Cognitive Psychology 107 (2018) 22–43

Contents lists available at ScienceDirect

Cognitive Psychology

journal homepage: www.elsevier.com/locate/cogpsych

Structure-function fit underlies the evaluation of teleological explanations

Emily G. Liquin*, Tania Lombrozo

Department of Psychology, Princeton University, Princeton, NJ 08540 USA

ARTICLE INFO

Keywords:
Explanation
Teleology
Causal reasoning

ABSTRACT

Teleological explanations, which appeal to a function or purpose (e.g., "kangaroos have long tails for balance"), seem to play a special role within the biological domain. We propose that such explanations are compelling because they are evaluated on the basis of a salient cue: structure-function fit, or the correspondence between a biological feature's form (e.g., tail length) and its function (e.g., balance). Across five studies with 852 participants in total, we find support for three predictions that follow from this proposal. First, we find that function information decreases reliance on mechanistic considerations when evaluating explanations (Experiments 1–3), indicating the presence of a salient, function-based cue. Second, we demonstrate that structure-function fit is the best candidate for this cue (Experiments 3–4). Third, we show that scientifically-unwarranted teleological explanations are more likely to be accepted under speeded and unspeeded conditions when they are high in structure-function fit (Experiment 5). Experiment 5 also finds that structure-function fit extends beyond biology to teleological explanations in other domains. Jointly, these studies provide a new account of how teleological explanations are evaluated and why they are often (but not universally) compelling.

1. Introduction

When the French naturalist Sonnerat described the peculiar primate that he encountered in Madagascar in the early 1780s, he emphasized its thin, elongated middle finger (Owen, 1863). We now know that this creature – the aye-aye – taps along logs to find grubs, and then uses its skinny finger to extract them. But local legends tell a different story. For example, the Sakalava people believe that the aye-aye enters houses through thatched roofs during the night to murder the sleeping humans within, using its elongated finger to cut the aortic vein of its victim (Goodman & Schütz, 2000).

What these evolutionary and traditional explanations for the aye-aye's elongated finger have in common is an appeal to *function*. They both support teleological explanations for a biological trait: that the aye-aye has a long finger to extract grubs, or that the aye-aye has a long finger to cut aortic veins. Such explanations, which appeal to a purpose, function, or goal, contrast with mechanistic explanations, which instead explain the presence of some trait by appeal to parts or causal processes, such as genes or natural selection.

While most agree that biological adaptations (such as the aye-aye's finger) can in fact be explained teleologically, mechanistically, or with both forms of explanation at once (e.g., Allen, 2009; Ayala, 2007), there's evidence that teleological explanations are favored in the biological domain. In explaining biological traits, both children and adults typically favor teleological explanations (e.g., that eyes exist "so people and animals can see") over mechanistic alternatives (e.g., that eyes exist "because bodies have special cells that

* Corresponding author.
E-mail addresses: eliquin@princeton.edu (E.G. Liquin), lombrozo@princeton.edu (T. Lombrozo).

https://doi.org/10.1016/j.cogpsych.2018.09.001
Accepted 28 September 2018

combine to produce eyes"; Kelemen & DiYanni, 2005; Lombrozo, Kelemen, & Zaitchik, 2007). Moreover, across domains, there's evidence that teleological explanations may be less cognitively demanding: they are accepted more often under speeded conditions (Kelemen & Rosset, 2009; Kelemen, Rottman, & Seston, 2013) and by people who engage in less reflective thinking (Zemla, Steiner, & Sloman, 2016). These findings provide some empirical support for a claim by Richard Dawkins: that "we humans have purpose on the brain. We find it difficult to look at anything without wondering what it is 'for,' what the motive for it or the purpose behind it might be" (Dawkins, 1995, p. 81).

In the current paper, we explore one hypothesis for why teleological explanations play a special role in explaining biological adaptations. The motivating idea, suggested by Lombrozo et al. (2007), is that a good "fit" between a biological trait and some function provides a cue to the adequacy and quality of a teleological explanation. So, for example, the "fit" between an elongated finger and grub-extraction provides support for the idea that the aye-aye's finger evolved to extract grubs, and can thus be explained by appeal to this function. Of course, this inference is imperfect (and thus defeasible): noses have a good fit to the function of holding up glasses, but they did not evolve to do so, and thus cannot be explained by appeal to this function. So while good structure-function fit may offer support for a teleological explanation, additional reflection (and in some cases, additional causal knowledge) will sometimes reveal that a teleological explanation is in fact unwarranted.

Across five experiments, we evaluate our hypothesis that structure-function fit provides a basis for evaluating teleological explanations. Before turning to our experiments, however, we provide a brief review of past research to motivate the three specific predictions of this hypothesis that we go on to test.

1.1. Teleological versus mechanistic explanations

The notion that people explain the world through different lenses has roots in Aristotle's four causes – the material cause, the formal cause, the efficient cause, and the final cause. The latter two correspond roughly to the distinction between mechanistic explanations and teleological explanations: the efficient cause is that which brings about the thing being explained, and the final cause provides the purpose for which a thing exists (Falcon, 2015). Dennett (1971) makes a related distinction in characterizing multiple "stances" that one can adopt in understanding and predicting a system's behavior: the physical stance allows interpretation in terms of causal mechanisms, while the design stance allows interpretation in terms of function and design. Keil (1994, 1995) similarly argues for multiple "modes of construal," available even to young infants, by which we interpret the world.

Research has demonstrated the psychological reality of these different "stances" or "modes" as reflected in different forms of explanation. *Mechanistic explanations*, which refer to the causal mechanism producing the thing to be explained, and *teleological explanations*, which refer to the function or purpose of the thing to be explained, have been shown to involve different types of reasoning and to produce different downstream cognitive effects. In particular, mechanistic and teleological explanations involve different causal commitments (Lombrozo & Carey, 2006), and encourage different criteria for causal ascription (Lombrozo, 2010). They also support different patterns of categorization (Lombrozo, 2009; see also Ahn, 1998) and generalization (Lombrozo & Gwynne, 2014), align with different goals (Vasilyeva, Wilkenfeld, & Lombrozo, 2017), and are differentially memorable across domains (Gwynne & Lombrozo, 2010).

Although teleological and mechanistic explanations have unique psychological profiles, they both seem to be treated as fundamentally causal. Within philosophy, Wright (1976) proposed that teleological explanations are implicitly causal, where the function they appeal to must have played a causal role in bringing about the thing being explained (see also Allen, 2009). As an example, we might explain why aye-ayes have a long, skinny finger by appeal to its role in extracting grubs. This is appropriate because long, skinny fingers were maintained and spread within the ancestral population of aye-ayes *because* this trait facilitated grub extraction (and thus led to differential reproductive success). Lombrozo and Carey (2006) examined whether people take this criterion into account when judging the acceptability of a teleological explanation. They found that people in fact rely on two criteria to judge the acceptability of a teleological explanation: first, the function must have played a causal role in bringing about the thing being explained (consistent with Wright's proposal) and second, the process by which the function did so must be perceived as generalizable.

1.2. The allure of teleological explanations

As the quote by Dawkins suggests, teleological explanations may hold some special, intuitive appeal. This perspective has been advocated most forcefully by Kelemen and colleagues, who have developed a position called "promiscuous teleology." Descriptively, the claim is that teleological explanations are not restricted to particular circumscribed domains, but instead are applied and favored "promiscuously" across domains. Much of this work uses endorsement of "scientifically unwarranted" teleological explanations – such as "rocks are pointy so that animals won't sit on them" – to measure teleological bias. Children across several cultures robustly endorse these unwarranted teleological explanations (Kelemen, 1999c, 1999d, 2003; Schachner, Zhu, Li, & Kelemen, 2017), and they are also quite prevalent among adults in other cultures who have not been exposed to western education (Casler & Kelemen, 2008; Sánchez Tapia et al., 2016).

At a processing level, promiscuous teleology could be underwritten by a "developmentally persistent cognitive default" to interpret the world in terms of functions (Kelemen et al., 2013, p. 1075). One source of evidence for this idea is that under speeded conditions, adults make the mistake of accepting unwarranted teleological explanations rather than (for instance) rejecting warranted teleological explanations (Kelemen & Rosset, 2009; Rottman et al., 2017). Even professional physical scientists exhibit this pattern of errors (Kelemen et al., 2013). Endorsement of unwarranted teleological explanations is also more widespread among people who