Folk Teleology and its Implications

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Normative scientific and philosophical accounts sometimes motivate psychologists’ theories. Psychologists are often curious about the match between these norms and ordinary people’s intuitions, and discrepancies between them raise questions about the scope of human rationality. One example of this trend is research on teleological thinking about the natural world: people’s explanations of objects or events that invoke purposes, goals, or functions. Teleological explanations contrast with mechanistic explanations, which cite antecedent physical causes. For example, a mechanistic explanation for the existence of a clock might describe its design and manufacturing process—the physical, antecedent causes of the clock’s existence. A teleological explanation can go beyond such bare physical facts and events: You might say that the clock is “for telling time,” even if you have only used it as a paperweight on your desk. For reasons we discuss later, the teleological/mechanistic contrast is not always clear cut, but in cases like this one, the intended nature of the contrast is apparent.

Teleological explanations are naturally suited to situations involving people and their intentionally-designed artifacts (like clocks), and they are also potentially acceptable for functional evolutionary adaptations (Allen & Bekoff, 1995; Wright, 1977). For example, we might say that a moth’s pattern of wing markings is for purposes of camouflaging it from predators. But especially for non-living natural objects and events, such as chemical elements and their reactions, Western scientific norms usually discourage teleological explanations (e.g., Bacon, 1623; but see Hawthorne & Nolan, 2006). These standards suggest that explanations like
“the moon is for lighting people’s paths at night” or “water is for sustaining the lives of animals and plants” are mistakes if “is for” means that they exist because they provide these benefits.

So here we have a normative standard: Mechanistic explanations of the physical world are superior to teleological ones, at least in accounting for nonliving natural things, such as the moon or water. This provides an opening for the psychologist, who can ask to what extent people observe this standard. The idea probably isn’t to call into question Western mechanistic norms. The psychologist may just be interested in the psychological phenomenon itself and its implications for rationality. The normative standard is a good starting point for this latter task.

Most research on this topic has in fact concluded that both children and adults readily accept scientifically unwarranted teleological explanations (e.g., Kelemen, 1999a; Kelemen & Rosset, 2009). For example, children often choose teleological explanations over those that cite natural causal forces: For many second graders, rocks are pointy because this keeps animals from sitting on them, not because rock-substance built up over time (Kelemen, 1999c). Adults exhibit similar explanatory tendencies when placed under time pressure, suggesting that teleological thinking persists throughout development and is only suppressed (but never erased) by age and schooling (Kelemen & Rosset, 2009). Rather than reserving teleological thinking for the intentional domain, people seem to use it in all domains.

An influential interpretation of these results—called “promiscuous teleology”—finds their source in humans’ beliefs about intentional agency in nature (Kelemen, 1999a; Kelemen & Rosset, 2009). At the core of this theory is the idea that humans are hard-wired to find agency in the world. People are drawn to teleological explanations because everyone, at least implicitly, believes the natural world originates in, or is infused with, intentions (Kelemen, 2004; Kelemen, Rottman, & Seston, 2013). According to Kelemen et al. (2013), for example, even trained
physical scientists implicitly believe that the ozone layer was intentionally created for a purpose; so when placed under time pressure, they reveal this (subconscious) belief by accepting explanations like “The Earth has an ozone layer in order to protect it from UV light.” This appears to be an intentional stance (Dennett, 1971) run amok.

Promiscuous teleology theory is mostly unchallenged within psychology (but see ojalehto, Waxman, & Medin, 2013; Greif, Kemler Nelson, Keil, & Gutierrez, 2007). To an interdisciplinary researcher in education, philosophy, or any other field, consensus seems to reign among psychology researchers: Humans have a teleological bias, and this is due to mistaken beliefs about agency in Nature.

The goal of this chapter is to re-examine the basis for this consensus. In particular, we will take a close look at (a) the evidence for non-normative teleological thinking and (b) its psychological basis. We’ll argue that the evidence for the first of these is strong: Children and non-Western adults do not automatically identify mechanistic explanations as the right sort of explanation. Instead, this standard emerges only through education and exposure to Western scientific norms. However, we will also argue that the prevailing interpretation of this teleological thinking—a deep-seated belief in an agentive natural world—is not strongly supported by the evidence, especially in the case of adults. Although the nature of this “agency in nature” hypothesis makes it difficult to rule out decisively, we view it as a particularly strong claim that requires strong evidence. We will describe some alternative proposals that we think offer a more moderate interpretation of the results, and we will offer suggestions for how future work could investigate these alternatives. Finally, we will briefly examine some implications for philosophy of our revised view of people’s teleological notions.
Before considering potential errors in people’s teleological explanations, it’s worth noticing where these explanations are warranted. Potentially appropriate teleological explanations occur in reasoning about artifacts. We often attribute purposes to man-made objects—for example, “knives are sharp because they are for cutting.” And we even explain their existence by referencing their purpose—for example, “books exist for reading.” This kind of reasoning has been the subject of research in psychology, with a leading interpretation being that people think that an artifact’s central properties derive from its designer’s intent (Bloom, 1996; Rips, 1989; but see Malt & Sloman, 2007).

While man-made artifacts might be the least controversial and most common targets of teleological explanation, they are not the only ones. Consider the following explanations:

(1) Hearts exist in people in order to pump blood.

(2) Hearts exist in people in order to make a thumping sound.

(3) Atoms bond in order to maintain electron stability.

(4) Heat transfer occurs in order for closed-systems to attain a state of equilibrium.

(5) Plants turn towards sunlight because they want light-energy.

These examples are varied and defy an obvious unifying rationale. For example, (2) seems immediately problematic, whereas (1) seems defensible. Example (5) seems to attribute desires and goals inappropriately to the plant, whereas a case could be made that (3) and (4) do not attribute such mental states. How do we explain these distinctions?

This section outlines three possible positions you might take on the proper role, scope, and rationale for teleological explanations. In exploring some proposed normative criteria for
what should motivate proper teleological explanations, our aim is to anticipate some possibilities for what does motivate them.

[B] Intentions-Only

One concern with some of our earlier examples is that they seem to get the order of causation backwards (Hempel & Oppenheimer, 1948). This concern is motivated by the assumption that a true explanation of a phenomenon describes its causes. Causes come before effects, so citing a function (an effect of a phenomenon) as the cause of that phenomenon cannot be warranted. Teleological explanations can legitimately describe literal goals or purposes of intentional agents, since these generally occur in the correct causal order. Fred’s intention for people to read his book is what caused him to write it. So his book exists in order to be read. However, for phenomena with no intentional origins (like the hearts, atoms, heat transfer, and plants in Explanations (1)-(5)), the current or future function cannot be a cause, and teleological explanations therefore seem difficult to justify. Teleological explanations are meant for the intentional domain, and using them outside this domain either gets the order of causation backwards or mistakenly posits non-existent intentional causes.

[B] Historical Teleological Explanation

A theory that claims hearts are no more “for” pumping blood than they are “for” making a thumping sound seems dissatisfying. The second explanation (2) is ridiculous in a way that the first explanation (1) is not. We can’t explain this difference by citing designers’ intentions, since no one designed the heart for either purpose. So what explains this distinction? An alternative approach to teleological explanations maintains the assumption described above—an explanation
of some phenomenon should cite its causal history—but loosens the criterion for what counts as cause.

For example, our intuitions about a teleological explanation for hearts might come from the fact that hearts evolved because they pump blood: If they had not had this effect, they would not exist today. In contrast, their thumping sound did not give the creatures that possessed hearts an evolutionary advantage, and so thumping is not a cause of their current existence. So teleological explanations that correctly cite evolutionary advantages do not get the order of causation backwards, after all.

Wright (1976) gives a more formal statement of this idea (see also Allen & Bekoff, 1995; Millikan, 1984). To continue our example, we can view the teleological explanation “hearts exist for pumping blood” as stating that (a) having one’s blood pumped is a consequence of having a heart, and (b) hearts exist as the result of their ability to pump blood. The more general formulation is that a teleological explanation of some phenomenon \( p \) in terms of some purpose or goal \( g \) claims that (a) the goal \( g \) is a consequence of \( p \), and (b) the phenomenon \( p \) exists/occurs because it fulfills the goal \( g \). The teleological explanation “hearts exist for making a thumping sound” is not warranted, since in this case (b) is false: The heart’s existence is not a result of its thumping sound.

Due to the central role of causal history in sanctioning teleological explanations, we will call this kind of account historical. This account not only encompasses cases involving intentional agents, but more broadly cases like natural selection (in which the functional capacity of an organ like the heart is what causes its existence in a population) and operant conditioning (in which a behavior’s outcome causes that behavior’s future occurrence).
The two accounts of teleological explanation just described share the assumption that (proper) explanations of phenomena should pick out the causes of those phenomena. For example, these accounts assume that a teleological explanation for a question like “why are there trees?” needs to describe the causes that brought trees into existence. In contrast, a third account rejects this assumption as a necessary constraint on explanations. Cummins (1975) argues that when we use a purpose-based explanation, it should be part of an analysis of a system. It should attempt to explain a component as an ingredient in the system’s causal structure—one of multiple parts that are simpler than the system as a whole—in order to account for the system’s over-arching capacity. The purpose of purpose-based explanations is to describe the role of that phenomenon in its larger system.\(^2\)

We can clarify this idea by returning to the heart examples (1) and (2). One “over-arching capacity” we might want to analyze is how organisms survive. In this case, explaining the heart in terms of its blood-circulating function is a good explanation: It identifies an essential causal role the heart plays in enabling organisms to survive, and the process by which it achieves this role is simpler and less sophisticated than the survival of the organism as a whole. The same cannot be said of an explanation of the heart in terms of its thumping sound, since this thumping sound does not play a causal role in the survival of the organism. So the account aligns well with our intuition that the “pumping blood” explanation in (1) is a good one, and the “thumping” explanation in (2) is a bad one. But what if the over-arching capacity we are interested in is an ad-hoc “sound-making” capacity of biological organisms? In this case, the account still lines up with our intuition that the “hearts are for thumping” explanation is a bad: The sound-making capacity of the heart is not really less complex than the sound-making capacity of the whole organism. All this analysis really
does is state that “organisms make sounds because their parts make sounds.” So this explanation fails to pass the reductionist test for a good explanation (i.e., breaking a system down into simpler parts).

Cummins’s account aims to justify statements about what something is “for” and how things can be “for” some purposes but not others, without appealing to the antecedent causes of that thing. The account applies mainly to biological and mechanical systems, but for our purposes we do not have to limit it to these cases. For example, the statement “trees are for providing a habitat for birds” might constitute a good explanation on a functional analysis, if it helps break down a larger ecological system into the causal roles that make it thrive.3 The important point is that this explanation does not appeal to the causes of the trees’ existence (though, of course, it does depend on the causal role of the trees in the larger system).

This glimpse at theories of teleological explanations suggests that some normative principles can successfully justify them. Only one of these theories constrains teleological explanations to the domain of intentional action. Of course, just because teleological explanations can be used in sophisticated, non-intentional ways does not mean this is how they are used. How reasonable are the teleological explanations that people rely on? The next two sections of this chapter examine the nature of these explanations in children and in adults.

[A] The Developmental Origins of Teleological Thinking

Since our aim is to vet people’s teleological intuitions, research on children’s thinking has the potential to be illuminating. We can treat developmental research on these intuitions like the memoir of an infamous historical character, asking questions like: Was he always rotten to the core? Or was he deep-down a good person, just misunderstood? If teleological thinking is inherently mistaken, then this seems to limit what philosophers can hope to gain by consulting
human intuitions about explanation quality. But if the deficiencies in people’s teleological intuitions are mere peccadillos, then these intuitions may ultimately be valuable (provided we can isolate the worthwhile aspects). Previous psychological research has brought two types of indictments against children’s teleological judgments. The first is that they represent incursions of teleological thinking beyond its legitimate domain of designed mechanisms. The second is that these judgments are the result of an innate belief in a supernatural creator, a source of all physical phenomena. We consider these two perspectives in turn.

[B] Promiscuous Teleology

Early work on teleological thinking examined the cognitive machinery that formed the basis of children’s thinking about biology and biological functions. On one account, children come equipped with a teleological “mode of construal” that is useful for reasoning about functions or goals and that is triggered only in contexts where these are salient, such as biology (Keil, 1992; see also Atran, 1994). “Promiscuous teleology” theory emerged as response to these claims of restricted, domain-specific teleological thinking. On this alternative view, the proper domain of teleological thinking is intentional action, but people overextend this thinking into virtually every domain. According to Kelemen (1999a), this occurs very early in life, as young learners move from (a) the observation that human action often exploits objects to further people’s goals to (b) the (faulty) inference that all objects must exist to further the goals of agents. When encountering an unfamiliar entity—whether natural or artificial—humans instinctively infer that this object, like others they have experienced, must exist to fulfill the purposes of people (or of other agents).
To distinguish these theories, Kelemen (1999a) took a straightforward approach to examining the scope of children’s teleological thinking: She showed preschoolers items from a variety of domains (animals, non-living kinds, artifacts) and asked what they thought these things were “for.” The children were given the option of saying that this question was silly and unanswerable for certain items (the questions were asked by a “silly puppet who sometimes asks questions that don’t have answers”). This simple procedure yielded striking results: Children spontaneously and consistently produced purpose-based explanations for every category, including animals (“tigers are for biting”), humans (“babies are for loving”), and non-living natural kinds (“clouds are for raining”). However, children rejected such responses for unfamiliar items (e.g., a “tryogaster”), suggesting that the results for familiar items were not due to an unwillingness to answer in the negative.

However, a concern in interpreting this result is that children’s responses could follow from a misunderstanding of what is meant by “what x is for.” Children might have interpreted this as meaning “what x is well-suited for” or “what x is used for” rather than “what x was created for.” Indeed, while children were liberal in assigning functions to all types of items, Kelemen acknowledged that some of these functions—for example, tigers are “for biting”—sound more like behaviors or traits, rather than functions or purposes. Children may simply have been listing the sorts of activities that these entities typically engage in, rather than actually entertaining ideas about purpose. In order to test this possibility, Kelemen asked children to arbitrate between two characters. One took the position that, for example, tigers are not “for” anything, but biting is simply a thing they do; the other insisted that tigers were really for this purpose. Children strongly sided with the second, purpose-insistent character, suggesting that they were not simply listing typical traits.
Kelemen (1999c) examined children’s teleological tendencies using a different approach, directly contrasting their preferences for mechanistic and teleological explanations of natural-kind properties. In this study, first through fourth graders saw several pairs of pictures, each pair consisting of one animal and one non-living natural kind. The experimenter emphasized a property of each (e.g., a rock’s pointiness) and then gave children an option of two explanations for this property. One was a purpose-based explanation (e.g., these rocks are pointy so animals won’t sit on them), the other was a mechanistic one (e.g., these rocks are pointy because “little bits of stuff piled up on top of one another over a long time”). Children preferred the teleological explanations, choosing them on about three-fourths of trials. This was the case not only for biological properties like smooth skin, but also for properties of non-living natural kinds like stones. These results suggest that children recruit teleological explanations even when a mechanistic alternative is at hand.

These experiments rule strongly in favor of promiscuous teleology’s claim that purpose-based thinking is unrestricted, extending outside domains like biology. But as described earlier, this theory makes further claims about the motive for this over-extension: It stems from a mistaken analogy to intentionally-designed artifacts. On this view, children believe tigers are “for biting” for the same reason that they believe clocks are “for telling time.” This claim is reminiscent of classic work in psychology on children’s “artificialism.” In a series of open-ended interviews, Piaget (1929) queried children’s beliefs about the origins of various natural kinds (e.g., the sun). Children tended to respond to these queries as if they believed these items were created by people; for example, the sun started “from matches” that came from a person’s house. Piaget’s evidence corroborated his larger theory, in which young children are incapable of abstract reasoning about naturalistic causes (like the origins of the sun or clouds) and abstract
entities (like God). Instead, children are “artificialists” in believing all objects to be man-made artifacts.

However, contemporary psychological research has challenged both Piaget’s general claim that children are incapable of understanding physical causation (e.g., Bullock, Gelman, & Baillargeon, 1982), and his specific claims concerning children’s beliefs about the human-based origins of natural kinds. For example, Gelman and Kremer (1991) supplemented Piaget’s open-ended interviews about origins with additional structured tasks and distinguished between “remote” items (such as stars) and “familiar” items (such as flowers). They found that the appearance of artificialism in children depended on how their beliefs were queried. When children encountered open-ended questions about unfamiliar topics (e.g., where the stars came from), they were prone to make guesses and to draw analogies to the domain of human action; but for more familiar domains (e.g., where flowers come from) or more targeted queries, children generally indicated that human-creation is characteristic of artifacts, but not natural kinds.

Further evidence that children can distinguish man-made artifacts and natural kinds comes from Greif, Kemler Nelson, Keil, and Gutierrez (2006). Rather than focusing on existential questions about origins, this study aimed to simulate the kinds of experiences children would actually have when learning and reasoning about the world. Preschool children saw novel artifacts and animals, and were encouraged to ask any questions they liked in order to learn more about them. This simple procedure yielded systematic differences in the kinds of questions that children asked. For example, children showed more curiosity about proper niche and location for animals, whereas they focused more on function and behavior for artifacts. Moreover, although children did not often ask what the artifacts were “made for,” they never asked what the animals
were made for. These results suggest that, in a naturalistic learning environment, children do not treat natural kinds as if they were intentionally-designed artifacts.

[B] Intuitive Creationism

If children do not confuse natural kinds with man-made artifacts in learning, then how can we explain their “promiscuous” teleological explanations? Kelemen (2004) argues that, although children do not mistake natural kinds for man-made artifacts, they do mistake natural kinds for agent-made artifacts. On this view, children are not “artificialists,” but “intuitive theists”: They believe that natural objects originate in supernatural, theistic design.

The “intuitive theism” view coheres with other proposals on the naturalness of religious thinking (e.g., Bloom, 2007), and it gives promiscuous teleology theory some wiggle room in those cases where children do not literally treat natural kinds like human-designed artifacts. Nevertheless, we shouldn’t dismiss discrepancies across task-types too readily, since it is a well-established tenet of developmental research that children are susceptible to how tasks are framed. Greif et al. (2006) found that, in naturalistic learning contexts, children did not treat natural kinds as (human-made or God-made) artifacts. By contrast, Kelemen’s studies (1999a, 1999b) found that, when directly asked “why” questions about natural and artificial kinds (e.g., “Why are rocks pointy?”), children conflated the two. How should we think about this discrepancy? One possibility is that the direct explanation-based studies are more sensitive, revealing non-obvious but core beliefs about theistic design in nature. Another possibility is that explanation-based studies lack “ecological validity”: Perhaps “why” questions provoke an unnatural response in children due to unintended pragmatic effects. For example, children may assume that a “how”-phrasing would have been used if adults were interested in mechanistic explanations, and
therefore interpret “why” questions as a request for a purpose—something children would not otherwise think about. We believe further work is needed to resolve these possibilities. Future research could examine tasks that bridge the gap between a Kelemen-style task and a Greif-style task in order to reconcile the discrepant results and to pinpoint the role of purpose-based thinking in children’s everyday mental lives.

Putting these concerns aside, however, we can view “intuitive theism” as suggesting that children’s creationist tendencies should be at least as strong as their teleological tendencies, since this view attributes the second of these to the first. In order to investigate children’s understanding of creationism and its alternatives, Evans (2001) asked children and their parents about the origins of several natural kinds—for example, “how did the very first sun bear [a kind of bear from Asia] get here on earth?”—examining both fundamentalist and non-fundamentalist communities. In both open-ended and forced-choice questionnaires, children in both communities preferred deity-based answers, especially for living natural kinds (given options like “it just appeared,” “it changed from a different kind of animal,” “God made it,” and “a person made it”). Community religiosity and parental religious beliefs increased children’s deity answers, but with a lower-bound: Non-religious parents could foster a shift away from creationism and towards evolution-based responses in older children, but in younger children an aversion to evolutionary answers—especially for the origin of species—was largely immune to parental influence.

These results suggest children have teleological beliefs about the natural world that parallel the explanatory tendencies Kelemen (1999a, 1999b) uncovered. Further work suggests these two effects are linked. Kelemen and DiYanni (2005) examined children’s responses to both direct questions about origins and open-ended questions about purpose. In this study,
elementary-school children answered both explicit questions about origins—for example, “did someone or something make the first ever river, or did it just happen?”—as well as requests for explanations—“why did the first ever river come to be here?” The key finding in this study was that children who produced creationist responses had a tendency to choose and generate teleological explanations.

Parental influence alone does not seem sufficient to explain either children’s creationist beliefs or their teleological explanations. However, it is important to draw a distinction between a preference for teleological or creationist thinking, and a difficulty in thinking about alternatives. In all the studies on origins we have reviewed, children were much less inclined towards creationism in their assessment of non-living than living natural kinds (Gelman & Kremer, 1991; Evans, 2001; Kelemen & DiYanni, 2005). Living natural kinds are unique in that the best alternative to creationist origins is natural selection. But children have difficulty understanding evolutionary mechanisms—for example, Evans (2001) cites work on essentialism as a natural roadblock to understanding evolution (e.g., Gelman, 2003; Shtulman, 2006). Children seem to take divisions between natural kinds as fixed: They believe in qualitative, fundamental, and unbridgeable differences between animals of distinct categories (e.g., cats and tigers, horses and zebras), and this understanding is difficult to reconcile with an evolutionary view. Creationist explanations, however, do not run into conflict with children’s essentialist tendencies. If this interpretation is right, then children’s creationist beliefs may not stem from their intrinsic appeal, but instead from a difficulty with alternatives.

Similarly, children’s apparent preference for teleological explanations might better be understood as a difficulty with available alternatives. Many studies have contrasted teleological explanations with fairly vague and complex mechanistic alternatives, and we might wonder
whether these contrasting explanations controlled for important factors such as the intelligibility or familiarity of the phenomena. For example, Kelemen (1999c) contrasted an explanation for pointy rocks that cited “bits of stuff piling up over time” with one that cited animals not sitting on them. Children might well find the causal process of bits of stuff building up over time far less interesting and intelligible than the causal process of pointy rocks poking an animal in the butt. Kelemen and DiYanni (2005) used more concrete mechanistic alternatives, and children’s choices of explanations in this study were more mixed: Children actually preferred physical explanations over teleological ones for half the items (floods, storms, and mountains), while showing the typical teleological preference for the other half (monkeys, birds, and rivers). Rather than displaying a bias toward teleological (or against mechanistic) reasons, children may be willing to entertain both types of explanations when they are placed on even footing.

We might wonder whether the distinction between (a) intrinsic preferences for purpose-based beliefs and (b) conceptual difficulties with alternatives to such beliefs is really a crucial difference. The answer depends on the conclusions we want to draw from the evidence reviewed here. One interpretation of this evidence is that children build up their understanding of the world on a case-by-case basis, recruiting supernatural agency for genuinely difficult and unfamiliar questions—such as why the “first ever” monkey came to exist—but entertaining naturalistic alternatives when they find these plausible and comprehensible (e.g., storms, mountains). However, Kelemen’s (1999c) theoretical claim is not simply that mechanistic explanations tend to try children’s patience, leading them towards unscientific alternatives. Likewise, Kelemen and DiYanni (2005) do not interpret their results as merely indicating that children struggle with mechanistic explanations within certain domains, such as living natural kinds. Instead, in both cases, the proposed takeaway is that purpose-based explanations have an intrinsic appeal due to
humans’ fundamentally mistaken view of the natural world. If this theory is right, it presents a nightmare for those hoping to gain insight from folk intuition, since teleological intuitions about nature seem to rest inherently on faulty premises. If Kelemen is right, the way kids conceptualize the natural world is fundamentally confused.

[B] Summary

We don’t think current evidence rules decisively in favor of this nightmare. Children are more willing to entertain teleological explanations than Western scientific norms would dictate, and they are more prone to creationist beliefs than we might expect from their parents’ level of religious belief (Evans, 2001; see also Kelemen, Callanan, Casler, & Pérez-Granados, 2005). But when it comes to learning and reasoning about the world, we see little evidence these tendencies cause children difficulties. We see it as an open question what drives children’s willingness to entertain teleological explanations, and whether this willingness negatively impacts their learning or understanding.

However, we are not done examining the evidence for inherent teleological errors. Possible support for such errors comes, not only from children, but also from adults. Adults can avoid teleological mistakes in situations where they can bring to bear their scientific knowledge, but they may still display underlying teleological thinking if they have not received scientific training or if they drop their guard under time pressure. Evidence of this sort has the potential to show that teleological thinking is a deep-seated and permanent aspect of the way we deal with empirical matters.
[A] Teleological Thinking in Adults

The evidence we’ve reviewed suggests that children have an affinity for teleological explanations of nature, despite cultural norms discouraging it. We noted difficulties in identifying the reason for this affinity: Despite strong claims about children’s domain-general creationist bias, the evidence seemed equally compatible with misunderstandings of particular mechanisms. In this section, we turn to evidence for teleological thinking in adults, which comes in three varieties: experiments with special populations, with adults under time pressure, and with normal college students. We argue, however, that an ambiguity (similar to that of the developmental studies) affects these findings. As Kelemen et al. (2013) note, adults’ teleological beliefs about nature could stem either from the creationist thinking we discussed earlier or from a more generalized idea of the world as embodying agent-like purposes, at the level of Nature (with a capital “N”) or “Gaia.” But the latter idea—at least in a form like “Nature is a powerful being”—less clearly violates scientific norms than does the former.

[B] Teleology in the Field

Teleological beliefs in children could reflect a transient developmental stage, with adults naturally outgrowing “superstitious” teleological thinking. Certainly, adults are more selective in their preference for teleology. However, adults’ advantage may depend more on education than on cognitive maturity. Casler and Kelemen (2008) investigated a population in which cognitive maturation and scientific education were decoupled: A Romanian community whose members varied widely in years of formal schooling. Using the procedure from Kelemen (1999c), this study compared low- and high-education Romanian groups. They found that the low-education group endorsed teleological explanations for every type of item, including non-living natural
kinds. While the rate of endorsement was lower than that of the preschoolers from Kelemen (1999c)—the low-education group chose unwarranted teleological explanations about half the time—this rate was markedly higher than that of the high-education group, who limited their teleological explanations to adaptive biological parts. Although not ruling out a role for maturation, these results suggest that maturation cannot entirely explain differences between children and adults. In the absence of formal schooling, people accept scientifically unwarranted teleological explanations regardless of age.

Lombrozo, Kelemen, and Zaitchik (2007) examined the maturation/education question using a different population: patients with Alzheimer’s disease. On the basis of evidence that Alzheimer’s causes conceptual and semantic deficits (e.g., Zannino, Perri, Carlesimo, Pasqualetti, & Caltagirone, 2002), Lombrozo et al. predicted that these patients would, like children, prefer teleological explanations. This prediction was borne out: When explaining natural phenomena, patients with this disease (but not control participants of the same age) preferred teleological explanations over mechanistic ones.

These results suggest that a preference for teleological explanations does not just reflect a transient developmental stage. One possibility is that scientific education may simply paper over the symptoms of a permanent teleological preference. The fact that it can appear after a lifetime of science education (as in the case of Alzheimer’s patients) could suggest that the teleological thinking never truly goes away: Science knowledge may suppress it, but not erase it (Casler & Kelemen, 2008). Another possibility, however, is that people do overcome incorrect teleological thinking but re-acquire it when cognitive deficits make proper scientific explanations difficult to grasp. Separating these possibilities calls for a different type of investigation, one examining
whether incorrect teleological reasoning can be evoked in normal adults who have scientific knowledge. Let’s take a look at evidence of this sort.

[B] Teleology under Pressure

If teleological thinking is suppressed but not overwritten, we should predict it to resurface when adults’ cognitive resources are strained, even in adults with science education. Three separate studies have tested this hypothesis (Kelemen & Rosset, 2009; Kelemen, Rottman, & Seston, 2013; Jarnefelt, Canfield, & Kelemen, 2015). Participants were asked to evaluate (as true or false) explanations for natural kinds, such as “moss forms around rocks in order to stop soil erosion.” Responses to these items were compared to control sentences such as “soup is hot because it is primarily liquid.” Participants were either forced to respond within three seconds, or were given unlimited time. Jarnefelt et al. used a different set of prompts, asking non-religious participants to judge whether pictures of natural kinds were “purposefully made by some being.”

These studies produced similar results: Participants in the “time-pressure” group—including a group of trained physical scientists—endorsed more unwarranted teleological statements than those in the untimed group. In contrast, the accuracy differences for the control sentences were either non-existent (in Kelemen & Rossett, 2009) or smaller (in Kelemen et al., 2013, and Jarnefelt et al., 2015).

These results were taken to show that people—even trained physical scientists and atheists—have tacit teleological beliefs, ones that emerge under time-pressure. However, time-pressure may have affected these tasks for a more mundane reason: the fact that the experimental items were much more difficult than the control items. For example, Jarnefelt et al.’s control task involved verifying whether objects were “human-made,” whereas the experimental task asked
whether they were “being-made.” For all non-religious groups, participants’ “yes” responses in the control task were in the range 1-9%. The low percentage makes it difficult to know whether the differential effects of time-pressure across tasks are due to an inherent difference in the tasks (human-made vs. being-made judgments), or simply due to a floor effect in the easy task but not in the difficult one. Perhaps speeded conditions would have had an identical impact on the test and control items had these items been equated for difficulty. Similar concerns apply to Kelemen and Rosset (2009) and Kelemen et al. (2013), in which errors on the control items were again near floor.

[B] Teleology under No Pressure

Although we have highlighted a difficulty interpreting time-pressure results, Coley and Tanner (2015), Kelemen and Rosset (2009), and Kelemen et al. (2013) offer notable findings that are unrelated to the time-pressure manipulation. In particular, unspeeded conditions in these studies led to a surprisingly high rate of teleological explanations among college students, participants whom we might have taken for granted as having an explicitly scientific view of nature. In the unspeeded conditions in Kelemen and Rosset and Kelemen et al., these students accepted explanations like “mosses form around rocks to stop soil erosion” roughly half the time. This suggests that even adults with Western scientific education need not be placed under cognitive load in order to reveal their teleological tendencies.

How should we interpret college students’ willingness to accept scientifically unwarranted teleological explanations without any kind of time pressure? One possibility compatible with the “suppressed but not overwritten” view is that suppression is rather weak, even for those acquainted with Western scientific norms. In other words, “adults maintain certain scientifically unwarranted
teleological ideas very explicitly” (Kelemen & Rosset, 2009, p. 142). An alternative explanation, however, is that many of the teleological explanations used in adult studies are less clearly defective than those in child studies. Participants in Kelemen et al. (2013) and Kelemen and Rosset (2009) may have found many of the test items—such as “Bees frequent flowers in order to aid pollination”—to be acceptable because they believed the phenomena could be due to natural selection (i.e., aiding pollination may help bees survive). Similarly, for “Many species develop protective ‘camouflage’ to avoid predators,” which Coley and Tanner (2015) found was endorsed by over 75% of college students (both biology majors and majors from other fields).

To what extent is the issue about the scientific plausibility of some test items a concern for interpreting these studies? If we make the assumption that teleological thinking in biology is motivated by scientifically-valid reasoning about natural selection, then we should be wary of concluding from these findings that college students maintain “scientifically unwarranted teleological ideas.” However, this assumption is not necessarily correct. Adults’ thinking about evolution may itself be infected by mistaken teleology. Students (and often, their teachers) have a notoriously difficult time correctly understanding natural selection (Bishop & Anderson, 1990; Shtulman, 2006; Nehm, Kim, & Sheppard, 2009; see Gregory, 2009 for a review). In particular, students’ misunderstandings are often related to their misattribution of goals and purposes to natural selection, which comes in two forms (Coley & Tanner, 2015; Gregory, 2009; Moore, Mitchell, Bally, Inglis, Day, & Jacobs, 2002). First, students often misunderstand mutations as occurring in response to the needs of the organism. These mutations are directed toward a need or goal, and they emerge within an individual to fulfill the goal (e.g., giraffes grew longer necks because of their need to reach leaves on tall trees). Second, students with a better grasp of natural selection as occurring at the level of populations, rather than at the level of individuals, can still
misconstrue this selective force as “guided.” Students often mistake natural selection as a force that is guided by a goal-directed or even agentive “Nature.” Both of these misconceptions conflict with an accurate understanding of natural selection as a two-step process of random variation and non-random sorting of variation due to survival and reproduction.

[B] Relations between Teleological Beliefs and Concepts of Natural Processes

Recognizing the importance of the link between science understanding and potentially correct teleological thinking, all three time-pressure studies collected measures of science understanding in the form of a quiz on natural selection and a quiz on geosciences (Anderson, Fisher, & Norman, 2002; Libarkin & Anderson, 2006). Both Kelemen and Rosset (2009) and Kelemen et al. (2013) found that these measures—especially the natural selection measure—predicted teleological endorsements, with poorer natural selection knowledge correlating with greater teleological acceptance. However, no link was found between these natural selection measures and endorsement of intentional design in Jarnefelt et al. (2015; when controlling for the belief-measures described below).

The finding that teleological explanations correlate with misunderstandings of natural selection suggests that these explanations are linked to mistaken beliefs about the natural world. What might be the source of this link? The previous section (The Developmental Origins of Teleological Thinking) reviewed evidence that children’s teleological explanations are due to their “creationist” beliefs. In order to assess potential developmental continuity of this link, all three time-pressure studies collected ratings of religious beliefs (e.g., “I believe there is truth only in one religion”) as well as “non-doctrinal” agency beliefs (e.g., “I believe that Nature is a powerful being”). Kelemen et al. (2013) found that both types of beliefs predicted unwarranted
teleological explanations. In fact, non-doctrinal beliefs predicted teleological explanations independently of, and more consistently than, religious beliefs. Further, this link existed within each sub-population (e.g., even within the group of trained physical scientists).

However, this connection between teleological thinking (on the one hand) and explicit beliefs about creationism and agency-in-nature (on the other) has proven less reliable in other studies (e.g., Kelemen & Rosset, 2009; Lombrozo et al., 2007). Part of the discrepancy could be due to variations in how beliefs were assessed. Of all the experiments, Lombrozo et al.’s (2007) study with Alzheimer’s patients queried beliefs most precisely, asking about the origins of the same items that earlier appeared in the explanation evaluation task. For example, participants were asked to choose between a teleological and a mechanistic explanation for the sun’s brightness, and they were also asked to describe their explicit beliefs about whether the sun’s brightness was due to intentional design. This precise method revealed no link between beliefs in intentional design and explanatory preference. Conversely, Kelemen et al.’s (2013) study, which found the strongest link between intentions-in-nature beliefs and teleological explanations, used a relatively vague belief-measure: agreement with the statement “Nature is a powerful being.” This statement is highly ambiguous and does not necessarily imply belief in intentional agency or design. Although the statement would certainly elicit approval from someone who believed in Nature as a deity, others could take it less literally to mean that natural forces are powerful, that they interact in global, pervasive ways, or that they strongly determine all physical events, among other innocuous interpretations.
Summary

What can these results tell us about the causes of adults’ teleological explanations? These explanations seem to correlate with mistaken understandings of nature. But are they rooted in beliefs about intentional design? As we mentioned earlier, Kelemen et al. (2013) contrast a purpose-based view of nature that is “intrinsic” with one that is “extrinsic.” The former is the “quasi-spiritual agentive theory that the Earth is a goal-directed living organism—in contemporary parlance, a cosmological belief in Mother Earth or ‘Gaia.’” The latter is the “creationist” beliefs we explored in the section on children: the “notion that nature is an artifact of intentional design” (p. 3).

It is unclear how to reconcile these two types of beliefs that hypothetically form the foundation of teleological thinking. On the one hand, the “earth as an intentionally designed artifact” proposal seems more consistent with the developmental continuity that originally motivated the “suppressed but not overwritten” view of teleological thinking. On the other hand, these beliefs about intentional design in nature are at best inconsistently linked to teleological explanations (e.g., Lombrozo et al., 2007). Willingness to endorse intentional creation in nature also does not seem to be linked to misunderstandings of scientific concepts like evolution (Jarnefelt et al., 2015). But the situation is not much better for “non-doctrinal” or “Gaia” beliefs. As noted above, only the vaguest of measures (“Nature is a powerful being”) is linked to teleological thinking.

The results reviewed in this section suggest that adults, like children, do not naturally identify mechanistic explanations as superior to teleological ones. Instead, mechanistic thinking is learned through scientific education. But these results give a less clear picture of why people sometimes find unscientific teleological explanations satisfying. While promiscuous teleology
theory claims this is driven by tacit creationism or Gaia-based beliefs, the evidence for this claim is unreliable across tasks and measures. While there appears to be a connection between unscientific teleological thinking and misunderstandings of scientific concepts like natural selection, it is not clear that the reason for this link is a tacit misunderstanding about the intention-based nature of the physical world. It’s worth canvasing other reasons why people might find it tempting to endorse incorrect teleological explanations.

[A] Alternative Interpretations of Scientifically Unwarranted Teleological Thinking

The previous sections reviewed research on teleological explanations, with evidence taken from a variety of tasks, populations, and methods. However, this research largely rests on a single core finding: People sometimes accept teleological explanations that go against Western scientific norms. Given this finding, the prevailing empirical method for investigating it has posited an underlying belief structure that might produce this explanatory process and then sought evidence for the existence of this structure. As we’ve seen, the best-known research program in this area has focused on creationist beliefs or Gaia-type beliefs, but we should consider other possible beliefs that could support the same teleological inferences.

[B] An Alternative Theory Based on Environmental Role

One alternative proposal by ojalehto, Waxman, and Medin (2013) argues that there are two aspects of teleological explanations that draw children and non-Western adults towards them: (a) these explanations capture interdependencies and ecological relations in the environment, and (b) the explanations take the perspective of entities within these environments. For example, children might find an explanation like “trees exist to give birds a place to live”
appealing because it captures environmental interdependencies that children find compelling and because this explanation can be understood by taking the perspective of the birds (“well, if you are a bird, trees are for providing homes, food, or shade,” p. 168). Although the explanation contains the words “exist to,” people may not interpret this phrase as citing the causes of this existence.

Methodological aspects of previous work may have promoted this kind of environment-based reasoning. For example, Casler and Kelemen’s (2008) task paired pictures of animals and non-living natural kinds and emphasized their shared environment before asking participants to explain a property of each. Adults unaccustomed to giving mechanistic explanations might interpret the “why” questions embedded in these prompts as a requests to describe the roles and relationships in these environments.

By emphasizing ecological relations and perspective-taking, ojalehto et al. (2013) deliberately contrast their interpretation of teleological explanations with a “Western” style of explanation that favors individuated entities isolated from context (p. 168). But although their account differs in some respects from Cummins’s (1975) “functional analysis” theory (see the earlier section on Forms of Teleological Explanation), they share the idea that teleological explanations can, without referencing causal history, highlight the role of some part or process within a larger system—for example, the role of trees in a bird’s environment or the role of the heart in biological organisms.

A description of children’s teleological thinking that is “role-based,” and less concerned with origins and design, lines up with evidence on children’s understanding of artifacts. Research in this domain suggests that knowledge of the connection between intentional creation and function does not emerge until late preschool (Matan & Carey, 2001; German & Johnson, 2002;
Children sometimes succeed at understanding internal mechanisms (Visalberghi & Tomasello, 1999) and in mapping parts and observed usage to functions (McCarrell & Callanan, 1995; Casler & Kelemen, 2005), but are less adept at thinking about the intentional origins behind these mechanisms, parts, or functions. If children care about the functions and roles that objects play in their environment, but have less interest in how these objects come to exist, we might interpret children’s teleological explanations as capturing information about current functions and roles, rather than intentional design.

One limitation of a purely role-based theory of teleological reasoning, however, is that it does not naturally account for the evidence suggesting that teleological explanations sometimes are linked to beliefs about causal history (e.g., Kelemen & DiYanni, 2005). People often deliberately and unabashedly use teleological explanations to capture causal predecessors: For example, we might say that “tigers have stripes for camouflage” because we believe the selective benefit of camouflaging is what caused stripes to spread in the tiger population. How should we understand this use of teleological explanations? And can we reconcile it with the more unscientific usage that has been the focus of this chapter?

**[B] An Alternative Historical-Causal Theory**

A philosophical account reviewed earlier—that of Wright (1977)—is helpful in understanding why historical teleological explanations are appealing. In a series of studies, Lombrozo and Carey (2006) examined the psychological reality of Wright’s account. Participants read vignettes that satisfied Wright’s conditions on such explanations. For example, participants learned about dogs with noses that were genetically engineered to glow in the dark at night, so that (a) the property (glowing noses) caused the function (visibility at night), and (b) the
property existed because it led to this function. Across stories, the presence/absence of intentional goals was manipulated: The genetic change was either done with the explicit, intentional goal of bringing about the function, or it was caused in another way (natural selection, supply-and-demand). Participants rated the acceptability of several types of explanations for “why the dogs have glowing noses,” including a teleological explanation (“Because the noses are attention-grabbing at night”) and a mechanistic one (“Because the noses were engineered to be that way”). The experiment controlled the reliability and generalizability of the causal connection between the function (e.g., visibility) and the property (glowing) being explained.

Lombrozo and Carey (2006) found that the presence of intentional goals (the engineer deliberately intending to create glowing noses to promote visibility) made no difference to participants’ evaluation of teleological explanations. They concluded that adults use something like Wright’s conditions to evaluate teleological explanations, with the additional constraint that the causal structure cited in a teleological explanation should be generalizable. These results suggest that people’s teleological intuitions are not sensitive to intentions per se, but instead to a generalizable kind of causal structure.

We might be concerned that the scenarios used in this study were somewhat contrived, since the unintentional scenarios involved the unwitting creation of a trait for reasons other than knowledge of that trait’s function (e.g., genetic engineering of glowing noses without knowledge of the functional advantage of the glowing). These results suggest that causal structure that is devoid of intentional agency, but that satisfies Wright’s conditions, will elicit teleological thinking. But do people ever encounter causal structure like this? Wright’s account is valuable in encompassing teleological explanations that do not depend on intentional agency, for example,
explanations based on natural selection and operant conditioning. Is there any reason to think that people use such sophisticated reasoning when trying to understand the natural world in less overtly scientific contexts?

On our view, systems in which function plays a causal role without involving intentional agency may not be so uncommon. One place we can find these is in stimuli from previous work on “unwarranted” teleological explanations. Consider the following examples from Kelemen et al. (2013):

(6) Moss forms around rocks in order to prevent soil erosion.

(7) Particles collide in order to produce chemical reactions.

(8) Molecules fuse in order to create matter.

Let’s reconsider these explanations through the lens of Wright’s (1977) and Lombrozo and Carey’s (2006) accounts. Example (6) attributes a function to moss-growth: soil-erosion prevention. In order for Wright’s account to warrant this explanation, moss-growth would have to occur because it results in erosion-prevention. Is this accurate? Not quite—but it is important to see exactly how this statement misses the mark. Figure 1 shows the hypothetical causal set up: Moss growth prevents soil erosion by absorbing excess water (e.g., from rain) that would otherwise get in the soil and cause it to erode. Moss, like any plant, requires water to grow, and more water generally promotes further growth. So, in fact, erosion-prevention is related to moss-growth: When moss prevents soil erosion, this involves a causal process (water-absorption) that typically benefits the moss, leading to subsequent moss growth. In this sense, moss growth occurs because of (something associated with) preventing erosion.
The teleological explanation in (6) is not completely right. Erosion-prevention is correlated with future moss-growth, but it is not really a cause of moss-growth. The actual cause of both erosion and of moss-growth is water absorption. So an explanation that cites the function of moss as a reason for its existence seems to confuse correlation for causation. But if this interpretation is correct, then our suggestion has achieved something: The mistake in the explanation, which is typically considered evidence for claims about tacit creationism or belief in “Gaia,” may actually be attributable to something that is common fare in psychology: confusing correlation for causation. Notice, though, that the confusion in question is not simply a matter of an association among “water,” “erosion,” and “growth.” The explanation involves causal thinking about the role of water absorption. The problem in this case is substituting one factor (preventing erosion) for another (rain absorption) as the cause of a third (moss growth).

[B] A Teleological Heuristic for Understanding Equilibrium Systems

Of course, we think it unlikely that the average undergraduate knows about the moss-rain-erosion causal structure we have just described. We don’t think this kind of knowledge is what motivated participants’ endorsement of this teleological explanation. Rather than attributing to them gardening-expertise, we are attributing to them something like the following thought: “Gosh, I have no idea what happens when moss prevents erosion. It doesn’t seem like an accident that moss does that, though. Maybe preventing erosion doesn’t just help the soil, maybe this also benefits the moss? Sure, that sounds like a good guess—lots of things in nature work that way, and I have no idea about the actual facts of the matter in this case.” In other words, we are attributing to participants a heuristic that they can use to explain how things work in nature. We suspect the fact that this heuristic was close to being correct in this case is not an accident or
isolated incident: Many things in nature tend to engage in symbiotic relationships or demonstrate self-stabilizing behavior. The explanations in (6)-(8) share this characteristic. The long-run dependability of this heuristic probably explains why people have it in the first place. When people find out that some phenomenon in nature acts in this feedback-loop-like manner, this confirms and rewards a teleological construal of that phenomenon.

Promiscuous teleology provides a different account from the one we have just sketched. On this view, as people learn more about the moss-rocks causal system, they confirm a secret belief that moss was designed by Gaia to stop soil from eroding, and this is what really drives acceptance of the teleological explanation. While we haven’t ruled out this theory, we suspect that sensitivity to reciprocal causal structures may more parsimoniously explain people’s teleological intuitions.

The domains of chemistry and physics provide further examples in which feedback loops (particle collisions causing chemical reactions causing further collisions) and equilibrium-tending systems are prevalent. Belief in such systems may promote acceptance of statements like (7) and (8). In the chemical sciences, textbooks make frequent use of teleological language, especially for systems that tend toward equilibrium or stability—for example, when describing atom bonding (“atoms bond to maintain electron stability”) or thermodynamic laws (“heat transfer occurs to attain a state of equilibrium”; Talanquer, 2007). Although it is possible that these textbook authors have reverted to an unscientific conception of the physical world as driven by intentional design, we think this is unlikely (and uncharitable)—these textbook formulations often accurately reflect the fact that the laws themselves are formulated in terms of end-states (e.g., in thermodynamics, heat-transfer in a closed system is framed in terms of this system statistically tending towards a certain state, maximum entropy; see Wicken, 1981).
course, students can misinterpret this teleological formulation as implying literal purposes or intentions within the system (Talanquer, 2006). But such cognitive biases are not the primary motivating factor for teleological formulations in this domain. Instead, the causal structure of the phenomena themselves is particularly well suited to teleological description. It is not clear that there exists a non-teleological formulation of certain thermodynamic laws (Wicken, 1981).

Systems that tend towards stable and self-sustaining behavior, or that involve feedback-loops, can often be understood in teleological terms. For this reason, we think it is plausible that people can directly recognize and understand this kind of causal structure without detouring into superfluous consideration of intentional design. Systems of this sort do not, in themselves, violate any norms of scientific explanation. In particular, they do not explain causes in terms of their effects, but they do recognize sequences in which a token cause can influence a token effect, which can in turn influence a second token cause of the same type as the first. For example, an instance of moss growth can cause an instance of water absorption, promoting later moss growth (see the loop in Figure 1). We think future research examining people’s understanding of the kinds of causal systems described here could be fruitful. What is normally taken as evidence for tacit belief in intentional agency in the natural world may in fact reveal a rich understanding of causal structure.

[A] Conclusion

In this chapter, we reviewed evidence on children’s and adults’ teleological thinking about the natural world. In contrast to strong claims that this kind of thinking is innately grounded in a tacit belief in an agentive Nature, we proposed that people’s teleological intuitions
may be the product of more reasonable ideas. It is worth briefly considering what this alternative perspective on people’s teleological intuitions can offer philosophy.

One potentially relevant area is work on explanation. Lombrozo (2015) reviews research on explanation in psychology and philosophy, noting relatively little crossover, but also proposing that a “functional” account of explanation generated from psychology could be valuable for philosophical theory. The functional account defines the psychological explaining process in terms of what it accomplishes: what explanation is meant to do.

Lombrozo and Carey (2006) propose one function of explanation is to “subserve future prediction and intervention.” People care not only that an explanation accurately describes the current state of the world, but also that it generalizes across past, future, and counterfactual states. One merit of an explanation is its ability to predict and to control future situations (p. 167; see also Hitchcock & Knobe, 2009). We think this account coheres nicely with our description of people’s teleological intuitions. People may often recruit teleological explanations, not because they are perfectly accurate, but because they are useful under conditions of limited knowledge or time. As scientifically minded adults, we take for granted a mechanistic explanation like “the sun is bright because of chemical reactions” because we know that it hooks into a network of physical principles and chemical laws. But if cognitive access to these scientific principles and laws is limited—as is the case of scientists in time-pressure experiments, inexperienced toddlers, and perhaps even some undergraduates (Rozenblit & Keil, 2002)—then a temporary teleological substitute may be better than nothing.

We are not arguing that a philosophical account should necessarily take into consideration the situation-specific tradeoffs between accuracy and usefulness. We are simply defending people’s tendency to adopt teleological explanations as a solution to these tradeoffs.
We do not think this tendency should be taken as evidence that people’s intuitions about explanation are worthless for normative accounts. Of course, this defense applies to the psychological studies we have reviewed here, and further evidence for teleological thinking could well show that people’s understanding of the physical world is hopelessly flawed in some domains. For example, recent studies of people’s beliefs about objects’ persistence and composition suggest that teleological thinking infects these beliefs (Rose, 2015; Rose & Schaffer, 2015). For example, whether people identify a collection of parts as a single object seems to depend on whether the collection has some joint use. Evidence of this sort could limit the extent to which metaphysicians can rely on folk notions of composition. Our present point is that the evidence we have reviewed about teleology in naïve scientific explanations does not necessarily show that these explanations are worthless or beneath consideration by investigators in other fields.

More broadly, we think philosophical accounts should not be too quick to accept the claim that people’s understanding of the physical world is grounded in tacit beliefs about supernatural agency. Current research has provided a wealth of interesting data on teleological thinking. But the dust hasn’t settled on potential interpretations, and the usual cautions are in place until we have a clearer view of the results’ meaning.
[A] References


Figure 1: A hypothetical causal system associated with teleological explanations ("Moss forms around rocks in order to prevent soil erosion").
Notes

1 We thank Nick Leonard and two anonymous reviewers for their helpful comments on this paper.

2 Strictly speaking, Cummins argues that a functional analysis is non-teleological, rather than being another type of teleological explanation. However, for our purposes, we will label this type of explanation as teleological, because a functional analysis still cites a goal or function.

3 And similarly, the statement “trees exist in order to be featured in hikers’ Instagram photos” could be considered a “bad” explanation, if this fails to capture the causal role of trees in an over-arching system that needs explaining. Note that this distinction would hold even if the statements “trees provide habitat for birds,” and “trees are often featured in hiker’s Instagram photos” are both true.

4 Defined as follows: “It is important for you to note that by using the term being we are deliberately non-specific. For us, being might refer to any kind of being who makes things deliberately,” (p. 74, italics in original).

5 In some cases, this reciprocal effect is due to natural selection, whereas in other cases, it is simply due to the fact that, if the phenomenon in question were not self-stabilizing, it would not exist and so we would not be talking about it. We conjecture that things in nature that have stuck around long enough to be the target of explanation are often those that have this kind of causal structure.
6 We also think this heuristic will sometimes be incorrect. Because this heuristic indicates a lack of knowledge about the facts of the matter, more usage of the heuristic should correlate with less scientific knowledge, as found by Kelemen et al. (2013) and Kelemen and Rosset (2009).

7 We are currently performing studies to verify empirically that people are sensitive to this kind of causal structure.