FlashReports

Science and God: An automatic opposition between ultimate explanations

Jesse Preston [a,*], Nicholas Epley [b]

[a] Department of Psychology, University of Illinois at Urbana-Champaign, 603 E Daniel St. Champaign, IL 61820, USA
[b] University of Chicago, 5807 South Woodlawn Avenue Chicago, IL 60637-1610, USA

ABSTRACT

Science and religion have come into conflict repeatedly throughout history, and one simple reason for this is the two offer competing explanations for many of the same phenomena. We present evidence that the conflict between these two concepts can occur automatically, such that increasing the perceived value of one decreases the automatic evaluation of the other. In Experiment 1, scientific theories described as poor explanations decreased automatic evaluations of science, but simultaneously increased automatic evaluations of God. In Experiment 2, using God as an explanation increased automatic evaluations of God, but decreased automatic evaluations of science. Religion and science both have the potential to be ultimate explanations, and these findings suggest that this competition for explanatory space can create an automatic opposition in evaluations.

© 2008 Elsevier Inc. All rights reserved.

Recent debates over intelligent design theory in science education have brought long-standing conflicts between science and religion back into public attention. On the surface, religion and science may seem to be very different domains: science is directed toward the understanding of physical systems, and religion is concerned with more intangible spiritual and moral issues (Gould, 1999). Some scientists suggest that science and religion can be reconciled as compatible belief systems (Collins, 2006). Others, meanwhile, are more skeptical and argue that the two ideologies are inherently opposed, and that belief in one necessarily undermines belief in the other (Dawkins, 2006; Zukav, 2001).

Although science and religion do not always conflict, a frequent source of tension concerns the competition for explanatory space. Religion and science offer different explanations for a wide array of phenomena, including some of the most fundamental human issues (e.g. intelligent design vs. natural selection). This direct opposition may cause the value of religion and science to become inversely related when these explanations are brought into mind. In the present research we investigate whether the evaluation of science and religion may be automatically opposed, such that increasing the perceived value of one as an explanatory system diminished automatic positive evaluations of the other.

Explanation and belief

Causal explanations enable people to understand and predict the world around them. Unexpected or unusual events automatically prompt a search for causes (Weiner, 1985), and causal infer-

ences can be generated spontaneously with little effort by the thinker (Hassin, Bargh, & Uleman, 2002). All explanations are not created equal, however, and people prefer those that appear most simple and coherent (Lombrozo, 2007). Explanations gain cognitive support and psychological value as they appear to explain more observations with fewer causes (Keil, 2006; Preston & Epley, 2005), especially those that explain diverse effects that are branched far apart on a causal tree (Kim & Keil, 2003). In contrast, alternate explanations for the same effects may possess a negative association between them (Thagard, 2006), such that the perceived validity of one can impact the perceived validity of the other (Sloman, 1994). Just as it is impossible to believe a single proposition to be both true and false simultaneously (Gilbert, 1991), it may be impossible to hold two competing explanations as both true (or both false) simultaneously. As a result, the availability of one plausible explanation may therefore diminish the perceived value of another (Morris & Larrick, 1995).

As broad explanatory systems, religion and science each provide answers to a wide array of fundamental questions and concerns, and so each have strong explanatory value. However, these belief systems often provide different explanations for the same phenomena, and this competition for explanatory space can trigger conflict. Instances of this recurring conflict can be found throughout history. Advances in scientific theories that contradict religious explanations can threaten these beliefs and are often met with resistance. Conversely, when scientific explanations are poor, the value of religious explanations may be enhanced. The central argument of intelligent design theory is to point out gaps or failings in scientific explanations, thereby enabling explanations based on other (generally divine) causes. This is sometimes called the *God of the Gaps* argument (Lupfer,

* Corresponding author. Fax: +1 217 244 5876.
E-mail addresses: jlp@cyrus.psych.uiuc.edu, jpresto@uwo.ca (J. Preston).

Tolliver, and Jackson (1996))—where science cannot explain, God is invoked as a cause.

Compounding this conflict, both religion and science can be used as *ultimate explanations*—primary causes that account for all events, but rely on no further underlying mechanisms. Most modern day religions depict God as the "unmoved First Mover" that is the ultimate cause of everything but itself has no cause. Science theoretically promises a method for understanding all of one's natural observations, with the principal goal to uncover the mechanisms that underlie all known phenomena. The search for the *theory of everything*, a single equation that would be able to describe all aspects of matter and physics without appealing to any deeper explanatory base, has been dubbed the holy grail of physics (Barrow, 1992) in a nod to the anticipated meaning that such an equation would provide. Conflict between science and religion over this prime explanatory space may create a negative association between the two, such that the value of one may be inversely related to the automatic evaluations of the other. Enhancing the apparent explanatory power of scientific explanations may automatically decrease positive evaluations of religion, and vice versa. Likewise, apparent *weakness* in scientific explanations may increase positive evaluations of religion, and vice versa. This research investigated whether people's automatic evaluation of concepts related to science and religion would indeed show evidence of such automatic opposition.

The present research

We manipulated, in two experiments, the perceived value of either science or God as an ultimate explanation, and then measured automatic attitudes toward science and religion using a semantic priming procedure with a categorization task. (Fazio & Olson, 2003). Explicitly reported attitudes toward science and religion may be well-formed and resistant to change, but previous research demonstrates that causal discounting does not require explicit evaluation of alternatives and can occur outside of conscious awareness (Oppenheimer, 2004). Before one has the opportunity to consciously consider whether the two are logically opposed or engage in effortful reconciliation we predicted that automatic evaluations of science and religion would diverge spontaneously.

Experiment 1 investigated the use of scientific theories as ultimate explanations. We were interested in questions of origin that might be explained by a creator, specifically the origin of the universe and the origin of life on Earth. We predicted that better theories would increase automatic positive evaluations of science, whereas weaker theories would decrease these evaluations. More important, we predicted that evaluations of God should be inversely related to the explanatory power of these scientific theories. Experiment 2 investigated whether manipulating the perceived value of a religious explanation would produce the opposite interaction, increasing positive automatic evaluations related to religion but decreasing those related to science.

Experiment 1: Scientific origins

Participants

One hundred twenty-nine six volunteers from The University of Chicago, The University of Western Ontario, and Harvard University agreed to participate in exchange for $5 or for partial course credit.

Procedure

Participants were seated in a private lab room in front of a computer. All instructions were given on the computer. Participants read two passages that briefly described the Big Bang Theory and the Primordial Soup Hypothesis. In the Strong Explanation condition, each passage concluded with a statement that "this was the best scientific theory on the subject to date, and does much to account for the known data and observations." In the Weak Explanation condition, each passage concluded with a statement that "this was the best scientific theory on the subject to date, but it does not account for the other data and observations very well, and raises more questions than it answers." Participants were asked, for each passage, to choose the best title from two options.

Evaluation task

Participants completed a semantic priming paradigm with a categorization task (Fazio & Olson, 2003). Positive (e.g. "EXCELLENT") or negative (e.g. AWFUL) target words appeared on the computer screen. Participants were asked to classify the words as positive or negative as quickly as possible by pressing a computer key. Each trial included a 250 ms premask (XXXXXX), a 15 ms presentation of a prime word (either "God" or "Science", or a control prime "Hat"/"Window"), and a 50 ms post-mask (XXXXXX). After the post-mask disappeared, the target word appeared and remained until participants classified it as positive or negative. The procedure included 120 randomly ordered trials: 20 for each prime type and target value.

Results

Reaction times were submitted to a 2 (Prime: God/Science) × 2 (Target Valence: Positive/Negative) × 2 (Explanatory Power of Science: Weak/Strong) ANOVA with repeated measures on the first two variables. The predicted three-way interaction was significant, $F(1,127) = 17.93$, $p < .001$. We simplified this three-way interaction by subtracting the mean reaction time to positive targets from mean reaction time to negative targets for each specific prime word to create an automatic attitude index toward Science vs. God. Thus, greater numbers of this scale denote more positive evaluations of the targets (see Fig. 1). In the Strong Explanation condition automatic evaluations of science were more positive than evaluations of God, $F(1,127) = 9.56$, $p < .001$. The reverse relationship was found in the Weak explanation condition, associations with God were significantly more positive than associations with science, $F(1,127) = 8.37$, $p < .001$.
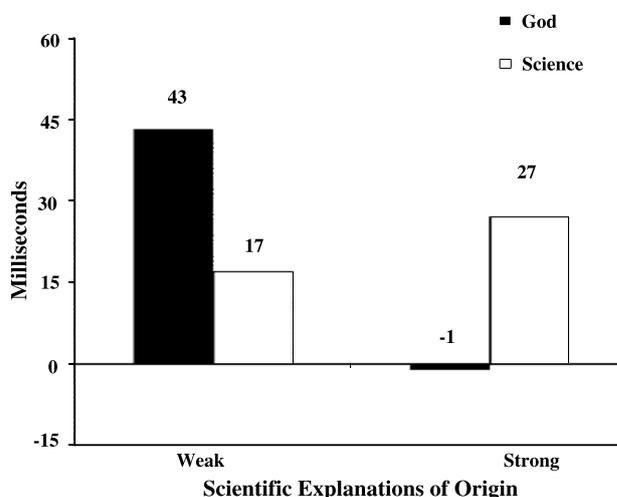

Fig. 1. Automatic evaluations of Science and God by explanatory power of Science, Experiment 1.

Experiment 2: Divine origins

A similar automatic opposition between religious and scientific beliefs should be observed by altering the perceived value of religious explanations (Preston & Epley, 2005). For example, a person who actively uses religious explanations in daily life may not find science particularly useful. But, if one begins to feel doubt or loses meaning for God, belief in science may be bolstered as a result. Experiment 2 examined whether using God as an ultimate explanations could create an automatic opposition between Science and God.

Participants

Twenty-seven undergraduates from Harvard University volunteered to participate for partial course credit.

Procedure

Participants were seated in a private laboratory room in front of a computer. Participants in the explanation condition were instructed to: "list SIX things that you think God can explain." Participants in the control condition were given the instructions: "list SIX things that you think can explain or influence God." Existing research demonstrates that this manipulation can influence the subjective value of religious beliefs, with those using God to explain other events reporting that religion is significantly more meaningful and important to them than those identifying events that could explain God's actions (Preston & Epley, 2005). All responses were typed into the computer. Participants then completed the semantic categorization task, as in Experiment 1.

Results

Reaction times were submitted to a 2 (Prime: God/Science) × 2 (Target word: Positive/Negative) × 2 (Religious explanation: Weak/Strong) ANOVA with repeated measures on the first two factors. The predicted three-way interaction was significant, $F(1,25) = 6.65$, $p < .02$. Reaction times were converted into an automatic attitude index as in Experiment 1 (see Fig. 2). In the control condition, evaluations of God and Science did not differ significantly, $F(1,25) = 1.32$, *ns*. But when God was used as explanation, automatic evaluations of God were more positive than evaluations of Science, $F(1,27) = 6.16$, $p < .05$.
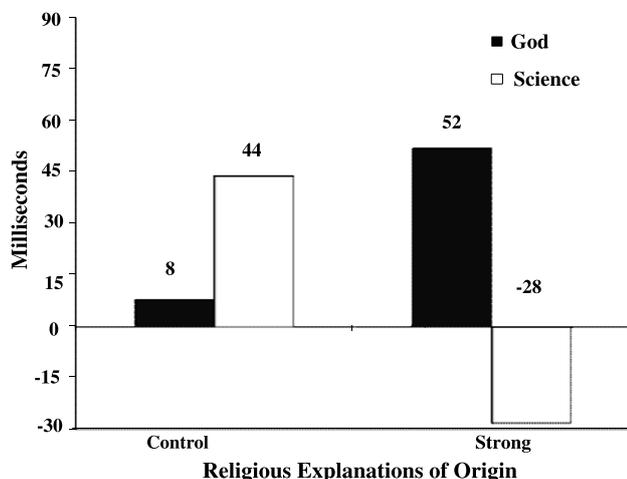

Fig. 2. Automatic evaluations of Science and God by explanatory power of God, Experiment 2.

General discussion

Religion and science offer inclusive systems of beliefs that help to organize people's understanding of the world they live in. When these different beliefs compete with each other for explanatory space, they also compete for their value. Here we report an automatic opposition between evaluations of Science and God according to their utility as ultimate explanations. In Experiment 1, exposure to apparently poor scientific explanations for the origins of the Universe and life on Earth enhanced positive automatic evaluations of God relative to Science, whereas apparently strong scientific explanations resulted in more positive evaluations of Science relative to God. In Experiment 2, a reciprocal relationship was found when God was used as a strong explanation. When people actively used God as an explanation for a variety of phenomena, automatic evaluations of science were diminished as evaluations of God were enhanced. These data suggest that using scientific theories as ultimate explanation can serve as an automatic threat to religious beliefs, and vice versa. Perhaps more important, these findings also indicate that explanatory weakness in one belief system can bolster automatic evaluations of the other. These automatic oppositions emerged despite making no explicit mention of the potentially opposing belief system or to the possible conflict between science and religion.

The implications of these findings are considerable, but some questions remain. The first concerns the mechanism underlying of the automatic opposition: whether these results stem from an automatic causal discounting as we have suggested, or reflect an awareness of the opposition publicized in the popular culture. If these effects do represent an explanatory opposition, then they should only arise where the alternative belief system seems appropriate. For example, scientific explanations of more mundane topics (e.g. photosynthesis) would not be expected to impact evaluations of God, where religious explanations do not apply. If these results represent a cultural knowledge of opposition, then we may not see these effects at all in societies where religion and science are viewed as compatible. In either case, there are significant implications of these findings. A second question concerns the interplay between automatic opposition and explicit attitudes. We expect this relationship to be complex, and impacted by many other social factors like religious background, education, and culture. Attitudes toward science and religion are often deeply held convictions and so may be resistant to change to by brief exposure to explanatory information. However, continued use of one system as ultimate explanation over time may result in an opposition of these explicit beliefs as well. Indeed, whereas 85–95% of the general US population reliably report belief in God (Gallup, 2005), this is only 40% among those with a B.Sc., and only 7% among members of the National Academy of Science (Larson & Witham, 1998). Automatic attitudes and evaluations of the kind we have demonstrated often serve as initial "gut" reactions that guide subsequent cognitive processing, and may be reflected in an experience of threat if one's explicitly preferred explanatory system is called into question. Such threat experiences may activate subsequent motivated reasoning to defend one's belief system among strong believers (Haidt, 2002), but may sow the initial seeds of doubt among weaker believers. How the automatic opposition impacts explicit beliefs, or how explicit beliefs impact the consequences of the automatic associations we have documented, is an important question for further research.

This is not to suggest that science and religion must always conflict, nor that one system of belief must necessarily be chosen over the other. But it may be that such reconciliations are only possible following mental effort exerted to overcome this initial opposition. How the automatic opposition impacts explicit beliefs, or how ex-

plicit beliefs impact the consequences of the automatic associations we have documented, is an important question for further research. In any case, conflict between science and religion is not an issue that is likely to go away any time soon. These experiments suggest is that the frequent competition between science and religion as ultimate explanations is likely to create an intuitive and automatic opposition that may present a permanent challenge for both systems of belief.

Acknowledgments

References

Barrow, J. D. (1992). *Theories of everything*. New York: Fawcett Columbine.

Collins, F. S. (2006). *The language of God: A scientist presents evidence for belief*. New York: The Free Press.

Dawkins, R. (2006). *The God delusion*. Boston/New York: Houghton Mifflin.

Fazio, R. H., & Olson, M. A. (2003). Implicit measures in social cognition research: Their meaning and use. *Annual Review of Psychology, 54*, 297–327.

Gallup Organization Annual Public Opinion Poll on Religious Belief (2005). Available from http://www.galluppoll.com/content/default.aspx?ci=1690.

Gilbert, D. T. (1991). How mental systems believe. *American Psychologist, 46*, 107–119.

Gould, S. J. (1999). *Rock of ages: Science and religion in the fullness of life*. New York: The Ballantine Publishing Group.

Haidt, J. (2002). Dialogue between my head and my heart: Affective influences on moral judgment. *Psychological Inquiry, 13*, 54–56.

Hassin, R., Bargh, J. A., & Uleman, J. S. (2002). Spontaneous causal inferences. *Journal of Experimental Social Psychology, 38*, 515–522.

Keil, F. C. (2006). Explanation and Understanding. *Annual Review of Psychology, 57*, 227–254.

Kim, N. S., & Keil, F. C. (2003). From symptoms to causes: Diversity effects in diagnostic reasoning. *Memory and Cognition, 31*, 155–165.

Larson, E. J., & Witham, L. (1998). Scientists are keeping the faith. *Nature, 386*, 435.

Lombrozo, T. (2007). Simplicity and probability in causal explanation. *Cognitive Psychology, 55*, 232–257.

Lupfer, M. B., Tolliver, D., & Jackson, M. (1996). Explaining life-altering occurrences: A test of the 'God-of-the-gaps' hypothesis. *Journal for the Scientific Study of Religion, 35*, 379–391.

Morris, M. W., & Larrick, R. P. (1995). When one cause casts doubt on another: A normative analysis of discounting in causal attribution. *Psychological Review, 102*, 331–355.

Oppenheimer, D. M. (2004). Spontaneous discounting of availability in frequency judgment tasks. *Psychological Science, 15*, 100–105.

Preston, J., & Epley, N. (2005). The explanatory value of meaningful beliefs. *Psychological Science, 16*, 826–832.

Sloman, S. A. (1994). When explanations compete: The role of explanatory coherence on judgments of likelihood. *Cognition, 52*, 1–21.

Thagard, P. (2006). Evaluating explanations in law, science, and everyday life. *Current Directions in Psychological Science, 15*, 141–145.

Weiner, B. (1985). Spontaneous causal thinking. *Psychological Bulletin, 97*, 74–84.

Zukav, G. (2001). *The dancing Wu Li masters: An overview of the new physics*. New York: Harper Collins.