare & Gelman, 2008).

Evidence for the coexistence of biological and supernatural thinking in explaining illness is not confined to developing countries nor to explanations of AIDS. For example, research with Vietnamese-American populations has shown that they believe in a mixture of biological and magical causes and remedies (Rutledge, 1992). Thus, Vietnamese-Americans have been found to cite germs, evil spirits, and magic spells as potential causes of illness and medical physicians, traditional healers, and sorcerers with magical powers as potential agents for curing illness. The findings that Vietnamese-Americans hold steadfast to their cultural traditions, teaching their children about traditional Vietnamese culture, sharing folk stories, and speaking Vietnamese in the home would suggest that these explanations are also transmitted to their children (Rutledge, 1992). To examine this possibility, Nguyen and Rosengren (2004) investigated ideas about illness among Vietnamese-American and European-American participants. Children (aged 4-7 years) and adults were asked to make causal

attributions for a series of illness-related stories (Study 1) and were asked about the causes of and remedies for illness (Study 2). Biological causality was the dominant form of reasoning about illness across the different ages and cultural groups. Nevertheless, as in the research on AIDS conducted in South Africa, magical causality was endorsed by children of both cultural groups and by Vietnamese-Americans adults.

Research by Raman and Gelman (2004) provides converging evidence for the coexistence of biological and supernatural explanations at the level of the individual mind in a cross-cultural study of explanations for illness in India and the United States. Moral ontologies for illness are widely endorsed in India and are based on supernatural phenomena including fate, "karma," and God's will (Shweder, Much, Mahapatra, & Park, 1997). Indian and American participants (preschool, first grade, third grade, fifth grade, and college students) were presented with vignettes that described symptoms of illnesses. Participants in both countries were presented with biological and nonbiological, supernatural explanations for each of the illnesses. Results indicated that across all ages in both countries although the biological model was the most prominent, supernatural explanations were also endorsed, by the same individuals, for the same events. There was also evidence for an increase in supernatural explanations with age. For example, Indian adults acknowledged significantly more moral and psychological causes than younger children.

Using Multiple Epistemologies to Reason About Death

Although a substantial amount of research has been done on children's biological understanding of death, relatively little is known about the development of nonbiological and supernatural beliefs about death. Research on conceptions of death has primarily focused on children's emerging grasp of the biological life cycle (Slaughter & Lyons, 2003). Investigators have asked when children come to realize that for all living things, death is inevitable, irreversible, and implies the cessation of living functions. Although there is some disagreement about the exact timetable of development, there is a broad consensus that children increasingly grasp these biological facts in the course of early and middle childhood (Kenyon, 2001). Nevertheless, a belief in the afterlife is widespread among adult

populations, including those in the United States and Western Europe (Greeley & Hout, 1999). By implication, despite their eventual understanding of the biological facts of death, including the inevitable cessation of living functions, children and adolescents also come to the conclusion that some form of afterlife is possible. Indeed, indications of this conclusion can be found even in studies that have targeted children's biological understanding. For example, Brent and his colleagues interviewed American and Chinese children ranging from preschoolers through to adolescents (Brent et al., 1996) concerning death (i.e., its finality, universality, causation, and irreversibility), and the continuity of life processes following death. Although by the age of 6 virtually all of the children agreed that everybody will die, that a dead person can neither come alive again nor do any of the things that he or she once did, this consensus was less evident among young adolescents. More than one third claimed that some form of continued existence was possible. Moreover, when asked to explain how a dead person might continue to do certain things, 15-year-olds, both in China and the United States, typically offered religious explanations. For example, they cited the continued existence of the soul, the possibility of reincarnation, or God's power. By implication, older children were constructing a nonbiological, religious conception of death.

Research by Rosengren et al. (2009) provides additional cross-cultural evidence from Mexican-American and Euro-American preschool children showing that although a biological explanation is often the default explanatory system for interpreting death (as in the domain of illness), signs of coexistence reasoning are apparent, including both target-dependent and synthetic thinking.

Some recent studies have systematically probed children's religious conception of death as well as their biological conception (Harris, 2011). This research has shown that in line with the findings for reasoning about AIDS, individuals are sensitive to specific aspects of the context in their thinking. For example, when presented with a narrative highlighting the biological aspects of death (e.g., the unsuccessful efforts of doctors to save the dead person) both children and adults are likely to assert that living functions, and particularly bodily functions, have ceased. By contrast, when presented with a narrative highlighting the spiritual aspects of death (e.g., a religious figure or ceremony), respondents are more likely to assert that living functions, and particularly spiritual or mental functions, continue.

Evidence for this type of target-dependent coexistence thinking has been found among children growing up in the predominantly Catholic culture of Madrid, Spain (Harris & Giménez, 2005) and also among Vevo children and adults of Western Madagascar, who worship and placate the ancestors (Astuti & Harris, 2008). There was no evidence in either cultural setting that the consolidation of a biological understanding of death precludes or undermines a belief in the afterlife (whether conceived in terms of the Christian Heaven or the life of the ancestors). Conversely, there was also no evidence that the gradual construction of a religious conception undermines children's biological understanding. On the contrary, Harris and Giménez (2005) found that older children (i.e., 11-year-olds) were more rather than less likely than younger children (i.e., 7-year-olds) to engage in coexistence reasoning by invoking both conceptions of death at different points in the interview. For example, when justifying the cessation of bodily functioning, children gave biological explanations referring to the breakdown of internal organs ("The heart doesn't beat and it can't distribute blood through the body and the organs") or to the process of bodily decay ("Because he is dead and the body disintegrates until there is only the skeleton left"). However, when justifying the continued operation of mental processes children frequently invoked God ("In heaven everything can work even if she is dead. God is credited to give you that") or the soul ("She is still alive in her soul"). Some children went beyond such examples of target-dependent reasoning to provide examples of synthetic reasoning. Instead of invoking biological and supernatural considerations at different points in the interview, for example, when discussing the fate of the body versus the mind, they brought both types of consideration together to offer a loose but inclusive account of both the biological and spiritual consequences of death. For example, a 7-year-old who had claimed that the body no longer functions after death explained: "Because without blood, the skull can't move. In Heaven he can [move] because he is like an angel but without wings." Similarly, an 11-year-old who had claimed that the body no longer functions explained: "If she is dead, the body can't work. She can't walk—she can't do things. The soul is the only active part." Thus, each child invoked biological and religious considerations in quick succession so as to justify different conclusions—the cessation of functioning granted biological considerations but some continued functioning granted religious considerations.

Examples of fully integrated thinking were rare in this study. Admittedly, the children were 7 and 11 years of age and it is plausible that adolescents and adults are better able to integrate the conflicting implications of the two frameworks. On the other hand, ethnographic data suggest that even among adults, a fully integrated and coherent account of death and the afterlife may be difficult to achieve. Thus, writing of Vezo adults, Astuti comments: "Most people found it hard to articulate what kind of existence the ancestors enjoy. . . . Some were indifferent even skeptical novices, whereas others struggled to produce a coherent account and readily gave up by asserting: "I don't know, I have never been dead" (Astuti, 2011, p. 17).

Finally, it should be noted that some studies have suggested that expectations of continued functioning after death decline in the wake of greater biological understanding. However, participants in those studies were questioned about a dead mouse rather than a human being (Bering & Bjorklund, 2004). Beliefs in the afterlife normally focus on human beings and not on animals (Poling & Evans, 2004). Consistent with this consideration, Astuti and Harris (2008) found that when respondents were asked about the death of a human being, adults were *more* likely than children to assert the continued functioning of mental processes after death.

Conclusions and Future Research

The coordination of natural and supernatural explanations poses a universal cognitive challenge. Within highly educated, industrialized communities, supernatural explanations persist; a considerable number of individuals endorse supernatural phenomena, ranging from God to ghosts and the afterlife (Evans, 2000). Within highly traditional, nonindustrialized communities, natural explanations are equally pervasive; folk-biological explanations are widely endorsed for inheritance (Astuti et al., 2004) or the total cessation of function after death (Astuti, 2007). Thus, we propose that the cognitive task of coordinating multiple explanatory frameworks is a general cognitive problem. Despite cultural differences in the content of particular belief systems, people in all societies are faced with the task of conceptualizing potentially contradictory explanations for biological phenomena.

We have provided evidence that natural and supernatural explanations often offer individuals

distinct, complementary causal information thereby contributing to our understanding of *how* and *why* these explanatory frameworks continue to coexist across development. Both kinds of explanatory frameworks provide a basis for interpreting phenomena of fundamental concern to all humans. Furthermore, we have presented converging developmental data from diverse cultural contexts demonstrating that natural explanations involving natural or scientific causes and supernatural explanations involving divine or religious causes are used by the same individuals to interpret the same to-be-explained phenomena. Despite the diversity of the cultural settings we have reviewed, we find essentially similar patterns of coexisting explanations (Evans et al., 2011).

The research summarized here indicates that the endorsement of allegedly competing epistemologies is commonplace in both Western and non-Western contexts among both children and adults. The developmental evidence for this phenomenon spans highly diverse cultural contexts, ranging from India to Madagascar. Across three different domains, notably the origin of species, illness, and death, there is considerable evidence for explanatory coexistence and for the proposal that from a psychological perspective, natural and supernatural explanatory frameworks are both invoked in consistent, predictable ways. Individuals use several forms of coexistence thinking (i.e., target-dependent, synthetic, and integrated) that differ in the extent to which and the means by which they integrate natural and supernatural explanations. Moreover, we anticipate that the coexistence of different explanatory frameworks extends beyond the emotionally charged domains that we have discussed. For example, accounts of procreation, wrongdoing and marriage frequently recruit both natural and supernatural frameworks, as described earlier.

Contrary to traditional accounts of cognitive development, the evidence that we have presented shows that supernatural explanations do not wane or disappear with age. If anything, in both industrialized and developing countries supernatural explanations are frequently endorsed more often among adults than younger children. This provides evidence against a replacement model of supernatural thinking (e.g., Piaget, 1928) and confirms instead that reasoning about supernatural or divine powers is an enduring aspect of cognitive development. As early as ages 3 to 5 years, children begin to use multiple epistemologies, sometimes to complement one another, often synthesizing them into a single explanatory system.

We anticipate both increasing compartmentalization and coherency in coexistence thinking across development, contingent upon personal values and cultural differences in how natural versus supernatural knowledge is organized (D'Andrade, 2008; Shweder et al., 1997). Indeed, metacognitive skills and cognitive flexibility likely facilitate both the capacity to increasingly compartmentalize natural and supernatural explanations (as in the nonoverlap account mentioned previously) as well as the capacity to reflect on potentially contradictory belief systems and integrate different kinds of explanations. Thus, rather than view nonoverlap or integration as representing incoherent reasoning, we view both as cognitively demanding and argue that both can potentially be understood as conceptual achievements.

Although a substantial amount of cognitive developmental research has documented conceptual change as involving the integration of hitherto separate or even competing concepts into a more complex whole (Carey, 2009), the relative dearth of research on supernatural cognition and the persistence of the replacement model has, to date, precluded the possibility that such conceptual integration can straddle the natural-supernatural divide. However, as emphasized previously, we speculate that integrated accounts of natural and supernatural explanations vary considerably based on cultural and individual differences in beliefs and values, especially if the two explanatory frameworks are typically invoked in different contexts to account for different aspects of the same phenomenon.

The research that we have described illustrates the impact of adult thinking on children. As children assimilate cultural concepts into their belief systems, from God to atoms to evolution, they engage in several kinds of coexistence thinking. Thus, when children live in a culture where multiple epistemologies are common, they may be more willing to embrace what may seem to be contradictory explanations to reason about illness, death, and the origin of species. Nevertheless, we still do not have a complete understanding of why certain individuals engage in one kind of coexistence thinking or another. In particular, we do not have a complete understanding of why some individuals are able to provide an integrated form of coexistence reasoning.

Why do some children and adults adopt a single explanatory approach when confronted with competing epistemologies? Why do other children and adults treat different epistemologies as complemen-

tary rather than competing worldviews? It is plausible that some individual differences are due to the ways in which adults convey their own coexistence thinking to children, but it is also conceivable that certain cognitive characteristics influence whether a child adopts a single consistent explanation, a coexistence explanation, or attempts to unify seemingly contradictory ideas into an integrated explanation. We anticipate substantial individual differences in coexistence reasoning. Indeed, cognitive development is characterized by heterogeneity and variability (Siegler, 2005) and it is unlikely that development is any more uniform with respect to coexistence thinking.

For adults, we suggest that some sort of cognitive confluence can trigger the effort to create a coherent, integrated model of different epistemologies. More specifically, we speculate that certain types of encounters and interactions with others lead adults to activate and compare different forms of explanation. This kind of concurrent activation has often been reported by individuals with strong Christian fundamentalist beliefs who are brought into contact with scientific evidence for evolution that appears, at first sight, to challenge those beliefs (Numbers, 1992; Poling & Evans, 2004).

Such concurrent activation may also occur in young children. We argue that contextual information, which is used to help reconcile both kinds of explanations, and cultural experience influences the interpretive frame for a particular event and subsequent attempts to achieve explanatory coherence. For example, the discussion that surrounds the death of a loved one may prompt children to combine the different explanations, secular as well as religious that are provided at home, school, and church, so as to achieve a more integrated framework. Importantly, in all cases, the issue of which explanations enter into the mix is clearly dependent upon the kind of ideas that an individual is exposed to in their family of origin and their broader culture.

The assimilation of findings on explanatory coexistence calls for the re-evaluation of the standard theoretical assumption that natural and supernatural explanations compete. Developmental data spanning diverse cultural contexts in a variety of domains crucial to human understanding do not support replacement models; natural explanations do not necessarily replace supernatural explanations following gains in knowledge, education, and technology. Given the breadth of the empirical data for explanatory coexistence, we hope that this review will pave a new path for research, one that

treats supernatural cognition as an integral part of cognitive developmental theory and not as an early or primitive mode of thinking that is outgrown in the course of cognitive development.

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