Scientific Researchers: Are Religious Believers Seen as Being Less Scientific?

by

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A Thesis Presented in Partial Fulfillment
of the Requirements for the Degree
Master of Science

Approved April 2018 by the
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ARIZONA STATE UNIVERSITY

May 2018

ABSTRACT

This study investigated whether research by researchers affiliated with a religious academic institution would be seen as of less scientific merit than research done by researchers affiliated with a nonreligious academic institution. Such a bias may exist given the different value systems underlying religion and science, the widespread perception of a conflict between religion and science, and research on differences in cognitive styles and stereotypes about religious versus nonreligious people. In this study, U.S. participants recruited from Amazon Mechanical Turk completed an online survey, which included an abstract of an article describing scientific research with authors' names and academic institutions, and questions on perceived scientific merit, religiosity, spirituality, religion as Quest, and perceived conflict between religion and science. There was a significant difference in the perceived merit of the researchers, with the group believing the researchers were affiliated with a religious academic institution rating the research as lower in scientific merit than the group believing the researchers were affiliated with a nonreligious academic institution. The perceived level of conflict between religion and science was found to moderate the relationship, such that higher levels of perceived conflict between religion and science showed a greater difference in scientific merit between groups.

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INTRODUCTION

In many ways, religion and science seem to emerge from different systems of beliefs and values. These systems sometimes complement each other, but are also often perceived as being in conflict with one another. A strong proponent of this idea is Richard Dawkins, a renowned evolutionary biologist, outspoken atheist, and critic of organized religion, who argues that religion is detrimental to science. He states that religion "subverts science and saps the intellect," and that religion prevents individuals from truly understanding the world (Dawkins, 2006). The notion of a tension between religion and science is also evidenced by the longstanding controversy surrounding the extent to which evolution and creationism should be included in education in the U.S., with some religious individuals seeking to avoid exposing children to an idea that is against their religious beliefs. In fact, there have been public debates about whether evolution or creationism is true, most notably the debate between Bill Nye, a scientist and popular television personality most known for his children's series "Bill Nye the Science Guy," and Ken Ham, a Christian fundamentalist and president of Answers in Genesis, a "Creationism apologetics organization" (Chappell, 2014). These differences are also evidenced by the public's perception of the relationship between religion and science. In a recent poll by Pew Research Center, 59% of Americans said that, in general, they felt that science was often in conflict with religion (Funk & Alper, 2015).

The goal of the present study is to investigate perceptions of the conflict between religion and science and how they might relate to bias within the scientific community. In particular, the focus will be on comparing how research conducted by scientists at religiously-affiliated versus nonreligious universities is perceived. To the extent that there

is a perceived conflict between religion and science, it may be reflected in negative evaluations of the scientific work of researchers at religiously-affiliated institutions, causing an unjustified bias in publication and reception of the research findings.

Part of why religion and science may be perceived as being in conflict comes from differences in many of the basic beliefs on which each is based. Some religious beliefs, for example, seem to directly contradict widely accepted scientific theories, such as beliefs in creationism (i.e., that the world was created by God in seven days) and the Big Bang theory and theory of evolution, which provide a conflicting account for how intelligent life came to be. Yet, beyond the content of beliefs, there may also be a tension between the core values that underlie science and religion.

Values Underlying Religion

One of the main functions of religion is to reduce feelings of uncertainty (Hogg, Adelman, & Blagg, 2010; van de Bos, van Ameijde, & van Gorp, 2006;). That is, there are things in life that humans do not innately understand, and religion can alleviate feelings of uncertainty by providing ideological answers to fundamental life questions, and establishes belief systems and practices for everyday life (Hogg et al., 2010). Examples of this are explanations for what happens after death, which help reduce the uncertainty and fear of death, and explanations for creation, which help reduce the uncertainty about where we came from and why we are here. In short, religions "address the nature of existence, invoking sacred entities and associated rituals and ceremonies. They … provide a moral compass and rules for living that pervade a person's life, making them particularly attractive in times of uncertainty" (Hogg et al., 2010, p. 1).

The uncertainty-reducing function of religion provides insight on some of the basic values that underlie religion. One of the most widely accepted psychological theories of basic human values comes from the work of Shalom Schwartz (Schwartz, 1992; Schwartz & Huismans, 1995). Schwartz defines human values as "desirable goals, varying in importance, that serve as guiding principles in people's lives," with the crucial distinguishing factor between values being the type of motivational goal they express (Schwartz & Huismans, 1995, p. 89; Schwartz, 1992). The values he proposed represent conscious goals and universal requirements of human existence, that are "needs of individuals as biological organisms, requisites of coordinated social interaction, and survival and welfare requirements of groups" (Schwartz & Huismans, 1995, p. 89). These are summed up in ten basic human values: *power, achievement, hedonism, stimulation, self-direction, universalism, benevolence, tradition, conformity,* and *security*. Schwartz also proposes that all ten human values form a circular structure, with compatible values contiguous to each other, and values in opposition with one another located on opposite sides of the circle (see Figure 2). For example, *power* (a value dealing with social prestige and control) and *achievement* (a value dealing with personal success and competence) are adjacent to one another and are related to *self-enhancement* (seeking to improve one's personal place in the social order). In contrast, the values of *power* and *achievement* are opposite of *universalism* (a value dealing with understanding, tolerance, and protection of the welfare of all) (Schwartz & Huismans, 1995).

Schwartz and Huismans (1995) conducted a cross-cultural study with samples of Israeli Jews, Spanish Roman Catholics, Dutch Calvanist Protestants, and Greek Orthodox to investigate specific values that correlate with religion. Participants filled out the World

Values Scale developed by Schwartz (which asks participants to rate how important each of the ten distinct values is in their life), and also responded to a question asking how religious they considered themselves to be. They found that self-reported religiosity correlated positively with the values of tradition, conformity, security, and benevolence across all samples, regardless of religion and nationality. Notably, three of these correlated variables- *tradition* (defined as "respect, commitment, and acceptance of the customs and ideas that traditional culture or religion provide"), conformity (defined as "restraint of actions, inclinations, and impulses likely to upset or harm others and violate social expectations or norms"), and security (defined as "safety, harmony and stability of society, of relationships, and of self")- share a common emphasis in Schwartz's theory on maintaining traditions and conservative ideas and practices (Schwartz & Huismans, 1995). Crucially, these values, in particular, might help fulfill epistemic motives that correlate with uncertainty-reducing motives tied to religion, by providing a sense of security and an adherence to past and present cultural beliefs, practices, and norms (Hall, Matz, & Wood, 2010).

In a later study Roccas and Schwartz (1997) surveyed participants in six Roman Catholic countries in Europe (Poland, Hungary, Czechoslovakia, Italy, Spain, and Portugal) using an expanded value survey, with the same self-report religiosity item used by Schwartz and Huismans. They replicated the finding that higher religiosity correlated with higher levels of tradition, conformity, security, and benevolence. Importantly, all of these findings by Schwartz and colleagues suggest that the basic values that correlate most strongly with religion are not specific to any one particular world religion.

Values Underlying Science

Whereas religion relies on more supernatural and biblical answers to life questions, science relies on logic, critical inquiry, and objectivity. To my knowledge, there is no published research examining which of Schwartz's basic human values correspond most strongly with scientific inquiry. Schwartz's value of *self-direction*, however, aligns with some of the principles that seem central to scientific inquiry. He defines self-direction as a value pertaining to independent thought and action-choosing, creating, and exploring. In Schwartz's circular model, self-direction is opposite the values of tradition, conformity, and security, supporting the idea that the values underlying religion and science may be in opposition.

Because science deals strongly with exploration, creativity is key when conducting science. For instance, Bronowski (1956) argued that a creative mind is needed for scientific advancement, that some of the greatest scientists of all time were highly creative, and it was their creativity that enabled them to make such great discoveries. He provided Copernicus and Kepler, who creatively looked at the planets and our solar system, as examples. In sum, Bronowski argued that a sense of personal exploration is essential for the progression of science. The National Academy of Science (1995) also argues that scientists use the tools of curiosity and creativity to influence scientific discovery. These tools, along with sound judgment, are needed for scientists to perform research that meets the rigorous standards for the scientific method.

Although there seems to be a consensus that creativity is important in scientific advancement, objectivity is also viewed as a vital aspect of scientific inquiry. For example, Longino (1990) evaluated arguments regarding value-free science and determined that "good" science should be free from personal and social values. In a

similar fashion, Kant (1781) argued that scientific knowledge must be objective, and independent of the whims of scientists. These ideas illuminate that the objective of scientific inquiry should be advancing scientific knowledge with impartiality, whereas the objective of religion, which is value-laden, is to follow the word and will of God or a higher power.

In an article discussing both the value and values of science, Jamieson (2015) argues that two of the main constructs that drive science are critical inquiry and skepticism. That is, scientists need to continuously critique their methods of inquiry and remain skeptical of research findings. One example discussed by Jamieson (2015) is of the published research finding that vaccines lead to autism. Although this finding was disproven, a large number of people still believe the initial (erroneous) findings. This illustrates why scientists need to be skeptical and critical of scientific work, and how critical inquiry can help progress science. As summarized by the National Academy of Science (1995), "the fallibility of methods is a valuable reminder of the importance of skepticism in science. Scientific knowledge and scientific methods, whether old or new, must be continually scrutinized for possible errors" (p. 6).

Finally, in his writings on the philosophy of science, Karl Popper (1959) also examined the idea of deductive (rather than inductive) reasoning as a driving force behind science. Inductive inference involves taking an observation (i.e., a singular statement) and generalizing it to a theory (i.e., a universal statement). In contrast, deductive reasoning starts with a theory, that then informs empirical tests that aim to disprove the theory. Inductive logic requires that all statements of science are capable of being conclusively decided by both truth and falsity. Statements of science are not

accepted dogmatically, they must be justified. Building on Kant's (1781) notion that a scientific principle is objective only if it can be tested and understood, Popper (1959) argued that although scientific theories are never fully justifiable or verifiable, they are nonetheless testable. To prove a theory true would require making every observation without finding one in opposition, whereas falsifying a theory only requires the observation of one case contrary to the theory. For example, the theory that all ravens are black can be falsified by the simple observation that there are white ravens at the New York Zoo (Popper, 1959). He also argued "it must be possible for an empirical scientific system to be refuted by experience" (Popper, 1959, p. 41) In other words, Popper argued that science should be oriented around the objective of seeking to disprove theories, rather than trying to prove them true.

To summarize, although there is relatively little empirical work investigating the values underlying science within Schwartz's model of basic life values, insights from the philosophy of science and even scientific governing bodies (i.e., the National Academy of Science) suggest that Schwartz's notion of self-direction may be a guiding principle of scientific inquiry. Furthermore, there are other basic values, such as skepticism, critical inquiry, and objectivity, that inform science and scientific research and that also may fulfill aims that are oppositional to those achieved by religion.

Existence of Perceived Conflict

A majority of Americans perceive a conflict between religion and science. Specifically, a recent Pew Research Center survey asked Americans if they felt that science and religion were "mostly compatible" or "often in conflict" with one another (Funk & Alper, 2015). Fifty-nine percent of participants said they felt science and

religion were “often in conflict,” whereas only 38% felt science and religion were “mostly compatible” (3% responded that they “did not know”). Due to increased media coverage of this conflict (i.e., the debate between Bill Nye and Ken Ham), and the increased visibility of ideas from Richard Dawkins, Sam Harris (a renowned neuroscientist, philosopher, and outspoken atheist), and Andrew Dickson White (a historian, educator, and cofounder of Cornell University), Ecklund and Scheitle (2007) investigated perceptions of the conflict between religion and science using data from a large sample of academic scientists. They analyzed data collected as part of a study of Religion Among Academic Scientists (RAAS), which examined the degree of belief in God and religious attendance of 1,646 scientists from 21 elite U.S. research universities. They found that nearly two-thirds of participants did not believe in God (31.2%) or indicated that they did not know if there was a God but felt there was no way of finding out (31.0%). They also found that 7.2% believed in a higher power but not a God, 5.4% believed in God sometimes, 15.5% had some doubts but did believe in God, and 9.7% had no doubt that God exists. They also found that, in the last year, just over half of the participants had not attended religious services at all (50.1%). They also found that 1.5% of participants attended religious services more than once a week, 7.1% attended once a week, 5.8% attended 2 to 3 times a month, 4.3% attended once a month, 4.5% attended 6 to 11 times per year, and 26.5% attended 1 to 5 times per year. In sum, these data indicated that a majority of scientists surveyed did not believe in God and did not attend religious services.

Using the same RAAS data set, Park and Ecklund (2009) analyzed responses to the item “there is an irreconcilable conflict between religious knowledge and scientific

knowledge." Participants responded on a 5-point scale ranging from *disagree* to *agree*, but in their analysis Park and Ecklund collapsed this into a dichotomous scale, with *agree* consisting of both *agree* and *somewhat agree*, and *disagree* consisting of both *disagree* and *somewhat disagree*. In contrast to the poll results from the Pew Research Center mentioned above, Park and Ecklund found that a majority (56.9%) of scientists felt there was *no* conflict between science and religion, whereas 36.6% felt there was some level of conflict (6.5% had no opinion). Interestingly, although a majority of scientists indicated that they did not feel there was a conflict between science and religion, the finding that a majority of scientists were not religious believers themselves, points to a potential disconnect; whereas academic scientists do not view religion and science as being in conflict when explicitly questioned, their own lack of religious beliefs may suggest a fundamental tension that they are unable or unwilling to report.

Why Religious Researchers Might Be Seen as Less Scientific

Why might this perception exist? One answer may come from research indicating differences in the cognitive processing styles of religious and non-religious individuals. For instance, research indicating that religious individuals have a more *intuitive cognitive style* (that is based heavily on one's intuitions or gut-level cognitive responses) and that nonreligious individuals have a more *analytic cognitive style* (that is characterized by a propensity to set aside intuitions when problem solving) (e.g., Pennycook, Cheyne, Seli, Koehler, & Fugelsang, 2012) may contribute to the belief that individuals who are highly religious lack the cognitive skills required for scientific inquiry.

Pennycook et al. (2012), for example, found that people who engaged in more analytical cognitive processing on a task were more likely to reject religious and

supernatural beliefs. In an initial study, a sample of MTurk participants completed two tasks designed to measure analytic cognitive style: the Cognitive Reflection Test (CRT) and a measure of Base-Rate Conflict (BRC). The CRT consists of three mathematical problems that elicit an implicit misleading intuition, e.g., "A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost?" The intuitive response is that the bat costs $1.00 and the ball costs $.10, however, upon further contemplation and use of arithmetic (i.e., engaging in analytic cognitive processing), many people arrive at the correct answer, which is that the bat costs $1.05 and the ball costs $.05. With the BRC, individuals are given base rate information about the frequency of certain cases in the population and asked to make a judgment. The judgment is designed so that individuals will make an error in judgment if they rely solely on their intuitions, such as a stereotype. To arrive at the correct judgment, individuals need to override their intuitions and engage in analytical cognitive processing. For example, on one item, participants were told 995 out of 1000 people from a fictitious sample were nurses and 5 were doctors. They were then told that one person was randomly selected from the sample, and that this person lives in a beautiful home in a posh neighborhood, is well spoken, and invested in his career. Participants were then asked which is more likely: this person is a doctor or this person is a nurse. Intuitively, the description may sound more like the life of a doctor than a nurse, but analytically, there is a much higher probability that this person is a nurse than a doctor (99.5% versus .5%). Pennycook et al. (2012) found a significant negative correlation between level of religiosity (measured using the Religious Engagement Scale, the Religious Belief Scale, and a measure of belief in God) and degree of analytic cognitive processing. In other words, participants

who were higher in religiosity were more likely to rely on intuition and less likely to engage in analytical thinking. These findings, which were replicated by Pennycook et al. (2012) in a follow-up study, are important because they identify a cognitive difference between religious and non-religious individuals that may be salient to the public, and, as a result, may contribute to the perceived conflict between science and religion.

Other research by Shenhav et al. (2012) found that MTurk participants who gave more intuitive answers on a Cognitive Reflection Test reported a stronger belief in God (on a scale ranging from *confident atheist* to *confident believer*). In a second study, they had participants take an online survey that employed the same belief in God scale as Study 1, as well as the previously used Cognitive Reflection Test. Replicating the results of Study 1, they found that more intuitive responses on these tests were significantly positively correlated with belief in God. Together, the findings of Pennycook et al. (2012) and Shenhav et al. (2012) identify a cognitive difference between religious and non-religious individuals that may influence people's perceptions of the compatibility between religion and science.

Another basis for the perception of a conflict between religion and science may be due to commonly held stereotypes about religious and non-religious individuals. Ehlrich and Van Tubergen (1971) investigated stereotypes about atheists, a group who, by definition, are nonreligious. In a study with 91 undergraduate participants, they found that the strongest positive stereotypes for atheists were that they were skeptical, critical, and scientifically minded. Caldwell-Harris and colleagues also found that atheists are seen as being logical, rational, and intellectual (Caldwell-Harris, Wilson, LoTempio, & Beit-Hallahmi, 2011). These stereotypes are all highly related to values underlying

science, so it stands to reason that atheists may be perceived as better able to conduct rigorous scientific research, and, by implication, people who are the opposite of atheists (i.e., highly religious individuals) may be perceived as less able to conduct scientific research.

Other research by Saroglou, Yzerbyt, and Kaschten (2011) found that religious individuals were seen as being more dogmatic than nonreligious individuals. In an online study, they asked participants whether they considered themselves a religious believer or non-believer, and then split participants into two groups on the basis of their response. Participants were then asked the extent to which they felt members of the opposite group (believers or non-believers) were characterized by 24 attributes, including honesty, impulsivity, altruism, conservatism, dogmatism, hedonism, competence, and extraversion. They found that religious believers were seen as being significantly more dogmatic and altruistic than non-believers, and that non-believers were seen as being more impulsive and generally competent than believers. This helps strengthen the idea that stereotypes may contribute to a perceived conflict between religion and science.

Additionally, in a series of two studies by Rios, Cheng, Totton, and Shariff (2015), Christians were seen as less competent in science by both Christian and non-Christian participants, and when this stereotype was made salient to participants in an experimental context, Christians underperformed on science-related tasks. Specifically, in Study 1, MTurk participants provided their religious affiliation and then rated four different groups (atheists, Christians, Jews, and Muslims) on how competent they felt each group was, compared to the average person, on overall competence, competence in science, trust in science, and warmth. They found that Christians were rated as

significantly lower in scientific competence than other groups and that atheists were rated as significantly higher in scientific competence than other groups.

In Study 2, participants in a lab study were randomly assigned to read a fictitious article saying that a majority of people felt Christians were bad at science (a high-threat group), that a majority of people felt Christians were good at science (low-threat group), or read no article at all (control group). Participants then filled out a 20-item self-report measure of their identification with science (e.g., "I am quite good at science."). They found that Christian participants reported significantly lower levels of scientific identification than non-Christian participants in the high-threat group, but that no significant difference emerged between Christian and non-Christian participants in the low-threat and no article (control) groups. One explanation for these findings is that if religious individuals are seen as relatively poor at science, it may be assumed that their decreased capacity for science is due to a conflict between the skills and values underlying scientific inquiry and their religious beliefs.

In conclusion, both actual (observed) differences in cognitive processing style and stereotypes about individuals who are highly religious and not religious at all (i.e., atheists) may play a role in the perception of a conflict between religion and science, and cognitive styles and stereotypes may even influence each other.

Subtle Bias in Evaluations of Intellectual Merit

The present research will build on classic findings in social psychology pertaining to evaluations of intelligence (e.g., Amabile, 1981; Goldberg, 1968). One study comes from the research by Goldberg (1968), who investigated the idea that men are seen as being more knowledgeable and competent in professional work than women. He had a

sample of female college students read excerpts of professional articles. Based on random assignment, participants were led to believe that the excerpts had been written by either a female author or a male author. Crucially, across the two conditions, participants read identical article excerpts. Goldberg then had participants rate the article excerpts on value, persuasiveness, and profundity, as well as rate the author on writing style, professional competence, professional status, and ability to sway the reader. Ratings of the excerpts and author were higher for almost all of the evaluative dimensions when participants were told the author was male rather than female. This illuminated the internalization of negative stereotypes about women's intelligence by women, themselves. Relevant to the present research, it also introduced a novel paradigm for evaluating perceptions of intelligence and competence in a subtle way.

Drawing on a similar methodology, Amabile (1981) explored perceptions of intelligence, ability, and competency. Specifically, participants in the study were asked to read excerpts from a book review in which a fictitious reviewer either gave the book a negative or positive review. Participants were asked to rate the reviewer on literary expertise, intelligence, competence as an editor, kindness, career success, self-confidence, fairness, and likeability. Amabile found that participants rated the reviewer who gave negative feedback as more intelligent and competent and higher in expertise than the reviewer who gave positive feedback. The conclusion was that negative reviewers were seen as being more intelligent, but less kind, or in other words, they were seen as being "brilliant, but cruel." Interestingly, the findings from Amabile's study might indirectly shed light on why religious individuals might be seen as less competent at science. Because much of religion revolves around "loving thy neighbor" and treating

others kindly, it may be that religious people are seen as being less capable of giving harsh criticism than non-religious people. This would imply, given the findings of Amabile, that religious people would be perceived as less intelligent and less competent at intellectual tasks like scientific research. Taken together, the research by Goldberg (1968) and Amabile (1981) helped introduce a research paradigm that has been effective for assessing perceptions of intelligence or competence, and, importantly, how such perceptions might vary based on participants' beliefs about others.

Present Research

In summary, previous research sheds light on the existence of a perceived conflict between the basic values underlying religion and science, which may lead to a disparity in perceived quality and merit of scientific research conducted by scientists affiliated with religious academic institutions versus nonreligious institutions. The goal of the present study is to investigate the perceived conflict further, and how it may shape perceptions of scientific merit in the context of psychological research. Specifically, I will explore two related research questions:

1. To what extent is religious identification perceived as reflecting a decreased capacity for scientific rigor?
2. How might this belief influence perceptions of the quality of scholarly scientific work?

My primary hypothesis is that research conducted by scientists at an academic institution with an explicit religious affiliation will be viewed as less rigorous and lower in scientific merit than research conducted by scientists at an (ostensibly) nonreligious academic institution.

Additionally, I will test a series of exploratory hypotheses involving potential moderating variables that might shed further light on why this lesser view of merit might exist. It is possible that participants' own levels of religiosity and approach to religion (e.g., being spiritual (versus religious), viewing religion as a process of questioning and re-examination, (i.e., quest orientation; Batson, 1976)), education level, and extent of perceived conflict between religion and science might moderate the primary hypothesis. For instance, it is possible that perceptions of a decreased capacity for rigorous science among religious scientists might be weaker among participants who are, themselves, relatively high in religiosity, because religious scientists may be viewed as ingroup members and may therefore be viewed more favorably, in general. Or, highly religious participants might feel that their own religious beliefs do not conflict with their knowledge and understanding of science, and may thus draw on their evaluations of themselves when rating the scientific abilities of similar (religious) others.

It is also possibe that participants' level of spirituality, as a construct that is distinct from religiosity, may moderate the primary hypothesis. It is unclear whether there will be a stronger or weaker effect among participants who are relatively high in spirituality, in part because individuals who are high in spirituality may consider themselves to be highly religious *and* highly spiritual or, alternatively, may consider themselves to be highly spiritual but *not* religious. Potential moderation by spirituality may be especially informative because it may provide insight into a slightly different aspect of religiosity. Relatedly, the term *quest orientation* describes a more self-directive approach to religion and spirituality. That is, individuals who are high in quest orientation view religion as a process of questioning and re-examination (Batson, 1976). Although

religious, the way in which individuals high in quest orientation experience their religiosity may lead them to perceive religiously-affiliated scientists in a very different way. This potential moderation will be especially informative due to the overlap of quest orientation with the self-directive nature of science.

Another potential moderator is participants' education level. Previous research has found that higher levels of education correlate with more frequent attendance at religious services (Glaeser & Sacerdote, 2002) within the general population. Assuming that more frequent attendance correlates with higher levels of religiosity, it seems that more educated, and thus more religious, participants may view religious researchers as a more favorable ingroup. Finally, it seems likely that the degree to which participants perceive a conflict between religion and science will moderate the primary hypothesized relationship, such that there will be a stronger effect among participants who view the values underlying religion and the values underlying science as conflicting.

To summarize, I will explore the following hypotheses in a set of post-hoc moderator analyses:

1. Participants' level of religiosity will moderate the relationship predicted in the primary hypothesis, such that there will be a weaker effect among participants relatively high in religiosity.
2. Participants' level of spirituality will moderate the relationship predicted in the primary hypothesis; however, it is unclear whether there will be a stronger or weaker effect among participants who are relatively high in spirituality.

3. Participants' level of quest orientation will moderate the relationship predicted in the primary hypothesis, such that there will be a weaker effect among participants who are relatively high in Quest orientation.
4. Participants' education level will moderate the relationship predicted in the primary hypothesis, such that there will be a stronger effect among participants with relatively low levels of education.
5. The degree to which participants perceive a conflict between religion and science will moderate the relationship predicted in the primary hypothesis, such that there will be a stronger effect among participants who view the values underlying religion and the values underlying science as conflicting.

Method

Participants

Five hundred and one adults (45.7% male, 53.1% female) participated in the study through Amazon Mechanical Turk, and were paid $0.40. Participants ranged in age from 19 to 82 years old (M = 38.01, SD = 12.94). The sample was predominantly (91.8%) non-Hispanic/non-Latino, with the following racial composition: 79.2% White/Caucasian, 8.4% Black/African American, 7.4% Asian, 1.0% American Indian or Alaska Native, 2.2% Multiracial, 1.6% other, and .2% race not reported. Participants indicated the following religious affiliations: 24.0% Protestant, 22.4% Catholic, 3.0% Jewish, 1.4% Mormon, 1.6% Buddhist, 2.4% Islamic, .8% Hindu, .2% Nontrinitarian, 10.6% religious or spiritual with no religious affiliation, 27.3% neither religious nor spiritual, and 6.2% other. Descriptive information for all the key variables is shown in Table 1.

Procedure

First, participants viewed an abstract from a published study in the area of developmental psychology. The specific article was chosen because it was a peer-reviewed publication that might elicit, on average, a moderate level of perceived scientific merit and a sufficient level of variability between participants in perceived scientific merit. This area of research seemed more ideal for purposes of this study than a study in the area of neuroscience or physiology, for example, which might result in a ceiling effect for perceived scientific merit in a non-academic sample. Because many participants might be unfamiliar with norms surrounding the reporting of information in academic publications, just before viewing the abstract, all participants read the following information:

> "In the first stage of this study, you will view the first page of a research paper published in a scientific journal. Essential components of the first page of scientific papers include: the title of the paper, displayed in bold font at the top of the page, the first initial and last name of each of the authors who wrote the paper, the academic institution (i.e., college or university) at which the research was conducted by the authors and their research team, and an abstract, which is a brief summary of the key elements of the research conducted by the authors and their findings the opening paragraphs of the introduction of the paper."

They were then instructed to read through the title, names of authors, the academic institution of the authors, and abstract carefully. The title and abstract of a published study on infants' attention to visual cues were presented, however, participants were provided with fictitious information about the names of the authors and the academic institution at which the research had been conducted. Specifically, participants were randomly assigned to one of two experimental conditions: a religious condition (in which participants were informed the authors were affiliated with a religious university)

and a non-religious condition (in which participants were informed the authors were affiliated with a (presumably) non-religious university). Manipulation checks were then employed to make sure participants paid attention to the title of the paper, the academic institution of the researchers, and the general topic of the research. As the key dependent measure, participants were then asked to rate the scientific merit of the research and expertise of the researchers.

Participants were next asked to report demographic information, as well as answer questions about their religious affiliation, church attendance, and belief in God, and a series of established scales that assessed a range of aspects of degree of religiosity and spirituality. Finally, participants were asked to what extent they felt there was a conflict between the values of science and the values of religion.

Measures

Religious affiliation manipulation. Based on random assignment, participants were led to believe that the study discussed in the abstract was either performed by researchers at a (fictitious) academic institution with an explicit religious affiliation (North Baker Christian University) or an ostensibly nonreligious academic institution (North Baker University).

Perceived scientific merit. To measure perceptions of the scientific merit of the research, participants completed a 9-item scale using items from the National Science Foundation Grant Review Manual, along with additional items that were created for this study (e.g., "To what extent is this research of high quality?" "To what extent does this research successfully measure what it claims to measure?" "How knowledgeable do you think the researchers who wrote the paper are in their field of study?"; measured using a

9-point scale ranging from *not at all* to *extremely*). Due to the high internal reliability (α = .93) of the items assessing perceived scientific merit, a composite variable was created by averaging participants' scores on the nine items. This item was used for the analyses.

Manipulation Checks. Three multiple-choice questions asking participants to recall the title of the research paper, the academic institution of the authors, and the general topic of the research presented in the abstract were included as checks on participants' attention to the key experimental information. These questions appeared immediately after the experimental manipulation. For the attention check on article title, participants were asked to identify the article's title from the following options: "Positive Emotions Trigger Upward Spirals Toward Emotional Well-being," "Adults' Eyes Trigger Shifts of Visual Attention in Human Infants," "Choice Under Conflict: The Dynamics of Deferred Decision," or "The Development of Depression in Children and Adolescents." For the attention check on general research topic, participants were asked to identify the general topic of the article from the following options: Infants' visual attention, Adult decision-making, or Language learning in adolescents. For the attention check on religious versus nonreligious academic institution, participants in the religious condition were asked to identify the authors' academic affiliation from the following options: North Baker Christian University, South Barber Christian University, or East Banes Christian University. Participants in the nonreligious condition were asked to identify the authors' academic affiliation from the following options: North Baker University, South Barber University, or East Banes University.

Demographic Information. Demographic variables including participants' age, gender, ethnicity, race, education level, academic field of study (when relevant), e.g.,

college major, political affiliation, political ideology (liberalism vs. conservatism) on social issues and economic issues, religious affiliation, and attendance at a religiously-affiliated educational institution were measured.

Centrality of Religion Scale. The Centrality of Religion Scale (Huber & Huber, 2012) was used to measure participants' level of religiosity. The scale consists of 14 items (α = .97) measuring the importance, or centrality, of religion in one's life (e.g., "How often do you think about religious issues?" "How important is it to take part in religious services?"; measured using a 5-point scale ranging from *not at all* to *very much/extremely*). Given that these items were sufficiently reliable, a composite score for this variable was created by averaging participants' scores on each of the individual scale items.

Spirituality. Three items (α = .98) were used to measure participants' level of spirituality (e.g., "To what extent do you consider yourself a spiritual person?"; measured using a 9-point scale ranging from *not at all* to *extremely*). Given the high reliability of these items, a composite score was created for each individual by averaging their scores on each individual item.

Religion as Quest. The 6-item Religion as Quest Scale (Batson, 1976; α = .71) was used to measure the degree to which religion is used as a means to better understand oneself and the world (e.g., "My religious development has emerged out of my growing sense of personal identity" "Questions are far more central to my religious experience than are answers"; measured using a 9-point scale ranging from *strongly disagree* to *strongly agree*). Given that these items were sufficiently reliable, after reverse-scoring

appropriate items, a composite score for this variable was created by averaging participants' scores on each of the individual scale items.

Perceived conflict between religion and science. To measure perceived conflict between religion and science, participants were asked, "To what extent do you feel there is a conflict between the values of science and the values of religion?," with responses measured on a 7-point scale ranging from *no conflict at all* to *high degree of conflict*.

Results

Sixty participants who failed the key manipulation check question about the name of the authors' academic institution were excluded from the analyses. The number of excluded cases for the religious academic institution condition ($N = 30$) and nonreligious academic institution condition ($N = 30$) were identical, so analysis proceeded without any corrections for excluded cases. The final sample size used for the analyses reported below was $N = 441$.

To investigate differences in the perceived scientific merit of the research for participants in the religious versus nonreligious institution condition, an independent samples *t*-test was performed. In support of the primary hypothesis, the perceived scientific merit of the research was rated as significantly lower when the researchers who conducted it were ostensibly at a religious academic institution ($M = 6.38$, $SD = 1.17$) than when the researchers were ostensibly at a nonreligious institution ($M = 6.61$, $SD = 1.07$), $t(439) = 2.14$, $p = .03$, $\eta^2 = .01$.

Separate moderation analyses were performed to investigate whether the relation between religious affiliation and perceived scientific merit was moderated by participants' degree of religiosity, spirituality, Quest orientation, education level, and

perceived conflict between scientific and religious values. That is, a series of regression models were tested with religious versus non-religious institution (coded as religious institution = 1, non-religious institution = 0), each moderator (mean centered), and their interaction term as predictors of perceived scientific merit. The only variable found to significantly moderate the relation between religious versus non-religious institution and perceptions of scientific merit was perceived conflict between scientific and religious values. In this regression model a significant main effect for authors' academic institution was found, such that participants who believed the researchers were affiliated with a religious institution perceived the research as having lower scientific merit than the participants who believed the researchers were affiliated with a nonreligious institution, b = -0.27, SE = 0.11, $t(399)$ = -2.41, p = .02. This, however, was qualified by the interaction between perceived conflict and religious affiliation condition, b = -0.14, SE = 0.06, $t(399)$ = -2.37, p = .02. Simple slopes were tested at low (-1 SD below the mean), moderate (mean), and high (+1 SD above the mean) levels of perceived conflict. At moderate and high levels of perceived conflict there was a significant negative association between religious institution condition and perceived scientific merit, indicating that research conducted by authors at a religious institution was more strongly related to perceived scientific merit at high levels of perceived conflict (b = -0.54, SE = 0.16, $t(399)$ = -3.38, $p < .001$) than for moderate levels of perceived conflict (b = -0.27, SE = 0.11, $t(399)$ = -2.41, p = .02). In contrast, there was no significant association between religious institution condition and perceived scientific merit at low levels of conflict (b = -0.003, SE = 0.16, $t(399)$ = -0.02, p = .98).

Discussion

In this study, an abstract discussing research on infants' cognition was perceived as significantly lower in scientific merit when participants believed that the researchers who conducted it were affiliated with a religious versus a (presumably) nonreligious academic institution. This finding suggests that perceptual biases, potentially rooted in people's beliefs about the capacity of highly religious individuals to engage in scientific reasoning, might influence the way scientific research is being perceived by the general public.

Degree of perceived conflict between religion and science significantly moderated the effect of religious versus nonreligious academic affiliation on perceived scientific merit, such that higher levels of perceived conflict correlated with lower perceived scientific merit of religious researchers' work. This finding indicates that this form of bias against researchers at religious institutions is only evident among individuals who perceive moderate and higher levels of conflict between religion and science. In other words, researchers' affiliation with a religious academic institution does not affect how individuals think about and perceive the research when they do not perceive a conflict between religion and science. Unexpectedly, none of the other proposed moderators (religiosity, spirituality, quest orientation, education level) were significant.

Although it stands to reason that individuals' own level of religiosity might impact the extent to which the work of researchers at religious institutions might be viewed as lower in scientific quality, the absence of a moderation effect may be explained by the findings of Goldberg (1968). He found that, despite the expectation that women would rate work by their own gender as higher or at least equal to males in terms of intelligence and competence, they actually rated males as higher in intelligence and

competence. This suggested that they had internalized the stereotype that men produce superior professional work than women, and a similar internalization may be evident in the findings from the current study. Although it was expected that religious individuals would rate the scientific merit of research done by religiously-affiliated researchers as equal to (or even higher than) that by researchers at institutions with no religious affiliation, religious participants may have prescribed to the stereotype that religious individuals are poor at science, and thus do less meritorious scientific work.

As shown in Table 3, bivariate correlations revealed that spirituality and religiosity had a significant positive correlation that was high in strength ($r = .88$, $p < .001$), quest and religiosity had a significant positive correlation that was moderate in strength ($r = .49$, $p < .001$), and spirituality and quest had a significant positive correlation that was moderate in strength ($r = .46$, $p < .01$). In other words, in this study, there seemed to be evidence that the measures assessing religiosity, spirituality, and quest were tapping into overlapping constructs, based on the significance and magnitude of these bivariate correlations. Given the lack of significant moderation by religiosity, it is not surprising, then, that moderation effects for spirituality and quest were similarly nonsignificant.

Why might participants' own level of education fail to moderate of the primary effect? A potentially relevant research finding is that education level and religiosity are often found to be positively correlated. For example, positive correlations have been found between education level and frequency of church attendance, as an indicator of religiosity, in large sets of national survey data. To investigate the correlation between education and religion, Glaeser and Sacerdote (2002) analyzed data from the 1998

General Social Survey and data from the 1981-2001 World Values Survey waves. In both sets of data they found a significant positive correlation between education level (measured by participants' highest degree earned) and frequency of church attendance. This, in fact, was the case in the present study, although the magnitude of the relationship was small ($r = .13$, $p < .01$). The positive correlation between education level and church attendance may partially explain why, in the present study, participants' level of education did not emerge as a significant moderator. That is, if those with higher levels of education attend religious services more often, a reasonable inference is that they are also more religious than those with lower levels of education. Given the lack of moderation by religiosity in the present data, it may not be surprising that education level was not a significant moderator either. Interestingly, however, education level and religiosity were unrelated in this study ($r = .04$, $p = .42$), despite a large significant positive correlation between church attendance and religiosity ($r = .71$, $p < .01$). Examination of the bivariate relations among these exploratory variables alone arguably leaves a number of questions unanswered.

Limitations and Future Directions

Despite the present findings, the study did have a few noteworthy limitations that highlight directions for future research. First, this study looked only at perceptions of research conducted at a hypothetical Christian versus a non-religious academic institution, and thus did not examine perceptions of other (non-Christian) religions. Yet, there is some evidence to suggest that there are certain connotations associated with the word Christian. Christians are often seen as being more conservative (Ericson, 2002; Schumaker-Matos, 2012), and it may be that perceptions of conservative ideology might

explain the ratings of decreased merit among researchers at a Christian university. Also, as mentioned previously, the findings of Rios et al. (2015) demonstrated that Christians, in particular, are perceived as being poor at science. These connotations and stereotypes may not be associated with other world religions, and may have influenced the specific findings of this study. Relatedly, there are also differing perceptions of Christians that vary by religious branch or sect, and participants may have been thinking of a specific sect, rather than Christianity, overall, when participating in this study. An important direction for future research is thus to investigate the extent to which the present findings replicate when comparing researchers at academic institutions affiliated with various other world religions (Islam, Judaism, Buddhism, etc.), or various specific Christian sects (Catholicism, Protestantism, Mormonism, etc.), to researchers at nonreligious institutions.

This study was also limited to a U.S. sample, although the perceived conflict between religion and science appears to be prevalent in other parts of the world as well. A poll by the Pew Research Center found that a large majority of individuals in Greece, Serbia, Croatia, and the Czech Republic reported they felt there was conflict between religion and science ("Religious Belief and National Belonging in Central and Eastern Europe," 2017). Historical examples from other countries, such as differences between scientists and churches in astronomical views, also suggest that this perceived conflict is not unique to the U.S. (Robinson, 1999). For example, in ancient Babylon priests and astronomers conflicted on whether lunar eclipses were based on time intervals or the restlessness of the gods. Also, Galileo and the Roman Catholic Church in Italy contended on the movement of planets in the solar system. Based on this, future research could seek

to replicate the findings in this study using cross-cultural samples. This could help shed light on whether this is a more global phenomenon, or if it is limited to views in the U.S.

It would also be helpful to investigate the effect using a sample of academic scientists from various STEM fields, to see if their perceptions differ (based on the results of Park & Ecklund) from those held by the adult respondents on Amazon Mechanical Turk, who represent a range of education and disciplinary backgrounds that is more representative of the general public, and to see if any differences between fields exists. Fellow scientists are the ones whose perceptions of scientific merit primarily determine whether or not research findings are accepted as valid and are ultimately published, so it would be important to determine if this same effect exists for them, or solely in the general population. Due to the nature of scientific inquiry, which is structured around the process of peer-review, if high quality and methodologically-sound research has a decreased likelihood of being published simply due to bias against researchers at religious academic institutions, this bias may be inhibiting potential advancements in scientific knowledge.

Furthermore, this study only looked at potential scientific merit of research, but not necessarily to the point that research could be prevented from being published due to a bias against researchers at religiously-affiliated institutions. Another avenue of future research could extend the impact by looking at pseudo-behavioral dependent variables, with participants being asked to make a decision regarding whether to accept or reject a manuscript by a religious versus non-religious researcher. The same manipulation could be employed as in this study, but participants could also be given a brief explanation of publication guidelines, and then asked if they would accept the research for publication in

a scientific journal. Individuals may see scientific research conducted at a religiously-affiliated institution as less meritorious, but this may or may not be a large enough difference to also justify refusing publication.

Overall, the implication of this research is that awareness needs to be raised of this bias so as to not hinder scientific knowledge and advancement. Researchers should be informed that scientific findings should be based solely on the merit of the findings and the integrity of the research methods used. Also, it would be helpful to establish more widespread and standardized blind review processes, across all scientific fields, for both journal and grant reviews, in terms of what information is conveyed to reviewers about the researchers and their institutional affiliations. This could also help limit publication and funding biases against religiously-affiliated academic institutions.

Finally, a methodological limitation stemmed from the multiple-choice options for the manipulation check on the researchers' academic institution. Participants in the religious academic institution condition were asked to identify the correct academic affiliation from a list of three universities that all had the word "Christian" in the name, whereas participants in the nonreligious academic institution condition were given a list of three universities in which none had the word "Christian" in the name. It would have been helpful to include both "North Baker University" and "North Baker Christian University" as options for both conditions, to differentiate participants whose correct identification of "North Baker Christian University" was based solely on the recognition of "North Baker" from participants who correctly identified both "North Baker" and "Christian" in the name. That is, participants who did not remember that "Christian" was part of the university name could have still "passed" the attention check in the religious

condition, and thus represents a methodological flaw that should be addressed in future studies.

Conclusion

In conclusion, recent worldwide polls have shed light on the existence of a perceived conflict between religion and science. The findings from the present study also provide evidence of a perceived conflict between religion and science, due to the difference in perceived scientific merit between research conducted by researchers at religiously-affiliated versus nonreligious academic institutions. More research should be done to further investigate this effect but, in the meantime, awareness needs to be raised among academics in the scientific community.

REFERENCES

Amabile, T. M. (1981). Paper presented at the Annual Meeting of the Eastern Psychological Association: *Brilliant but Cruel: Perceptions of Negative Evaluators*. (New York).

Batson, D. C. (1976). Religion as prosocial: Agent or double agent? *Journal for the Scientific Study of Religion, 15*(1), 29-45.

Bronowski, J. (1956). *Science and human values.* New York: Julian Messner, Inc.

Caldwell-Harris, C. L., Wilson, A. L., LoTempio, E., & Beit-Hallahmi, B. (2011). Exploring the atheist personality: Well-being, awe, and magical thinking in atheists, Buddhists, and Christians. *Mental Health, Religion & Culture, 14*(7), 659-672.

Chappell, B. (2014, Feb. 4). Who "Won" the Creation Vs. Evolution Debate? [News Article]. https://www.npr.org/sections/thetwo-way/2014/02/06/272535141/who-won-the-creation-vs-evolution-debate

Ecklund, E. H., & Park, J. Z. (2009). Conflict between religion and science among academic scientists? *Journal for the Scientific Study of Religion, 48*(2)*,* 276-292.

Ecklund, E. H., & Scheitle, C. P. (2007). Religion among academic scientists: distinctions, disciplines, and demographics. *Social Problems, 54*(2), 289-307.

Ehlrich, H. J., & Van Tubergen, G. N. (1971). Exploring the structure and salience of stereotypes. *The Journal of Social Psychology, 83,* 113-127.

Ericson, E. E. Jr. (2002). Christian, therefore conservative. *Modern Age: A Conservative Review, 44*(1).

Funk, C., & Alper, B. A. (2015). Perception of conflict between science and religion. *Pew Research Center, Washington, DC.*

Glaeser, E. L., & Sacerdote, B. (2002). Education and religion. *NBER Working Paper Series, 8080,* 1-53.

Goldberg, P. (1958). Are Women Prejudiced Against Women? *Trans-Action,* 28-30.

Hall, D. L., Matz, D. C., & Wood, W. (2010). Why don't we practice what we preach? A meta-analytic review of religious racsm. *Personality and Social Psychology Review, 14*(1), 126-139.

Hogg, M. A., Adelman, J. R., & Blagg, R. D. (2010). Religion in the dace of uncertainty: An uncertainty-identity theory account of religiousness. *Personality and Social Psychology Review, 14*(1), 72-83.

Huber, S., & Huber, O. W. (2012). The centrality of religion scale (CRS). *Religions, 3,* 710-724.

Jamieson, K. H. (2015). Communicating the value and values of science. *Issues in Science and Technology,* 1-11.

National Academy of Sciences. (2009). *On being a scientist: A guide to responsible conduct in research: Third Edition.* Washington, DC: The National Academies Press.

Pennycook, G., Cheyne, J., Seli, P., Koehler, D., & Fugelsang, J. (2012). Analytic cognitive style predicts religious and paranormal beliefs. *Cognition, 123,* 335-346.

Popper, K., R. (1959). *The Logic of Scientific Discovery.* New York: Hutchison & Co.

"Religious Belief and National Belonging in Central and Eastern Europe." Pew Research Center, Washington, DC. (2017).

Rios, K., Cheng, Z. H., Totton, R., & Shariff, A. F. (2015). Negative stereotypes cause Christians to underperform in and disidentify with science. *Social Psychology and Personality Science,* 1-9.

Robinson, B. A. (1999). *Conflicts between science and religion: A brief overview; examples; causes*. Retrievded from http://www.religioustolerance.org/scirel_ov1.htm

Saroglou, V., Yzerbyt, V., & Kaschten, C. (2011). Meta-stereotypes of groups with opposite religious views: Believers and non-believers. *Journal of Community & Applied Social Psychology, 21,* 484-498.

Schumaker-Matos, E. (2012). *Christian is not synonymous with conservative.* Retrieved from https://www.npr.org/sections/ombudsman/2012/03/30/149717982/christian-is-not-synonymous-with-conservative

Schwartz, S. H (1992). Universals in the content and structure of values: Theoretical advances and empirical tests in 20 countries. *Advances in Experimental Social Psychology, 25,* 1-65.

Schwartz, S. H., & Huismans, S. (1995). Value priorities and religiosity in four western religions. *Social Psychology Quarterly, 58*(2), 88-107.

Shenhav, A., Rand, D. G., & Greene, J. D. (2012). Divine intuition: Cognitive style influences belief in god. *Journal of Experimental Psychology, 141*(3), 423-428.

van de Bos, K, van Ameijde, J., & van Gorp, H. (2006). On the psychology of religion: The role of personal uncertainty in religious worldview defense. *Basic and Applied Social Psychology, 28*(4), 333-341

APPENDIX A

CONSENT

January 10, 2018

Dear Participant:

We are researchers in the School of Social & Behavioral Sciences at Arizona State University.

We are interested in people's evaluations of research conducted in academic settings. We are inviting your participation, which involves reading an overview of a specific study published in a scientific journal and answering questions about your perceptions of the research. You will also be asked to provide some basic demographic information.

This is an online study that takes approximately 10-12 minutes to complete. In return for participating in the survey, you will be paid $0.40.

Your participation in this study is voluntary. You can skip questions if you wish. If you choose not to participate or to withdraw from the study at any time, there will be no penalty. You must be 18 years old or older to participate in this study.

Although there is no direct benefit of participating in this study, there is the potential for you to gain a better understanding of the process of conducting psychological research. There are no foreseeable risks or discomforts to your participation.

The responses you provide in this study will be anonymous—that is, the researchers can in no way link the responses you provide in the study to any personally identifying information including computer IP address or geographic location. The only record of your participation will be in the form of your randomly-generated study completion code, which will allow MTurk to process your payment upon study completion. The results of this study may be used in reports, presentations, or publications but your name will not be known. All data collected in this study will be reported in aggregate form.

If you have any questions concerning this research study, please contact the research team at: d.hall@asu.edu / (602) 543-2382. If you have any questions about your rights as participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board at Arizona State University, through the ASU Office of Research Integrity and Assurance, at (480) 965-6788.

Sincerely,
Deborah Hall, Ph.D.
Erik Porter, B.S.

APPENDIX B

SURVEY ITEMS

Instructions

In the first stage of this study, you will view the first page of a research paper published in a scientific journal. Essential components of the first page of scientific papers include: the title of the paper, displayed in bold font at the top of the page the first initial and last name of each of the authors who wrote the paper the academic institution (i.e., college or university) at which the research was conducted by the authors and their research team an abstract, which is a brief summary of the key elements of the research conducted by the authors and their findings the opening paragraphs of the introduction of the paper

As you view the research paper, you should read and pay close attention to the first four components listed above. That is, you should carefully read the title of the paper, the authors' names, the academic institution of the research team, and the abstract. In a later stage of this study, you will be asked to recall these key elements of the paper.

You are not expected to be an expert or even knowledgeable in the area of research the paper describes. Regardless of what your background in scientific research is, please do your best to read through and attend to the key elements of the paper.

Religious-Affiliated Abstract

Adults' Eyes Trigger Shifts of Visual Attention in Human Infants

B. Williams, R. Jones, E. Park
North Baker Christian University

Abstract—Two experiments examined whether infants shift their visual attention in the direction toward which an adult's eyes turn. A computerized modification of previous joint-attention paradigms revealed that infants as young as 3 months attend in the same direction as the eyes of a digitized adult face. This attention shift was indicated by the latency and direction of their orienting to peripheral probes presented after the face was extinguished. A second experiment found a similar influence of direction of perceived gaze, but also that less peripheral orienting occurred if the central face remained visible during presentation of the probe. This may explain why attention shifts triggered by gaze perception have been difficult to observe in infants using previous naturalistic procedures. Our new method reveals both that direction of perceived gaze can be discriminated by young infants and that this perception triggers corresponding shifts of their own attention.

The direction of other people's gaze can reveal where they are attending, and thus indicate sources of potential interest or danger in the environment. Gaze monitoring may have played a crucial role in the evolution of socialization (Humphrey, 1976). In infants, the emergence of the tendency to look where another person looks is a fundamental landmark in the development of referential communication. In standard paradigms for measuring this behavior (Butterworth & Jarrett, 1991; Corkum & Moore, 1995; Scaife & Bruner, 1975), normal infants 10 to 12 months old are reliably found to look in the direction toward which adults turn their heads and eyes.

detectors within the primate visual system. Many cells in the monkey superior temporal sulcus respond selectively to the direction of perceived gaze (Perrett & Mistlin, 1990). Furthermore, neuropsychological studies of patients with inferotemporal damage, and related lesion studies with monkeys, also suggest there may be specialized detectors for the direction of perceived gaze within the visual system (Campbell, Heywood, Cowey, & Regard, 1990). In reviewing these data, Baron-Cohen (1995) recently proposed that a modular eye direction detector (EDD) plays a central role in the development of social cognition, and implied that it must be operating before the emergence of joint attention behaviors toward the end of the 1st

Nonreligious-Affiliated Abstract

Adults' Eyes Trigger Shifts of Visual Attention in Human Infants

B. Williams, R. Jones, E. Park
North Baker University

Abstract—Two experiments examined whether infants shift their visual attention in the direction toward which an adult's eyes turn. A computerized modification of previous joint-attention paradigms revealed that infants as young as 3 months attend in the same direction as the eyes of a digitized adult face. This attention shift was indicated by the latency and direction of their orienting to peripheral probes presented after the face was extinguished. A second experiment found a similar influence of direction of perceived gaze, but also that less peripheral orienting occurred if the central face remained visible during presentation of the probe. This may explain why attention shifts triggered by gaze perception have been difficult to observe in infants using previous naturalistic procedures. Our new method reveals both that direction of perceived gaze can be discriminated by young infants and that this perception triggers corresponding shifts of their own attention.

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Demographics

1. What is your age in years?

2. What is your gender?

3. What is your ethnicity?

4. What is your racial background?

5. What is the highest level of education that you have completed?

6. What area did you study in school? Or, what would you consider to be the primary focus of your studies?

7. What categorization best describes your political affiliation?

8. How would you describe your political orientation on social issues?

9. How would you describe your political orientation on economic issues?

10. What is your religious affiliation?

11. How often do you attend church or religious services?

12. What are your views about the existence of God?

Perceived Scientific Merit Scale

Not at All		Slightly		Somewhat		Very Much		Extremely High Degree
1	2	3	4	5	6	7	8	9

1. To what extent does this research advance knowledge and understanding within a scientific field?

2. To what extent is this research of high quality?

3. To what extent is this research well-reasoned, well-organized, and based on sound rationale?

4. To what extent does this research successfully measure what it claims to measure?

5. How knowledgeable do you think the researchers who wrote the paper are in their field of study?

6. To what extent are the conclusions drawn from the findings warranted?

7. How well designed was this study?

8. To what extent were the procedures accurate and appropriate?

9. What amount of confidence do you have that these research findings are true and accurate?

Centrality of Religion Scale

Not at All		Moderately		Very Much/Extremely
1	2	3	4	5

1. How often do you think about religious issues?

2. To what extent do you believe that God or something divine exists?

3. How often do you pray?

4. How interested are you in learning more about religious topics?

5. To what extent do you believe in an afterlife—e.g. immortality of the soul, resurrection of the dead or reincarnation?

6. How important is it to take part in religious services?

7. How important is personal prayer for you?

8. How often do you keep yourself informed about religious questions through radio, television, internet, newspapers, or books?

9. In your opinion, how probable is it that a higher power really exists?

10. How important is it for you to be connected to a religious community?

11. How often do you pray spontaneously when inspired by daily situations?

12. How often do you experience situations in which you have the feeling that God or something divine is present?

13. How often do you experience situations in which you have the feeling that God or something divine wants to communicate or to reveal something to you?

14. How often do you experience situations in which you have the feeling that God or something divine intervenes in your life?

Spirituality Items

Not at All Slightly Somewhat Very Much Extremely High Degree
1 2 3 4 5 6 7 8 9

1. To what extent do you consider yourself a spiritual person?

2. To what extent is spirituality important to you?

3. To what extent does spirituality contribute to your life?

Religion as Quest Scale

Strongly Disagree Somewhat Disagree Neither Agree nor Disagree
1 2 3 4 5 6
Somewhat Agree Strongly Agree
7 8 9

1. It might be said that I value my religious doubts and uncertainties.

2. I do not expect my religious convictions to change in the next few years.

3. I have been driven to ask religious questions out of a growing awareness of the tensions in my world and in my relation to my world.

4. My religious development has emerged out of my growing sense of personal identity.

5. God wasn't very important to me until I began to ask questions about the meaning of my own life.

6. Questions are far more central to my religious experience than are answers.

APPENDIX C

TABLE 1

Table 1

Descriptive statistics of Demographics

Participant Age (Years)	*M* (*SD*)	38.01 (12.94)
Participant Gender	Male (%)	229 (45.7)
	Female (%)	266 (53.1)
	Prefer not to answer (%)	1 (0.2)
	Other	3 (0.6)
Participant Ethnicity	Hispanic/Latino (%)	39 (7.8)
	Non-Hispanic/ Non-Latino (%)	460 (91.8)
Participant Race	Wite (%)	397 (79.2)
	Black/African American (%)	42 (8.4)
	American Indian or Alaska Native (%)	5 (1.0)
	Asian (%)	37 (7.4)
	Multiracial (%)	11 (2.2)
	Other (%)	8 (1.6)
Participant Education Level	Some or No High School (%)	1 (0.2)
	High School Degree or GED (%)	51 (10.2)
	Some College/2-Year College Degree (%)	151 (30.1)
	4-Year College Degree (%)	194 (38.7)
	Some Graduate School	17 (3.4)

	(%)	
	Master's Degree (%)	61 (12.2)
	PhD or Professional Degree (%)	17 (3.4)
Participant Area of Study	Physical or Life Science (%)	62 (12.4)
	Social Science (%)	57 (11.4)
	Math/Statistics (%)	21 (4.2)
	Business (%)	94 (18.8)
	Humanities (%)	42 (8.4)
	English (%)	41 (8.2)
	Arts (%)	50 (10.0)
	Computer Science/IT (%)	71 (14.2)
	Other (%)	62 (12.4)
Participant Political Affiliation	Strong Republican (%)	35 (7.0)
	Moderate Republican (%)	45 (9.0)
	Weak Republican (%)	37 (7.4)
	Strong Democrat (%)	96 (19.2)
	Moderate Democrat (%)	83 (16.6)
	Weak Democrat (%)	49 (9.8)
	Independent (closer to Republican than Democrat) (%)	33 (6.6)
	Independent (closer to Democrat than Republican) (%)	55 (11.0)
	Independent (with no leaning toward Republican or Democrat)	52 (10.4)

	(%)	
	Other (%)	10 (2.0)
	Prefer not to answer (%)	5 (1.0)
Political Ideology (Social)	Extremely Liberal (%)	99 (19.8)
	Moderately Liberal (%)	104 (20.8)
	Slightly Liberal (%)	95 (19.0)
	Neither Liberal nor Conservative (%)	76 (15.2)
	Slightly Conservative (%)	56 (11.2)
	Moderately Conservative (%)	47 (9.4)
	Extremely Conservative (%)	22 (4.4)
Political Ideology (Economic)	Extremely Liberal (%)	68 (13.6)
	Moderately Liberal (%)	95 (19.0)
	Slightly Liberal (%)	81 (16.2)
	Neither Liberal nor Conservative (%)	90 (18.0)
	Slightly Conservative (%)	77 (15.4)
	Moderately Conservative (%)	57 (11.4)
	Extremely Conservative (%)	32 (6.4)
Participant Religious Affiliation	Catholic (%)	112 (22.4)
	Protestant (%)	120 (24.0)
	Jewish (%)	15 (3.0)
	Latter-Day Saint (%)	7 (1.4)

	Buddhist (%)	8 (1.6)
	Hindu (%)	4 (0.8)
	Islamic (%)	12 (2.4)
	Nontrinitarian (%)	1 (0.2)
	Other Religious Affiliation (%)	31 (6.2)
	I am religious or spiritual, but have no religious affiliation (%)	53 (10.6)
	I am not religious or spiritual and have no religious affiliation (%)	136 (27.1)
Participant Church Attendance Rate	Never (%)	242 (48.3)
	A few times a year (%)	107 (21.4)
	More than a few times a year but less than once a month (%)	28 (5.6)
	1-3 times per month (%)	34 (6.8)
	Once a week (%)	67 (13.4)
	More than once a week (%)	16 (3.2)

APPENDIX D

TABLE 2

Table 2

Correlations between Key Study Variables

	1	2	3	4	5	6	7
1. Education Level	1.00						
2. Church Attendance	.13**	1.00					
3. Scientific Merit	-.03	-.001	1.00				
4. Religiosity	.04	.71**	.006	1.00			
5. Spirituality	.03	.56**	.05	.88**	1.00		
6. Quest	.09*	.29**	-.01	.49**	.46**	1.00	
7. Perceived Conflict	-.004	-.12**	.08	-.17**	-.18**	-.002	1.00

Note: *$p < .05$, **$p < .01$.

APPENDIX E

TABLE 3

Table 3

Regression Coefficients for Exploratory Moderation Analyses: Religiosity, Spirituality, and Quest

Variable	B	SE_B	*p*
Constant	6.49	0.06	< .001
Religious vs. Nonreligious Condition			
(0 = nonreligious, 1= religious)	-0.32	0.12	.01
Religiosity (mean centered)	0.003	0.05	.96
Condition x Religiosity	-0.05	0.1	.63
Constant	6.48	0.06	< .001
Religious vs. Nonreligious Condition			
(0 = nonreligious, 1= religious)	-0.027	0.11	.02
Spirituality (mean centered)	0.02	0.02	.42
Condition x Spirituality	-0.01	0.04	.86
Constant	6.49	0.06	< .001
Religious vs. Nonreligious Condition			
(0 = nonreligious, 1= religious)	-0.23	0.11	.03
Quest (mean centered)	-0.02	0.04	.62
Condition x Quest	0.04	0.07	.60

APPENDIX F

TABLE 4

Table 4

Regression Coefficients for Exploratory Moderation Analyses: Religiosity, Spirituality, and Quest

Variable	B	SE_B	*p*
Constant	6.49	0.06	< .001
Religious vs. Nonreligious Condition			
(0 = nonreligious, 1= religious)	-0.28	0.11	.015
Education Level (mean centered)	-0.07	0.05	.114
Condition x Education Level	0.1	0.09	.257
Constant	6.49	0.06	< .001
Religious vs. Nonreligious Condition			
(0 = nonreligious, 1= religious)	-0.27	0.11	.211
Perceived Conflict (mean centered)	0.04	0.03	.017
Condition x Perceived Conflict	-0.14	0.06	.018

APPENDIX G

FIGURE 1

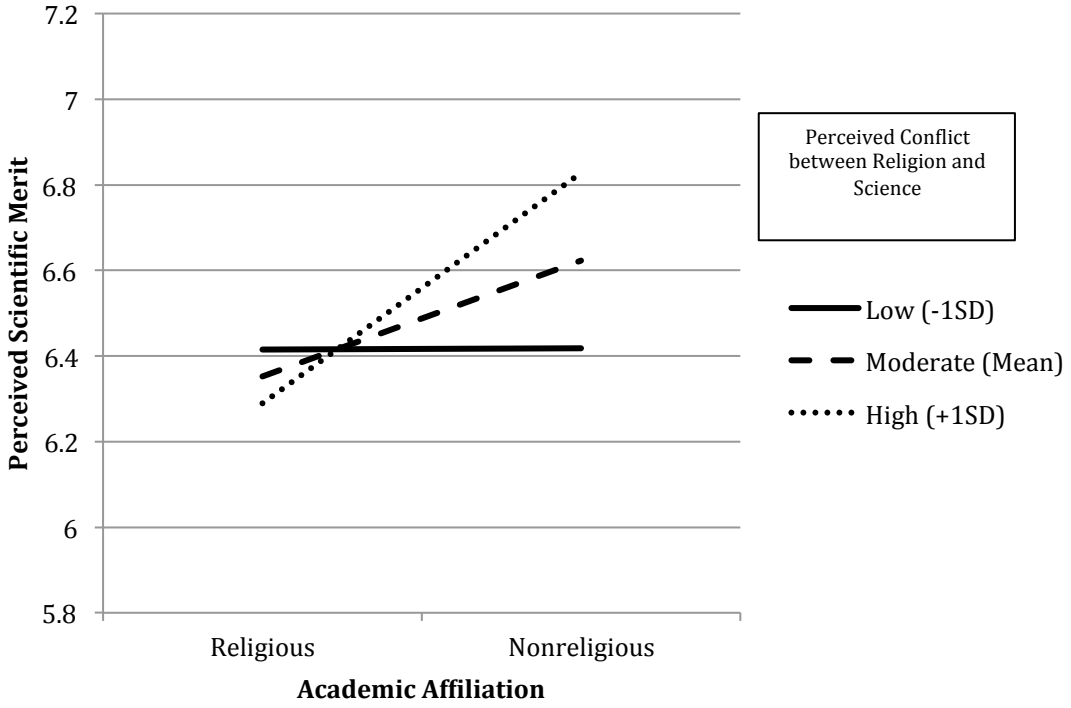

Figure 1. Moderation of Effect of Religious Affiliation Condition on Perceived Scientific Merit by Level of Perceived Conflict between Religion and Science.

APPENDIX H

FIGURE 2

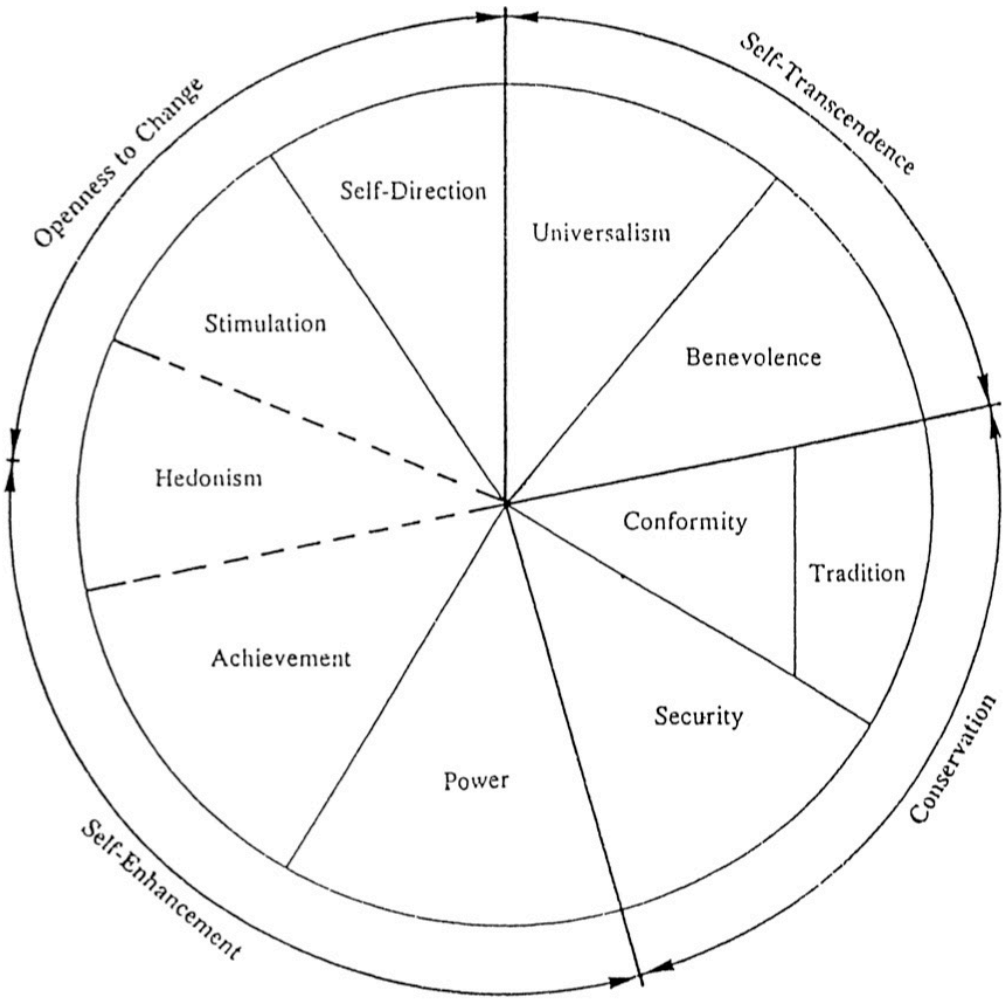

Figure 2. Schwartz's Human Values Model (from Schwartz & Huismans, 1995).