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Brief article

The Human Function Compunction: Teleological explanation in adults

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ABSTRACT

Research has found that children possess a broad bias in favor of teleological – or purpose-based – explanations of natural phenomena. The current two experiments explored whether adults implicitly possess a similar bias. In Study 1, undergraduates judged a series of statements as "good" (i.e., correct) or "bad" (i.e., incorrect) explanations for why different phenomena occur. Judgments occurred in one of three conditions: fast speeded, moderately speeded, or unspeeded. Participants in speeded conditions judged significantly more scientifically unwarranted teleological explanations as correct (e.g., "the sun radiates heat because warmth nurtures life"), but were not more error-prone on control items (e.g., unwarranted physical explanations such as "hills form because floodwater freezes"). Study 2 extended these findings by examining the relationship between different aspects of adults' "promiscuous teleology" and other variables such as scientific knowledge, religious beliefs, and inhibitory control. Implications of these findings for scientific literacy are discussed.

1. Introduction

As debates about teaching Intelligent Design in American Schools illustrate, there exists substantial popular resistance to scientific ideas. While many factors contribute to such resistance, part of the explanation may be found in various conceptual biases (e.g., Bloom & Skolnick Weisberg, 2007; Evans, 2000; Gelman, 2003; Kelemen, 1999a; Rosset, 2008; Shtulman, 2006). Among these is an early emerging "promiscuous" teleological tendency to explain all kinds of natural phenomena by reference to a purpose. For example, from preschool, children attribute functions to entities like lions, mountains, and icebergs, viewing them as "made for something" (Kelemen, 1999a). When asked about properties of natural entities like pointy rocks, children prefer teleological explanations over physical–causal ones, endorsing that rocks are pointy "so that animals won't sit on them", not because "bits of stuff piled up over time" (Kelemen, 1999b; but Keil, 1995). Among school-aged children, such teleological intuitions explicitly link to beliefs about intentional causality in nature (Kelemen & DiYanni, 2005) with children's ideas not straightforwardly explained by parental explanations (Kelemen, Callanan, Casler, & Pérez-Granados, 2005) or ambient cultural religiosity (Kelemen, 2003).

Adults, of course, do not show much overt sign of sharing children's beliefs about the intrinsic functionality of icebergs or a rock's sharp edges. Presumably then, children readily outgrow such fanciful purpose-based ideas, especially as their familiarity with ultimate causal explanations increases. Indeed, research with college-educated adults seems to support this trajectory. When tested on child-appropriate tasks, they eschew children's broad teleological endorsements, restricting functional ascriptions to body parts and artifacts (Kelemen, 1999a; Kelemen, 1999b; Kelemen, 2003).

Despite this, however, recent findings hint that "promiscuous teleology" may not be a passing stage of immaturity. For instance, research using child-assessment materials that compared Alzheimer's patients to healthy controls found that teleological intuitions reassert themselves when the coherence of causal knowledge is eroded

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by disease (Lombrozo, Kelemen, & Zaitchik, 2007). This raises the possibility that rather than being part of a childhood stage, teleological explanation remains an explanatory default throughout development. That is, while the acquisition of scientifically warranted causal explanations might suppress teleological ideas, it does not replace them. This "co-existence" position makes a prediction: Even healthy, schooled adults should display scientifically unwarranted promiscuous teleological intuitions when their capacity to inhibit more primary purpose-based intuitions is impaired by processing demands. To test this, we asked undergraduates to judge the correctness of warranted and unwarranted explanations of various natural phenomena under speeded conditions.

2. Study 1

2.1. Method

2.1.1. Participants

Participants were 121 university students, randomly divided into one of three conditions: fast speeded ($n = 42$), moderately speeded ($n = 40$), and unspeeded ($n = 39$). Science class background did not differ across groups. Participants averaged 2.5 (SD = 2) completed college science classes.

2.1.2. Procedure

In a classroom setting, groups of 5–10 participants read through the instructions with an experimenter. For the two experimental (i.e., speeded) conditions, these indicated that participants would see explanations for "why things happen" appear one at a time on an overhead screen, and that they were to decide whether the sentence described a correct ("good") or incorrect ("bad") explanation by checking the appropriate box on an answer sheet. The experimenter explicitly stated in her instructions that "by *good* we mean *correct*" and offered non-teleological examples of both "good" and "bad" explanations so that the "correct" versus "incorrect" contrast was clear. The conversational terms "good" and "bad" were selected as response options rather than "correct" and "incorrect" because of methodological issues associated with asking for speeded judgments that require negation of the alternative response option. Control (i.e., unspeeded) participants followed the same procedure but read the sentences directly on the answer sheets.

2.1.3. Stimuli

Stimuli were 80 sentences describing simple explanations for why things happen: 26 test sentences and 54 control sentences. The test sentences described scientifically unwarranted purpose-based explanations for biological (e.g., "ferns grow in forests because they provide ground shade"; $n = 10$) and non-biological (e.g., "the sun radiates heat because warmth nurtures life"; $n = 16$) natural phenomena. Table 1 provides samples.

Four types of control sentences were designed to track participants' abilities to evaluate sentences at speed. Two types were "good" explanations that were either teleological ($n = 8$; e.g., "stoplights change color because they control traffic") or causal ($n = 24$; e.g., "water freezes because the temperature drops"). Two types involved unwarranted, incongruous "bad" explanations that were either teleological ($n = 6$; e.g., "animals grow ears because they need to smell things") or causal ($n = 16$; e.g., "polar bears are white because the sun bleaches them"). Test items included, there were equal numbers of teleological versus causal explanations and explanations meriting "good" versus "bad" judgments.

Speeded sentences were presented consecutively in one of two orders, using PsyScope software (Cohen, MacWhinney, Flatt, & Provost, 1993). Each sentence remained on screen for either 3200 ms (fast speeded condition) or 5000 ms (moderately speeded condition) after which the next sentence appeared automatically. A pause, indicated by an "*" and ended by the experimenter's keypress, was inserted every 10 sentences to prevent people from losing their place due to a missed item and to give time to turn the page. The stimuli were divided into 10 blocks of 10 sentences each. Each block contained seven control sentences (two teleological, five causal) and three teleological test sentences. Two blocks of practice items were excluded from analyses.

Table 1
Sample items included in both Study 1 and 2 (presented with Study 2 phrasing and using Study 2 item type labels).

Explanation type	Test items
Implicit biological	Earthworms tunnel underground to aerate the soil Mites live on skin to consume dead skin cells Mosses form around rocks to stop soil erosion
Explicit biological	Finches diversified in order to survive Germs mutate to become drug resistant Parasites multiply to infect the host*
Implicit non-biological	The sun makes light so that plants can photosynthesize Water condenses to moisten the air Molecules fuse in order to create matter
Explicit non-biological	Earthquakes happen because tectonic plates must realign Geysers blow in order to discharge underground heat The earth has an ozone layer to protect it from UV light*
Explanation type	Control items
Good physical	Flowers wilt because they get dehydrated Bread rises because it contains yeast People get the flu because they catch a virus
Bad physical	Zebras have black stripes because they eat coal Gusts of wind occur because animals exhale together Clouds form because bits of cotton collect together
Good teleological	Children wear gloves to keep their hands warm Teapots whistle to signal the water is boiling People buy vacuums because they suck up dirt
Bad teleological	Cars have horns to illuminate dark roads Eyelashes developed so that people can wear mascara Mothers kiss babies in order to scare them

* Item appeared in Study 2 only.