Chapter 10
Is intuitive teleological reasoning promiscuous?

This is the final draft of a paper that appears in the following book: W. Gibson, D.J. O'Brien, and M. Turda (Eds.). (2020). *Teleology and modernity* (pp. 185-202). Abingdon and New York: Routledge.

Johan De Smedt and Helen De Cruz

Humans have a tendency to reason teleologically. This tendency is more pronounced under time pressure, in people with little formal schooling and in patients with Alzheimer's. This has led some cognitive scientists of religion, notably Kelemen, to call intuitive teleological reasoning promiscuous, by which they mean teleology is applied to domains where it is unwarranted. We examine these claims using Kant's idea of the transcendental illusion in the first *Critique* and his views on the regulative function of teleological reasoning in the third *Critique*.[1] We examine whether a Kantian framework can help resolve the tension between the apparent promiscuity of intuitive teleology and its role in human reasoning about biological organisms and natural kinds.

The cognitive science of religion (CSR) is the multidisciplinary study of the cognitive basis of religious beliefs and practices. A basic assumption that unites this methodologically and conceptually diverse field is that religion is a product of everyday, mundane reasoning processes, and not some special domain of human cognition that requires religion-specific explanations. One domain CSR authors investigate is teleological thinking. People spontaneously adopt a teleological stance in thinking about a wide range of events and objects in their environment. For instance, they believe that features of the natural environment have a purpose (e.g., clouds are for raining), that the anatomical features of animals and plants have a purpose (e.g., thorns are there to protect plants from being eaten) and that significant

life events happen for a reason (e.g., Jessica thinks she failed her year because the universe was telling her she needed to study something else).

Some CSR authors have argued that humans spontaneously exhibit promiscuous teleological thinking, an over-attribution of teleology, beyond the domain where such attribution would be appropriate.[2] Humans make questionable inferences, such as that trees are for generating oxygen, or that the purpose of lions is to be displayed in zoos. However, other authors have questioned this interpretation.[3] In this chapter, we argue that Kant's views on teleological thinking can help throw new light on this debate. In particular, as we will show, Kant held that intuitive teleology helps us to make sense of the world – and thus is regulative of our cognition – but that it also makes us habitually overstep the boundaries of reasoning.

The first section provides an overview of Kant's transcendental illusion and its relevance for cognitive science today. The second section gives an overview of the CSR literature on intuitive teleological thinking. The third section looks into possible problems for the promiscuous teleology hypothesis and provides alternative explanations: we propose that while teleological reasoning is salient and tenacious across a wide variety of age groups and cultures, it can be flexibly deployed depending on the availability of alternative explanations and the extent to which someone deems teleology appropriate. The fourth section looks in detail at Kant's discussion of teleology in the third *Critique*, and his evaluation of the design argument. The fifth section shows that Kant's transcendental illusion can help make sense of an intuitive teleology which on the one hand helps regulate our cognition (a positive role), but at the same time generates questionable inferences (a negative role).

Kant's transcendental illusion and its relevance for cognitive science

In the *Critique of Pure Reason*, Kant proposed a comprehensive metaphysics and philosophy of mind that still has relevance for cognitive scientists today. His distinctive contribution to the rationalism-empiricism debate was to argue that the mind structures our experiences. While some of Kant's proposals would be considered strange by cognitive scientists (e.g., he believed space and time were impositions of the mind, not inherent features of the world), his broad idea that the mind structures experience is now accepted, which makes it hard to appreciate how innovative it was in the eighteenth century. According to Kant, the mind actively shapes and structures experience by several co-operating faculties of the mind, in particular, sensibility and understanding. Everything we experience has a priori elements, that is, elements that our reason supplies, prior to experience.

While this contribution to our current understanding of how the mind works is well known among cognitive scientists, a second feature of his work has received relatively little attention in the contemporary study of the human

mind. This concerns the limits of reasoning, of metaphysical reasoning in particular. Indeed, the *Critique of Pure Reason* is more a systematic probing of the *limits* of the human mind than of its powers. Unlike rationalists, Kant did not think that we could obtain any knowledge of the world merely through reasoning alone. Yet we do try to get knowledge of the world by reason alone when we engage in metaphysical speculations, for instance, about the existence of mathematical objects outside of space-time. This gives rise to a problem: our metaphysical ruminations are fruitless.

In the A and B Prefaces of the first *Critique*, Kant considered the state of metaphysics. Metaphysics, the philosophical inquiry about ultimate reality, was supposed to be the queen of sciences, providing a comprehensive picture of the world. Yet Kant clearly saw that while natural philosophers (who now would be called scientists) were making progress, metaphysicians seemed to be stuck in a rut. Rationalists such as Descartes thought it was possible to use one's reason and in this way to arrive at knowledge about God, the soul and the universe, ideas that are outside of our experience. Kant disagreed: this is an illicit use of reason as there are inherent limits to our knowledge (which he detailed in the *Analytic*): we can learn about the world of our experience, and about the categories, high-level templates that are a priori and that we need to make sense of our experiences. But we tend to overstep these limitations, when we use principles such as causation, which are outside our experience. Kant bemoaned this tendency: '[Reason] begins from principles whose use is unavoidable in the course of experience and at the same time sufficiently warranted by it. With these principles it rises … ever higher, to more remote conditions.'[4] For example, the idea that everything has a cause for its existence may accord with our everyday experience, but it is a mistake to apply this to the universe as a whole, as cosmological arguments do.

We look for ultimate explanations which gives rise to a specific reasoning error, the transcendental illusion. The transcendental illusion occurs when we 'take a subjective necessity of a connection of our concepts … for an objective necessity in the determination of things in themselves'.[5] As Grier summarises, this tendency of human reasoning, the transcendental illusion happens when we 'take subjective demands for unification of thought to be objective characteristics of things'.[6] For example, we tend to conceptualise events in terms of cause and effect, but for Kant, it would be a mistake to infer from this cognitive tendency that causation is an actual feature of the world.

The transcendental illusion is not an easily avoidable error. Simply thinking more deeply won't solve it. Rather, the illusion is a result of the way our reasoning is structured. Kant repeatedly drew an analogy between the transcendental illusion and optical illusions; for example, the moon appears larger when it is rising than when it is high up in the sky, even to an astronomer who is not deceived by this optical illusion.[7] In this, Kant prefigures some contemporary work in cognitive science about cognitive biases that persist in spite of education and reflection. For example, even highly educated people

erroneously maintain they are less biased than others.[8] Part of Kant's overall project is thus to uncover the illusion in transcendental judgments while protecting us from being deceived by it, but it can never bring it about that transcendental illusion (like logical illusion) should ever disappear and cease to be an illusion. What we have here is natural and unavoidable illusion.[9]

Kant's position on the transcendental illusion is subtle, as he holds the following claims, which are in tension, albeit not contradictory. First, the transcendental illusion is the result of reasoning in an improper way. Our knowledge has to be limited to experience, and cannot go beyond it. Second, the transcendental illusion also plays a positive role. It helps us to regulate our cognition. As we will see further on, Kant's *Critique of Judgment* provides an in-depth exploration of teleological reasoning as a heuristic device. We conceptualise biological organisms (animals and plants) as having natural purposes *(Naturzweck)*. Although they are not products of design, they nevertheless have features similar to artefacts, for example, they have parts that are in dependence relations, such as the leaves and trunk of a tree: 'The leaves, too, though produced by the tree, also sustain it in turn; for repeated defoliation would kill it, and its growth depends on their effect on the trunk.'[10] On the other hand, they are unlike artefacts in that they produce offspring looking like themselves, 'one gear in the watch does not produce another; still less does one watch produce other watches'.[11] Kant found himself in the peculiar position of finding fault with arguments such as the design argument and the cosmological argument, and at the same time holding that the reasoning that underlies these arguments is irresistible given the way our minds are structured.

Contemporary cognitive science has hardly paid attention to Kant's second bugbear, the limits of reason and how these lead us to making unwarranted metaphysical claims. However, there is one notable exception, the cognitive science of religion. CSR investigates the cognitive biases underlying religious belief formation. CSR authors have argued that religious beliefs are underpinned by ordinary inference systems that we use in everyday forms of reasoning. For example, our belief in an immaterial soul may be the result of ordinary reasoning processes that are involved when we think about other people and their mental states. When one makes inferences about, say, what one's grandfather would want or do, his nearby physical presence is not required. After grandfather's death, our intuitive psychology continues to generate inferences about what he would have wanted, which makes the idea of a continued existence of his mental states, separate from his body, plausible. This spontaneous thinking about dead people's mental states does not yet amount to a fully-fledged set of afterlife beliefs, which tend to include reincarnation or reward/punishment after death, but they make such beliefs plausible, and thus more likely to be culturally transmitted.[12]

The same may be true of teleology. While intuitive teleological thinking may have originated in reasoning about living things and artefacts, it may have

facilitated the generation and transmission of religious beliefs, including belief in fate and in creationism. In the next section, we provide a brief overview of the CSR literature on teleology.

Thinking teleologically

Young children and adults exhibit a tendency to think about objects and events as for a purpose. Research on teleological thinking has focused on significant life events and on features of the natural world. We here provide a review of this evidence, focusing on people's belief that things happen for a reason, and on their belief that natural kinds are created for a purpose. Both of these tendencies are often labelled 'promiscuous teleology', the tendency to over-attribute purpose. We show that teleological thinking is tenacious, although it can be subdued by education. The next section reviews some objections to promiscuous teleology.

People often attribute purpose to significant life events, both negative and positive, as if things happen for a reason, for example, they might attribute meeting their future partner by being seated next to them on a transatlantic flight as happening for a reason – they were seated together so they would meet and fall in love. Or, they might interpret a serious illness as a way to help them realise what truly matters to them. Such teleological causes are often attributed to supernatural agents or non-agential forces, such as karma or the universe. People realise there are non-teleological natural causes involved as well – the seating arrangement on the plane, or the genetic or environmental causes of illness. Cross-culturally this joint appeal to non-teleological natural and teleological supernatural causes happens frequently. South Africans explain AIDS individuals in particular as a result of supernatural agency, such as a curse by a witch, and naturalistic causes, in this case, infection with HIV.[13] Likewise, the Azande, an African small-scale society, know that termites are the natural cause for why granaries collapse, but in order to explain why *this* granary and not some other does so, and why it collapsed on *that* person, they appeal to purposeful agency, in particular witchcraft:

> The Zande knows that the supports were undermined by termites and that people were sitting beneath the granary in order to escape the heat and glare of the sun. But he knows besides why these two events occurred at a precisely similar moment in time and space. It was due to the action of witchcraft.[14]

Across cultures, people tend to regard supernatural explanations and material explanations as complementary rather than competing. While explicitly supernatural explanations emerge only in older children, probably as a result of cultural socialisation, five-year-olds already teleologically explain significant life events, for example, they happen so as 'to teach a lesson' or to 'send a sign'.[15] This indicates that teleological thinking about life events is an

early-developed tendency, later mediated by culturally transmitted belief systems, be they religious or non-religious.

Several studies have probed the relationship between religious beliefs and teleological explanations for life events in adults. Committed theists offer more teleological explanations for significant life events they encountered compared to committed atheists.[16] However, about a quarter of atheist participants do appeal to fate or the universe to explain such events, for example, 'I think this occurred as a way for the universe to show me that no matter what I thought my mission in life was, I was meant to be a person who lived my life for others and strives to make everything around me a little better and more kind and loving'.[17] Likewise, people, regardless of religious belief, give teleological explanations for life events, including half of the atheists, and three quarters of the theist participants.[18]

Taken together, this research indicates an enduring tendency to think teleologically about life events. It remains unclear, however, what cognitive capacities might underlie this tendency. Heywood and Bering speculate that teleological thinking is the application of ordinary social reasoning processes (where we might think that people do things for a reason) to life events. In other words, the way we think about people's motivations is extended to non-agential entities such as the universe.[19] However, findings about the relationship between mentalising and teleological thinking have been mixed: people who are better at social reasoning do not necessarily attribute more agency to fate or the universe, which one would expect if social reasoning lies at the basis of attributing teleology to life events.[20]

Kelemen argues that children and adults spontaneously exhibit a tendency to believe that objects, including natural objects such as clouds, trees or mountains, serve a purpose.[21] She terms this tendency 'promiscuous teleology', and contrasts it with 'selective teleology'. Selective teleology is the ability to use teleological reasoning in domains where this is appropriate.[22] These domains include artefacts and anatomical adaptations. For example, chairs are for sitting on and molars are for chewing with. Kelemen argues that people overextend teleology beyond artefacts and anatomical adaptations, hence 'promiscuous teleology'.[23]

In an early experiment that probed participants' teleological tendencies, children were presented with a particular object, such as a tiger. They were then offered two possible accounts for why the object is there. One was teleological: tigers are made for walking, for going in the zoo. The other was non-teleological: tigers are not 'for' anything, they just are. Children had to indicate which explanation they found more plausible. They tend to endorse teleological explanations for whole biological entities (e.g., tigers) more than adults do, whereas their endorsement for teleological explanations for artefacts are similar to adults. The two kinds of accounts in this experiment are not equivalent: one is an explanation, the other is not. Later studies have pitted teleological against non-teleological explanations for why objects such

as rocks and clouds exist. Some teleological functional explanations were self-serving, for example, 'the rocks were pointy so that animals wouldn't sit on them and smash them', whereas others were other-serving, for example, 'the rocks were pointy so that animals could scratch on them when they got itchy'. Non-teleological explanations appealed to causal processes, for example, 'rocks were pointy because bits of stuff piled up on top of one another for a long time'. Kelemen found that while American adults endorsed teleological explanations selectively for biological parts (e.g., the length of a giraffe's neck), children of six and seven years old applied it indiscriminately, using it also for non-biological natural kinds, such as rocks, mountains and clouds. Moreover, British and American schoolchildren do not differ in their tendency to assign purpose to whole objects and organisms.[24] Because the teleological stance is not specific to artefacts, but applies to a variety of objects, including natural kinds and (parts of) biological organisms, it is dubbed 'promiscuous teleology'.

In order to establish that teleological thinking is a deep-seated human tendency, one would have to show that it occurs cross-culturally. There have as yet not been any systematic studies that compare teleological thinking across cultures. However, there are some studies indicating that the tendency to overattribute teleology is not just present in western cultures, but also in China and Latin America. Rottman et al. investigated teleological thinking in Chinese adults, both under speeded and unspeeded conditions, that is, in conditions where one is put under time pressure versus those where participants can take their time.[25] Chinese adults tend to be low in religiosity, due to decades of state-encouraged atheism. Given the connection between theism and some forms of teleological thinking (in particular, about life events), this is a relevant population to test whether intuitive teleological thinking about objects is also present in a low-religiosity population. Chinese participants endorsed promiscuous teleological explanations, for example, they tend to endorse teleological explanations such as 'the earth has an ozone layer to protect it from UV radiation,' and this tendency increased when they were put under time pressure.

Western education can decrease the tendency to reason teleologically. One clue to the role of education in teleological thinking is the observation that adults offer fewer teleological explanations compared with children. One experiment examined the effects of Western formal schooling by looking at teleological reasoning in Romani adults who had attended school, and those who had not. Romani value practical skills and cultural traditions of their communities, which is why only a third of Romani primary school-age children are regularly enrolled in school in Romania. Romani adults with varying degrees of school exposure were presented with explanations for a wide range of phenomena, for example, sand might be grainy because 'bits of shells got broken up and mixed in making it that way' (mechanistic) or 'so that it wouldn't get blown away and scattered by the wind' (teleological).[26]

The tendency to endorse teleological explanations for non-biological natural kinds (such as sand) decreased with the number of years of schooling.

Secondary and tertiary education continue to decrease the endorsement of teleological explanations. Kelemen et al. compared to what extent people with different levels of education endorsed faulty teleological explanations such as 'germs mutate in order to become drug resistant'.[27] Participants included undergraduates, people from the greater Boston area (typically with a bachelor's degree) and holders of PhDs in either STEM subjects or humanities who are active scholars. Having a PhD further decreased teleological tendencies, regardless of whether it was in STEM or in the humanities.

More indirect evidence for the mitigating role of education was found in adults who were given teleological and non-teleological true-and-false explanations. Under speeded conditions, undergraduate students were more prone to endorse false teleological explanations (e.g., 'the sun radiates heat because warmth nurtures life'), but not false mechanistic explanations (e.g., 'hills form because floodwater freezes').[28] Adults with Alzheimer's show an increased tendency to endorse teleological explanations, for example, older adults without Alzheimer's tend to endorse that rain exists 'because water condenses into clouds and forms droplets', whereas Alzheimer's patients think rain exists 'so that plants and animals have water for drinking and growing', probably because Alzheimer's diminishes access to mechanistic explanations, the kind of explanations we acquire during education. Taken together, these studies suggest that teleological thinking is a cognitive default that we turn to in the absence of other explanations.

Critiques of promiscuous teleology

While evidence for promiscuous teleology is substantial, the hypothesis faces a number of difficulties. It has an epistemic normative flavour: people *inappropriately* extend teleology to domains where physical-causal explanations are more appropriate. Elqayam and Evans find this problematic since empirical evidence cannot arbitrate between competing normative theories.[29] At best, empirical evidence can be used to establish a certain cognitive tendency, in this case, the tendency to attribute teleology to a wide range of domains. This tendency can be gauged only descriptively, yet researchers like Kelemen seem to assume that promiscuous teleology is the result of a mistake; while it is a natural tendency, it needs to be corrected by education. Next to this, some of the causal-mechanistic explanations used in these experiments were plainly wrong, for example, 'rocks were pointy because bits of stuff piled up on top of one another for a long time' is a wrong explanation, and yet it is offered as a causal-mechanistic, more appropriate, alternative by Kelemen.

Kelemen realises that some philosophers and biologists hold that we can sometimes appropriately use teleological explanations for functional features

of organisms.[30],[31] For example, it would not be a mistake to say that giraffes have long necks so that they can eat the leaves that grow high up in trees, or so that the males can use their necks in fights with other males. But Kelemen insists that intuitive teleology is quite different from these scientific explanations: while authors like Neander and Mayr do not see natural selection as a process akin to intentional design, laypeople (and especially the child participants in her studies) assume that natural objects, including biological species, are intentionally designed.[32] Still, labelling this unlearned teleological thinking as promiscuous requires a substantial metaphysical assumption on the part of cognitive scientists, namely that there is no teleology in nature, except for local teleology at the functional level (which is what authors like Neander and Mayr accept). A biologist can rightfully maintain that leaves are there to provide energy and oxygen for plants, but this is not the same as venturing into Gaia beliefs, such as that the Amazon forest forms the lungs of the Earth, providing oxygen for us all. The latter would require some explanation of who does the providing (e.g., Gaia, Mother Nature). Cognitive scientists have no scientific framework for adjudicating whether Gaia and other supernatural teleological beliefs are sound. This falls outside of the remit of science, which is methodologically naturalistic.

Belief in supernatural agency, particularly in an agential nature (Gaia beliefs) predicts teleological tendencies in educated adults, including physical scientists and humanities scholars.[33] In a study in Finland and the US, participants were shown photographs of objects (e.g., giraffe, maple tree, mountain and paw of a tiger) and were asked if the object was 'purposefully made by some being'.[34] The study also included some control objects such as a pair of scissors and a cello because these would always have to yield 'yes'. Participants had to respond very quickly yes or no for each of these pictures. People who had a higher belief in God, or in the Earth as a purposeful agent (Gaia beliefs), had a higher tendency to judge that natural objects were made for a purpose. Among Finnish subjects, the idea that objects such as mountains would be purposefully made by some being was only 1% for atheists under unspeeded conditions, but it shot up to 23% when they were put under time pressure. To compare, Finnish religious participants endorsed 'made for a purpose' explanations in 25% of trials under unspeeded conditions, going up to 41% under time pressure. The idea that God or Gaia made natural objects for a purpose is in line with agential beliefs, and stating that these participants made a mere mistake means cognitive scientists were straying from the methodological boundaries of science. After all, a theist looking at a picture of a mountain might think the mountain is there to remind us of God's majesty. In this case, the theist, by her own lights, is not making a mistake.

Also, note that the mitigating influence of education on teleological thinking is a relatively recent phenomenon in Western culture. Until well into the nineteenth century, natural theologians and natural philosophers encouraged teleological thinking, linking the laws of nature to divine

providence and divine design. Paley's *Natural Theology*, which explains in teleological terms a variety of biological and astronomical features such as the function of the swim bladder in fish or the seasons, was a standard textbook in British universities during the first half of the nineteenth century.[35]

One can reinterpret promiscuous teleology in non-normative, purely descriptive terms, perhaps describing it as broad-scope teleology. Normativity is superfluous to evaluate empirical claims. It is sufficient to say that promiscuously teleological statements such as 'clouds are for raining' are at odds with Western scientific claims. Promiscuous or broad-scope teleology could then be described as the tendency to accept teleological explanations that are at odds with Western science, without judgments about their appropriateness.

Greif et al. are sceptical about promiscuous teleology and instead argue that people spontaneously apply teleology to artefacts only. Unlike the promiscuous teleology research, which pits alternative teleological and non-teleological explanations of the same event or object against each other, Greif et al. gave preschoolers the opportunity to ask open-ended questions about unusual-looking artefacts (such as the crullet, which allegedly makes playdough balls, or the garflom, which would flatten towels) and unfamiliar animals such as the tarsier, saiga, pangolin and civet.[36] Children asked about the names of artefacts and animals, for example, 'what is it called?' However, they asked animal-specific questions only for the animals, such as 'what does it eat?', 'where does it live?' and – tellingly –teleological questions only about the artefacts, for example, 'what do people use it for?' If children were genuinely promiscuous in their teleological thinking, one would expect them to ask such questions about the animals as well.

One possible explanation for this anomalous study is that the promiscuous teleology studies ask for explanations, whereas the open question design of Greif et al. looks at a much larger body of relevant knowledge, including ecological features (what an animal might eat and where it might live). When children are specifically asked to judge explanations for why particular objects or events occur, teleology comes to the foreground. This may be in part because mechanistic-causal explanations are more difficult to understand. Even for adults, mechanistic-causal knowledge is surprisingly shallow, for example, the vast majority of Americans do not know how climate change happens.[37] Likewise, people think they know how a helicopter, the tides or a zipper function, but when asked to explain this in detail they fall short – this persistent cognitive bias has been termed the illusion of explanatory depth.[38] When confronted with this lack of mechanistic knowledge, people revert to teleological explanations, a cognitive default that is flexibly deployed when other explanations are not available or do not seem appropriate. This flexible teleological stance also explains why theists and people with Gaia beliefs are more likely to endorse teleological explanations, both under speeded and unspeeded conditions. They do so because teleological explanations may

seem more appropriate or relevant to people who think certain agents (God, Gaia) act in the world.

Promiscuous teleology has further been criticised because it leads to two paradoxes. First, cognitive scientists assume that knowledge about the differences between animals and artefacts is innate[39]: grasping this distinction comes natural to infants, without instruction or demonstration on the part of their parents or the experimenters. Making this distinction is presumably a part of ordinary human development. In tension with this claim, promiscuous teleology seems to assume that young children are confused about these two domains. Second, the promiscuous teleology hypothesis seems to assume that western education is the sole means by which people learn to limit teleological reasoning to the appropriate domain of artefacts and perhaps parts of organisms. But there is significant cross-cultural evidence to show that people from non-Western cultures have sophisticated biological knowledge (ethnobiology), in some cases better than that of Western laypeople, particularly in the domain of ecology.[40] For example, Quecha farmers in Peru and Bolivia know that rain is important for agriculture. They use the mid-winter visibility of the Pleiades (June) as a guide for the amount of rain that is to be expected during the coming season, and postpone planting if the Pleiades are only dimly visible in the night sky. During an El Niño year, cirrus clouds are more abundant, which means that fewer stars of the Pleiades are visible.[41] The Quecha then anticipate that rains will come late and be sparse, and thus postpone planting potatoes for several weeks. They do not think that the Pleiades are 'for raining', but use the reliable relationship between star visibility and meteorological phenomena (in particular, less precipitation during an El Niño year) to guide their agricultural decisions.

As an alternative to promiscuous teleology, Ojalehto et al. propose what they term relational-deictic teleology, which they describe as 'teleological thinking about nature [that] reflects relational reasoning about perspectival relations among living things and their environments'.[42] This may suggest that teleology is not merely an unreflective stance, but that it can be sensibly deployed to look at different features of a local ecology. For example, one can observe that birds nest in trees. Intuitive teleological reasoning can help us see this relationship: the trees are 'for' birds to nest in. However, Ojalehto et al. did not demonstrate that people do not privilege teleological explanations. Rather, they hold that people might think teleologically in different ways, in that teleological thinking does not just seem to depend on taking an agential perspective. For example, the Nyishi (a North Indian small-scale society) have long known that hornbills nest in tree cavities (they traditionally wore cane helmets crested with a hornbill beak). From the perspective of a hornbill, tree cavities are there to build nests in. Thus, Nyishi think of tree cavities as being 'for' hornbills to build their nests in. This tracks an appropriate ecological relationship in teleological terms. Contemporary Western ecologists find such teleological reasoning equally useful. For example, increasing traffic and the

resulting noise pollution forces Western scrub jays *(Aphelocoma californica)* to leave their native pine tree forests, and this explains why pine trees are no longer doing well in California. These birds cache pine seeds for their own consumption, but as they forget many cache sites, this behaviour helps pine trees to spread.[43] For an ecologist, it is useful to teleologically think of these birds as fulfilling a valuable ecological function: spreading the seeds of the pine trees, even though it is misleading to say scrub jays are there 'for' the spread of pine seeds. Contrary to what some cognitive scientists argue, namely that teleological reasoning is promiscuous, it can be useful for practicing scientists in clarifying ecological relationships.

Thus, taking into account the recent empirical evidence for promiscuous teleology and some recent criticisms, we find that teleological reasoning is not a passive tendency, but that it can be modulated by a variety of cultural factors and beliefs. In this way, teleological reasoning can play a positive role in structuring our knowledge about the world, for example, in predictions about upcoming precipitation and in elucidating ecological relationships. In the next section, we consider Kant's views on teleology in the third *Critique*, which we draw upon to answer the normative question of whether intuitive teleology is promiscuous.

Kant's views on teleology

Kant's views on teleology can be situated in a historical context of natural philosophers trying to make sense of teleology in the absence of Aristotelian final causes. Aristotle's theory of causation was widely used until the late Middle Ages to explain adaptiveness in nature. For example, why are our incisors suitably shaped to tear food, and why are our molars shaped so as to enable us to chew? Aristotle argued that one has to look at the function of teeth to understand why this is the case: our teeth were not simply shaped by chance, but by their function. Throughout Antiquity and the Middle Ages, this idea of teleology was widely accepted (see Boulter, this volume). Each object, natural or biological, has its own teleology. It is in the teleology of a walnut to grow into a nut tree. Not all walnuts grow into trees, but only walnuts (not, say, chestnuts) grow into walnut trees, because they have the potential to do so.

In the seventeenth century, Aristotelian final causes were replaced by universal laws of nature. Particularly in the domain of physics, authors such as Isaac Newton, John Ray and Robert Hooke no longer explained the behaviour of objects as a result of their natures and their inherent teleology, but rather as a result of general laws of nature that could be indiscriminately applied to every object. This mechanistic world view privileged efficient causation at the expense of final causation.[44] However, the life sciences did not, at the time, fit neatly in this picture. How do laws of nature explain that poppy seeds grow into poppies, rather than daisies?

Natural theology was one solution to make teleology more intelligible: the reason that body parts seem so well adapted to fulfil their function, such as the eye which seems fit for seeing, is that God designed the world as a complex and intricate machine. Authors such as Bernard Nieuwentijdt,[45] and later William Paley, likened nature to a clock or watch, intricate and well-designed to fulfil its purpose. The design argument thus served an epistemic function, helping natural theologians to make sense of teleology in a world without final causes. However, as we have argued elsewhere, there is an asymmetry between the design argument and intuitive teleological thinking.[46] Intuitive teleology gives the design argument its appeal, but intuitive teleology can survive without the design argument. Even without reference to a divine designer, people still discern teleology in nature. Moreover, teleological thinking is spontaneous, but inference to a designer is not.[47] Further, the link between theism and teleology is inconsistent: some studies find increased teleology in theists, whereas others do not.

Outside natural theology, the design argument was deemed problematic because it relies on an inductive inference about human-made objects, which are designed for a purpose, and natural objects, which, by analogy, presumably are also designed for a purpose.[48] Moreover, it has a certain circularity, because the design argument explains teleology by invoking God (an intelligent designer), while arguing for the existence of God on the basis of the teleology that is observed. As Kant remarked:

> Thus if we introduce the concept of God into the context of natural science in order to make the purposiveness in nature explicable, and then in turn use this purposiveness to prove that there is a God, then neither natural science nor theology is intrinsically firm; a vicious circle makes both uncertain, because they have allowed their boundaries to overlap.[49]

There were several alternatives to the design argument to explain teleology in nature in the seventeenth and eighteenth centuries. The main theories on offer were *evolution* and *epigenesis*. (Note that these terms had a different meaning to their meaning today.) Evolution and epigenesis were proposed by natural philosophers and physicians to explain embryological development. Due to the decline of the scholastic view that each kind of object has its own nature and propensities, the fact that fern spores grow into ferns could no longer simply be explained by final causes (that it is in the nature of fern spores to grow into ferns), but had to be explained by reference to general laws. Evolutionists such as Jan Swammerdam argued that embryonic development occurred because gametes already contained all the information of the adult state. By contrast, epigeneticists such as Johann Blumenbach argued that embryos are formless, but that their development is guided by a *Bildungstrieb*, a unified biological force that explained phenomena such as regeneration (of polyps and other primitive organisms), the repair of wounds and embryonic development. Blumenbach emulated Newtonian physics, providing a set of

laws that explained how the *Bildungstrieb* functions, for example, it was stronger in younger organisms, and worked with varying degrees on different organs.[50]

This is the intellectual backdrop for the third *Critique*. Its second part, the *Critique of Teleological Judgment*, probes whether it is legitimate to think about nature in teleological terms. Although Kant was enthusiastic about the Newtonian project for physics, he was sceptical of Blumenbach's theory (with which he was familiar)[51]; he did not think that Newtonian forces could explain living things. At best, the *Bildungstrieb* was a heuristic device.[52]

Why do we have this heuristic? According to Kant, 'Natural purpose is not a constitutive concept either of understanding or of reason.'[53] In line with the work in cognitive science that shows people have a tendency to discern teleology in nature, Kant affirmed that we conceive of animals and plants in terms of natural purposes because of the way our cognitive faculties work. As human beings, given the cognitive capacities we have, we cannot but conceptualise living things in teleological terms. *We* impose teleology on nature, even though we shouldn't.[54]

The third *Critique* argues against the use of teleological principles in formulating biological laws which go beyond the use of teleology as a heuristic device. Kant thought that natural science could only legitimately use mechanistic laws and not teleology. In this he dismissed contemporary teleological scientific theories, such as Blumenbach's, which refer to end-states to explain how biological forces such as the *Bildungstrieb* operate. For example, to explain embryonic growth or the repair of a wound, one needs to make reference to the adult, unblemished state of the organism. While Kant recognized the heuristic force of the *Bildungstrieb* because it used Newtonian principles to explain biological phenomena, he also thought that the use of teleology to explain mechanical nature was inappropriate. As a result, he refused to recognise biology as part of the sciences; it was not a *Wissenschaft* – at most, it was a *Naturlehre*, a collection of generalisations.[55]

Kant's pessimism about biology is encapsulated in the following statement:

> [W]e may boldly state that it is absurd for human beings even to attempt it, or to hope that perhaps some day another Newton might arise who would explain to us, in terms of natural laws unordered by any intention, how even a mere blade of grass is produced.[56]

This statement has received a lot of scrutiny. In particular, the question remains whether evolutionary theory would satisfy Kant's requirements of providing an explanation for the apparent teleology in nature without any appeal to God, but purely with reference to mechanistic causes. As we have seen, a number of contemporary biologists and philosophers of biology talk confidently about teleology. While Mayr's teleonomy does not state that organisms are designed, he nevertheless acknowledges features of goal-directedness in organisms, particularly in adaptive design. In philosophy of

biology, neo-teleology has a concept of normative function: the function of a heart is to pump blood, and it has acquired this function as a result of its evolutionary history. However, there is continued discussion on whether using such teleological talk is correct. Cummins argues there is a problem with inferring function as a result of past selective pressures.[57] We could claim that the function of the human hand is to manipulate tools. But at some point in our evolutionary history, hominins had hands that were not used to manipulate tools, as they had not yet begun to fashion stone tools. The same can be said about other examples of adaptations such as wings. The first, rudimentary wings in vertebrates did not develop for flying, but likely for capturing small prey, leaping and sliding or gliding. Flight developed only later, after the evolution of wings.[58]

Kant argued that talk about teleology can be a useful heuristic, but can never capture real biological properties. His views on teleology as a heuristic can also shed light on intuitive teleology, as our concluding section will intimate.

Conclusion

Kant's remarks about teleology and his concept of the transcendental illusion provide resources to think about intuitive teleology and its role in human cognition. The claim that intuitive teleology is promiscuous is a normative claim based on psychological findings. Authors such as Kelemen have argued that children and adults without schooling or without access to acquired causal mechanistic explanations (due to time pressure or Alzheimer's) improperly attribute teleology to natural kinds, for example, clouds are for raining, mountains are for climbing. Such normative claims are problematic because one cannot straightforwardly derive a normative claim from descriptive psychological results, because this normative claim is not based on psychological results, but on a metaphysical framework that goes beyond the scope of the sciences: cognitive science cannot adjudicate whether supernatural agents exist. At best, one can argue that teleological thinking is persistent, occurs for both biological properties and non-biological natural kinds and is modulated by education. It appears to be a cognitive default that people turn to in the absence of causal mechanistic explanations. Moreover, ethnobiology (see third section) shows that teleological thinking can be useful and sophisticated.

Taking a Kantian perspective, one could argue that intuitive teleology regulates and structures our cognition by helping us to make sense of biological relationships and functions. This is why, unsurprisingly, teleological thinking has resurfaced within evolutionary theory in the form of adaptive design. For example, eyes evolved across many taxa because it is useful for animals, living on a planet with a central light source (the sun), to capture light waves that allow them to more easily navigate, hunt prey, evade predators and find conspecifics. The statement 'eyes are for seeing' helps to

capture these adaptations. It also explains why teleology can play a positive role in ecology. For example, while the ozone layer is not actually there to protect us from harmful UV radiation, it seems intuitive to think that it serves this purpose, and the (incorrect) teleological inference 'the ozone layer exists to protect us from harmful UV radiation' does capture an actual relationship between the ozone layer and life on Earth, namely that most life forms on this planet could not exist if it were not for the protective effects of the ozone layer.

To conclude, intuitive teleology is an explanatory default, which plays a useful role in cognition, but competes with culturally acquired causal mechanistic explanations. Kant believed that teleology had a separate role in our cognition, and that it was inevitable, given our cognitive makeup, that we would continue to appeal to teleological explanations. Future work on teleology could expand this Kantian framework, as outlined in the third *Critique*, by further exploring the positive heuristic role of teleology in evolutionary and ecological thinking.

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