

HOW CONCERNS OF DEATH AFFECT SCIENTIFIC VIEWS: THE EXISTENTIAL  
UNDERPINNINGS OF SUPPORT FOR INTELLIGENT DESIGN AND DISCOMFORT  
WITH EVOLUTION

by

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## ABSTRACT

Intelligent design theory (IDT) has received support from the general public, educators, elected officials, and a minority of scientists, who advocate that it be taught alongside evolutionary theory (ET) in high school science classes. Correspondingly, ET has faced considerable opposition from these groups. Given the tremendous amount of scientific evidence supporting ET and the fact that IDT is inherently unscientific (AAAS, 2006) and lacks any empirical support, it is important to understand the underlying psychological motives that likely influence these views. We tested whether the popularity of IDT and antagonism toward ET might be partially accounted for by IDT's more existentially satisfying explanation of life's origins. In four studies, we found that reminders of death in a diverse range of participants increased acceptance of IDT and/or rejection of ET. These effects were reversed among participants who learned that naturalism, which underlies ET but not IDT, can be a source of transcendent meaning (Study 4), and among natural-science-student participants, for whom ET is an existentially meaningful worldview (Study 5). These reversals demonstrate that individuals' tendency to respond to mortality salience by shifting their scientific beliefs is likely due to a search for transcendent meaning in response to existential threat. Finally, the failure to find effects of mortality salience on acceptance of IDT or ET among a sample of Christian club members (Study 6), who likely already hold an existentially satisfying worldview, is discussed. This research highlights the previously unrecognized factor that is causally related to the formation of scientific beliefs, and indicates when and for whom this factor is most likely to operate.

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## **DEDICATION**

To Marjali

## INTRODUCTION

(Intelligent design) proponents are not Luddites, objecting to science and its technological fruits, but they do not like naturalistic evolution. Like all conservative Christians, they insist on a significant explanatory role for God, and in life having a divinely directed purpose and meaning. Evolution epitomizes the offensive, strictly materialist framework in which scientists practice science today. (Scott, 1997, p.283)

It is an all too common error to confuse intelligent design with religious belief. While creationism draws its conclusions primarily from religious sources, intelligent design argues from observations of the natural world. And it has a good pedigree. A universe intelligible by design principles was the conclusion of many of the great pioneers of modern science. (Noble, 2009, para. 4)

Only 39% of Americans "believe in evolution" (Gallup, 2009). A quarter of high school biology teachers in the U.S. devote at least some class time to the teaching of intelligent design theory (IDT; the belief that an intelligent designer created life as we know it today), with nearly half of those teachers viewing it as a valid scientific alternative to evolution (Berkman, Pacheco, & Plutzer, 2008). Given that IDT is inherently unscientific (AAAS, 2006), why do some science educated individuals, such as science teachers, endorse intelligent design over evolution? As the opening quotations suggest, the common assumption is that religious motives underlie the fervent support IDT has seen since its emergence. However, proponents of IDT claim that it is a

scientific theory and not based on religion. Although religious views likely play a role in the widespread support for IDT, and antagonism towards ET, given the explicit claim that IDT is scientific and the lack of scientific credibility for it, underlying psychological motives likely influence the willingness of educated individuals to accept IDT as a viable scientific alternative to ET. We argue that acceptance of IDT and rejection of ET may be partly explained by underlying existential concerns, and that support for IDT may be a "terror management" (Pyszczynski, Solomon, & Greenberg, 2003) strategy, allowing those who wish to maintain some allegiance to the scientific worldview, but who find ET to lack any sense of transcendent meaning, to embrace a seemingly scientific theory of life's origins that also addresses broader existential concerns.

### **Intelligent Design Theory**

Proponents of IDT contend that it is a scientific theory, which argues that natural phenomena are too complex to be explained through natural processes, such as evolution, and thus the only possible explanation for the complexity of life is that it was created by an "intelligent designer". For example, leading proponent and biochemist Michael Behe (1996) has argued that biological components, such as the human eye, could not function without all of their parts, and, according to Behe, if the human eye could not function, albeit less effectively, with parts missing, then it must have been created in its current form. Because IDT states that biological components could only have resulted from an intelligent designer creating them, it is likely to be particularly appealing to religious believers because it readily allows for the existence of a God (i.e., the intelligent designer).

Although proponents of IDT claim it is not based on religious ideology (Behe, 1996), the history of the IDT movement can be traced directly back to religious creationism (Scott, 2009).

IDT has been called "creationism in a cheap tuxedo" ("Warning," 2005) and "creationism's Trojan horse" (Forrest & Gross, 2004). The clearest evidence for IDT's religious underpinnings came from early drafts of the pro-IDT science textbook, *Of Pandas and People* (Davis & Kenyon, 1989). The drafts, which were not intended for public consumption but were discovered during a Dover, PA trial, revealed that the term "creationism" was frequently used, and was replaced with the term "intelligent design" in later drafts. Thus, the authors of this textbook made an explicit connection between religious creationism and intelligent design (McMaster, & Johnstone, 2007). Simply put, IDT is creationism masked in scientific language, and written by tenured scientists (e.g., Behe, 1996). Although IDT has been written about most extensively by scientists, the theory has widely been advertised among religious believers (Scott, 1997). Because IDT allows for the existence of God, religion likely plays an important role in the IDT movement.

Despite its religious history, IDT is consistently portrayed as a scientific theory by its proponents (e.g., Behe, 1996). Consistent with this notion, the majority of letters to editors on IDT that appeared in major U.S. newspapers from 1986 to 2003 portrayed it as a scientific theory (Martin, Trammell, Landers, Valois, & Bailey, 2006). More to the point, the "founding document" (Scott, 2009) of IDT, *The Mystery of Life's Origin*, was written in 1984 by three scientists: Dr. Charles Thaxton, a physical chemist; Dr. Walter Bradley, the former Head of the Department of Mechanical Engineering at Texas A&M; and Dr. Roger Olsen, a geochemist (Thaxton, Bradley, & Olsen, 1984). Books on IDT include the science-class textbook *Of Pandas and People*, which was published a few years after *The Mystery of Life's Origin* in an attempt to push IDT into U.S. high-school biology classrooms. Other science-themed IDT books followed, most notably biochemist Michael Behe's *Darwin's Black Box* (1996). *Darwin's Black Box* was written by a tenured, peer-reviewed research scientist, used scientific language, portrayed IDT as

a scientific theory, and was published as a popular science book by a mainstream publisher (i.e., Free Press). However, despite the appearance of being scientific, a Dover Pennsylvania court ruled in 2005 that IDT is not scientifically based and is instead religiously based (McMaster, & Johnstone, 2007). More specifically, IDT is inherently *unscientific* because it does not rely on natural explanations, and is scientifically untestable (AAAS, 2006). In addition, according to many, including IDT proponent Michael Behe, the definition of science would have to be so broad in order to place IDT within the realm of science that pseudosciences would also be considered scientific, including astrology (McMaster, & Johnstone, 2007). Consequently, the claim that IDT is in line with scientific principles is necessarily false, and, unsurprisingly, there is no scientific evidence in support of IDT.

Despite its lack of scientific evidence and inherently false claim to be a scientific theory, IDT has received considerable support from the general public. As of February 21st, 2009, *Darwin's Black Box* was ranked 3rd on Amazon.com's bestsellers list for books on organic evolution. The 2008 mainstream film "Expelled: No Intelligence Allowed" portrayed IDT as a viable scientific theory that is being unfairly silenced under the oppressive, dominant Darwinistic view. It opened in over 1,000 theatres, which at the time was the largest number of theatres to ever open a documentary (boxofficemojo.com, n.d.b). The film made nearly \$3 million on its opening weekend, putting it ahead of notable Oscar winning documentaries such as Al Gore's "An Inconvenient Truth" and Michael Moore's "Bowling for Columbine" (boxofficemojo.com, n.d.a).

Elected officials have also endorsed IDT. Former President George W. Bush stated in 2005 that "both [IDT and ET] ought to be properly taught... so people can understand what the debate is about" (Bumiller, 2005). Similarly, former Senate Majority Leader Bill Frist ("Frist voices support," 2005), State Senator Stephen Wise (Soergel, 2009), Senator Chris Butters (Free

Library, 2005), and Senator Sam Brownback (Brownback, 2005) have also voiced support for IDT. In addition, school boards in several U.S. states have moved to teach IDT alongside ET in high-school science classes (Gewin, 2005), and several of these boards have been successful. Louisiana now allows outside sources, such as pro-IDT material, to be used in science classes. In 2008, the Texas state education board voted to allow IDT to be taught alongside ET; this law will affect the content of the state's science textbooks for the next 10 years. In January, 2010, a bill was introduced in Mississippi that would require arguments for and against ET in high school biology classes. Despite the Dover, PA, ruling in 2005 that IDT cannot be included in Pennsylvania high school science classes, the IDT movement continues to garner considerable support.

The spread of IDT at the expense of ET is not limited to the U.S. In Canada, the Minister of State for science and technology refused to answer when questioned about whether he supported ET, stating "I am a Christian, and I don't think anybody asking a question about my religion is appropriate" (McIlroy, 2009). In addition, the Social Sciences and Humanities Research Council of Canada (SSHRC) refused to fund research on the consequences of the IDT movement on the grounds that there was not "adequate justification for the assumption... that the theory of Evolution, and not Intelligent Design, was correct" (Hoag, 2006). Finally, in June, 2009, the province of Alberta passed a law that would allow parents to remove their children from science courses that include evolution ("Evolution Classes," 2009).

Support for IDT and opposition to ET have also spread beyond North America. In Asia, considerable controversy arose in September of 2009 when new guidelines were being created for science education at all levels in Hong Kong. The point of contention was a component of the guidelines that included 'alternatives' to evolution (i.e., IDT) that were to be taught (Cyranoski, 2009). In Europe, in late 2006, a pro-IDT group sent out 'information packages' that promoted

IDT to all of the secondary school science departments in the U.K. At least 59 of these schools reported that these packages were useful teaching tools (Randerson, 2006). Similarly, in 2009 a consortium of 30 Christian groups sent out materials to every household in the Netherlands that tried to discredit ET as an 'unproven theory' (de Hond, 2009).

ET, however, is not an unproven theory. As biology professor Kenneth Miller, an expert witness in the Dover, PA, trial, stated, "not a single observation, not a single experimental result has ever emerged in 150 years that contradicts the general outlines of the theory of evolution." he continues, "Any theory that can stand up to 150 years of contentious testing is a pretty darn good theory, and that's what evolution is" (McMaster, & Johnstone, 2007). Given that IDT is not a scientific theory, yet it has international appeal, whereas the true scientific theory, ET, is widely opposed, it is important to understand the motives that influence these views. Religiosity likely plays a role; however, given that supporters include science educated individuals, underlying psychological motives are also likely to play a role.

Indeed, recent studies have demonstrated that psychological motives, which often operate implicitly, can play an important role in shaping sociopolitical beliefs and ideologies. For example, based on their comprehensive meta-analysis and literature review, Jost, Glaser, Kruglanski, and Sulloway (2003) concluded that political conservatism is at least partly rooted in the basic human need to manage feelings of threat and uncertainty. The authors reviewed evidence showing that politically conservative attitudes relate positively to death anxiety, intolerance of ambiguity, and low self-esteem. The desire to find meaning is another psychological motive that influences sociopolitical views. According to the Meaning Maintenance Model (MMM; Heine, Proulx, & Vohs, 2006), humans have a tendency to establish relationships between concepts (i.e. meaning). When meaning is threatened, for example, by a perceptual anomaly (e.g., having an experimenter switched without participants consciously

knowing; Proulx & Heine, 2008), people are motivated to re-establish meaning, by affirming other meaning frameworks. Studies have found that after a meaning threat, participants are more inclined to punish cultural norm violators, thereby affirming the meaning framework that norm violators should be punished, by suggesting a harsher bond for a convicted prostitute (Proulx, & Heine, 2008).

Terror Management Theory (TMT) posits that, instead of a desire to find meaning between concepts, people are largely motivated by existential angst—concerns about their mortality and the consequent meaninglessness of life (Greenberg, Pyszczynski, & Solomon, 1986). Mortality concerns have also been found to influence sociopolitical beliefs. For example, researchers have found that reminding people of their own mortality, thereby activating an unconscious motive to maintain psychological security, influences attitudes toward hypothetical political candidates (Cohen, Solomon, Maxfield, Pyszczynski, & Greenberg, 2004), actual political figures (e.g., George W. Bush and John Kerry), foreign policy strategies (e.g., Landau et al., 2004; Pyszczynski et al., 2006), and individuals that disparage one's political view (McGregor et al., 1998). Thus, although dispositional political and religious ideologies may be central factors underlying the success of the IDT movement and corresponding doubt about ET, fundamental psychological motives, such as the need to maintain psychological security, are also likely to influence these beliefs when activated.

In the present research, we examined whether implicit anxieties stemming from individuals' awareness of their own mortality might be a cause of the widespread support for IDT and skepticism of ET seen among a wide range of North Americans. Specifically, we tested whether heightened awareness of mortality would lead individuals to embrace IDT and reject ET. We hypothesized that acceptance of IDT, and corresponding rejection of ET, may be a

“terror management” strategy – that is, stimulated by the basic need to maintain psychological security (Pyszczynski, et al., 2003).

### **Terror Management and Acceptance of Intelligent Design versus Evolution**

Building on the work of Becker (1973), Terror Management Theory (TMT) posits that humans’ unique awareness of their mortality and eventual death has the potential to produce debilitating terror and anxiety (Greenberg, et al., 1986). In order to avoid explicitly experiencing chronic dread in response to the frequent but subtle mortality reminders that confront most people in everyday life, individuals are thought to regularly employ implicit psychological mechanisms that inhibit death-related thoughts, and thereby prevent the experience of terror (Pyszczynski et al., 2003). These mechanisms include enthusiastic adherence to meaningful, existentially satisfying conceptions of reality, referred to as “worldviews,” such as religious, moral, and political belief systems. Worldviews may promote a sense of immortality—thereby buffering against existential anxiety—by construing the universe as an orderly, comprehensible, predictable, and meaningful place where death can be literally or symbolically transcended. For example, a sense of literal immortality may be provided by religious belief in an afterlife (Jonas & Fischer, 2006; Norenzayan & Hansen, 2006), and a sense of symbolic immortality may be provided by “living on” through one’s accomplishments, offspring, or cultural affiliations (Lifton, 1983).

IDT may be one such equanimity-providing worldview, albeit a slightly unusual one. IDT proposes that current naturalistic accounts are insufficient to explain complex organic phenomena and that therefore an intelligent and presumably supernatural “designer” is responsible for the origin of all life (Behe, 1996). IDT may calm existential concerns through the implications of its assertion that human life was intentionally created, rather than resulting from

seemingly random and meaningless forces of nature (e.g., natural selection). This may provide a sense of symbolic immortality—taking comfort in something larger and more significant than one’s own brief life—via the understanding there is a purpose to the human enterprise.

Furthermore, whereas many mollifying religious and ideological worldviews have little appearance of being evidence-based or rationally derived, IDT is presented as a scientific theory, and was proposed and developed by scientists who are tenured faculty at major academic institutions (e.g., Behe, 1996; Behe, Dembski, & Meyer, 2000). This packaging may make IDT existentially appealing in a broader way than most worldviews, which tend to be adhered to in response to existential threat only by dispositional devotees (e.g., Rosenblatt, Greenberg, Solomon, Pyszczynski, & Lyon, 1989). By couching their theory in explicitly scientific terms, IDT’s authors have made the theory amenable to educated individuals with some level of basic scientific knowledge—individuals who may be hesitant to adopt explicitly religious resolutions to existential concerns. For the average college-educated North-American, it may be difficult to embrace a Biblical view of the world and simultaneously maintain a feeling of belongingness in the broader culture of Western science-educated individuals, not to mention derive satisfaction from the sense of certain understanding of the world that science offers. IDT may provide a solution to this quandary; it is written as a scientific theory that appears largely consistent with accepted scientific knowledge, addressing educated individuals’ need to maintain a sense of connection with their dominant cultural worldview—yet, by implying an intentionality to the human enterprise, it provides additional equanimity in the face of death and meaninglessness, addressing the basic human need to manage existential anxiety and terror. IDT thus may be viewed as an attempt to retain the psychological merits of science while compensating for its psychological shortcomings, and because it superficially appears consistent with both the scientific and religious worldviews, a wide range of individuals (e.g., some science teachers,

university students, religious believers) may feel that they can support IDT and maintain allegiance to their science-educated and/or religious communities.<sup>1</sup>

In contrast, on its face, ET does not confer any sense of greater meaning or purpose, instead asserting that human life is the result of the same natural forces that produce bacteria and cockroaches. Although scientists may be able to find a sense meaning and purpose in life from the notion that all life is connected by virtue of resulting from the same explicable biological forces, for the average non-scientist ET may appear quite existentially bleak. Consequently, existential concerns may lead individuals to question ET, particularly if IDT is an available option. Consistent with this expectation, Goldenberg and colleagues (2001) found that reminding individuals of their mortality led them to prefer an essay emphasizing human uniqueness over an essay emphasizing humans' biologically evolved animal nature (i.e., their "creatureliness")—the latter of which is akin to reminding individuals of the implications of ET. Similarly, priming individuals with creatureliness has been found to increase death-thought accessibility (Cox, Goldenberg, Pyszczynski, & Weise, 2007). Consistent with this claim, under reminders of death participants show increased dislike for breast-feeding, which has been associated with creatureliness cognitions (Cox, Goldenberg, Arndt & Pyszczynski, 2007). A study that directly examined the relation between existential angst and views of ET found that creationists who read about ET responded with heightened death-thought accessibility (Schimel, Hayes, Williams, & Jahrig, 2007). More broadly, studies have shown that the stronger individuals' belief in evolution, the less likely they are to believe in concepts such as a soul or the afterlife (Lombrozo, Thanukos, & Weisberg, 2008). Indeed, the negative correlation between religious and evolution beliefs can largely be accounted for by belief in God and the afterlife, suggesting that acceptance of evolution may be untenable for those who have taken a more spiritual approach to finding meaning in life, and vice-versa.

Nonetheless, it is also possible that existential anxieties would not necessarily lead to the rejection of ET, at least in individuals who are familiar with the theory, despite the theory's strong negative stance on the question of whether human life was intentionally created. Studies have shown that death reminders (i.e., mortality salience primes) typically motivate more fervent support of accepted cultural worldviews (Pyszczynski et al., 2003), so we might expect science-educated individuals, and natural-science students in particular, to respond to heightened mortality salience by staunchly supporting ET, given that, in the Western scientific worldview, ET is the most widely accepted and empirically supported explanation of species' origins. At the very least, some science-educated individuals—such as the undergraduate psychology students who constitute most psychological research samples—may find themselves unable to reject ET as a way of assuaging existential anxiety, given the importance of ET to their psychology-student cultural worldview. These individuals may nonetheless embrace IDT in such circumstances, given the theory's scientific veneer, but they may fail to see its logical incompatibility with ET—an incompatibility that tends to be downplayed by IDT proponents (e.g., Behe, 1996, October 29), and thus avoid shifting their views on the more standard scientific doctrine. Thus, while we expected most individuals to respond to heightened mortality salience by espousing a stronger belief in IDT and weaker belief in ET, we expected university-educated psychology students to respond by embracing IDT, but not necessarily changing their views of ET.

### **The Present Research**

In 6 studies, we manipulated participants' awareness of their own death, then asked them to read a passage about ET and/or a passage about IDT. After reading each passage, participants rated how much they liked the authors and agreed with the theory; these ratings served as the

dependent variable in each study (see Appendix A). In Study 1, we used a within-subjects design, and participants were psychology undergraduate students. Study 2 again used a within-subjects design, but tested whether effects generalized beyond the fairly homogeneous sample used in Study 1, by including a more diverse sample of undergraduate students from across North America. In an attempt to maintain ecological validity, in both Studies 1 and 2 we used published passages, written by leading experts on ET and IDT, to expose participants to these theories. These passages are available to the public, and thus represent the way in which many individuals will in fact encounter the theories.

In Study 3, we used a between-subjects design, and, to control for the possibility that the passages used in Studies 1 and 2 had stylistic differences, or content differences beyond the specifics of IDT or ET which influenced results, we used controlled passages that were made to be identical (except for the key manipulated variables) across conditions. In addition, to test whether effects generalize more broadly, to the general population outside the university domain, Study 3 included a large non-student adult sample. In Study 4, we used a between-subjects design, and again a psychology undergraduate sample. The main goal of Study 4, however, was to test our theory about the causal process underlying effects—that shifting views of IDT and ET in response to mortality salience was a result of participants seeking to support a theory that addressed existential concerns. Thus, in Study 4, we manipulated whether naturalism, the scientific perspective that underlies ET but not IDT, was presented as providing transcendent meaning. We expected that the meaningful-naturalism manipulation would moderate the effect of mortality salience on views of IDT and ET. Our focus, here, on the importance of experiencing a sense of transcendent meaning as a way of coping with existential dread, is consistent with previous research demonstrating humans' basic need to maintain meaning (Heine, Proulx, & Vohs, 2006; Proulx & Heine, 2009). However, to our knowledge, this is one

of the first studies to directly manipulate the meaningfulness of a potential terror-management mechanism, to test whether a fundamental motivation to find greater existential meaning accounts for effects of mortality salience.

To establish boundary conditions, in Study 5 we used a within-subjects design and a sample of natural-sciences students (e.g., biology, chemistry, physics), for whom evolution and naturalism are already a primary source of meaning and a central worldview. For these individuals, we had the opposite prediction as in previous studies; given their predominant belief system, they were expected to respond to mortality salience by showing greater support for ET, the theory that provides them with a sense of meaning and even identity, and greater antagonism toward IDT, which they should recognize as scientifically invalid and thus inconsistent with their central worldview. In Study 6, we used a within-subjects design and a sample of students who were members of Christian religious clubs, individuals likely to hold strong religious views. For these individuals, IDT is likely appealing since it allows for the existence of a God. For these individuals, we had the same prediction as Studies 1 through 4, that they would respond to mortality salience by showing greater support for IDT, the theory that provides them with a sense of existential meaning and is consistent with their religious worldview, and greater antagonism toward ET, which is inconsistent with their central worldview. However, given the importance of their religious beliefs, we expect the effects to be stronger among Christian religious club members than Studies 1-4. On the other hand, since Christian club members already have a stable defence against existential angst in their religious views, they may not need to embrace a theory that appears to be secular on its surface (i.e., IDT) after reminders of death. Consistent with this account, previous research has found that religious participants do not reject an author who is critical of a secular institution after a death reminder, presumably because their religious views act as a defence against mortality concerns (Norenzayan, Dar-Nimrod, Hansen,

& Proulx, 2009). Thus, although we expect religious club members to respond to a death reminder with increased support for IDT, there is also the possibility that IDT is too far removed from religion to be affirmed by Christian club members.

In all six studies, we also examined whether effects were due to increased religiosity in response to mortality salience, and whether they varied by dispositional belief systems such as Christianity. Journalists, educators, and political commentators have assumed that public support for IDT results from religious fervor and a Christian desire to reinstate the teaching of creationism (Martin, et al., 2006). Furthermore, studies have shown that mortality salience promotes increased belief in supernatural beings and the afterlife, among religious individuals (Norenzayan & Hansen, 2006; Osarchuk & Tatz, 1973), and that religiosity protects against existential concerns (Jonas & Fischer, 2006). These findings suggest that if heightened existential concerns promote shifting views of ET and IDT, they may do so via the mediational path of increased religiosity, or only for individuals expressing a Christian faith. However, IDT is not explicitly religious, makes no promise of an afterlife, and reads more like a scientific theory than a religious one. Thus, IDT may provide the existential benefits of religion even in non-religious individuals—which would have major implications for the many individuals who either do not have strong religious convictions or would like to reconcile their religious beliefs with their science education. The theory may provide a solution for individuals caught in the ever-present opposition between religion and science (Dawkins, 2006), and who would rather avoid choosing between the two. In other words, belief in IDT may be a ‘blanket’ terror management strategy, utilized by individuals as a way of regulating existential threat, regardless of their religious affiliations or religiosity.

No previous study has examined whether the implicit motive of terror management might account for the widespread public support for IDT seen throughout the U.S. and other Western

nations. The present research is thus the first to examine whether psychological motives influence the ongoing debate between proponents of IDT and ET—a debate which, at present, may be the most salient of any scientific or educational debate in popular culture, and which likely has the largest influence on the future of science education.

## STUDY 1

### Method

#### Participants

122 undergraduate psychology students at East or West coast universities (72% female; 43% at Union College, 57% at University of British Columbia) completed paper/pencil or online questionnaires in exchange for course credit (effects did not vary by university or questionnaire method).<sup>2</sup>

#### Procedure

Participants were randomly assigned to either an experimental mortality-salience (MS) condition, in which they were asked to write about the thoughts and feelings aroused by imagining their own death (previously found to promote mortality salience), or to a control condition in which they were asked to write about the thoughts and feelings aroused by imagining dental pain (Pyszczynski et al., 2003). They then completed a mood measure (the Positive and Negative Affect Schedule, or PANAS; Watson, Clark, & Tellegen, 1988), allowing us to test whether mood might influence responses, and to create a delay between the independent and dependent variables. (Previous research has shown that the psychological mechanisms used to manage death anxiety typically take effect after unrelated distracter tasks such as this, due to effortful suppression of anxiety thought to occur immediately after mortality reminders; Pyszczynski et al., 2003; Pyszczynski, Greenberg, & Solomon, 1999).

Participants next read a passage arguing for ET, which, they were told, was “written by Professor Richard Dawkins, a famous evolutionary theorist,” and a passage arguing for IDT, “written by Professor Michael Behe, a famous scientist who argues for the theory of intelligent

design.” Both passages, fully reproduced in Appendix B, were excerpted (and slightly amended) from the authors (Behe, 1996; Behe, et al., 2000; Dawkins, 1996; Dawkins, 2006). Both were 174 words, written in a similar style, and made a similar analogy to the Copernican revolution. We also ensured that neither passage referred to religion, creationism, or any kind of supernatural belief. Instead, both passages read as brief descriptions of a scientific theory and extant empirical support for it; neither could be readily interpreted as espousing any religious ideology. Thus, if participants responded to mortality salience by embracing IDT, this response could not be attributed to a desire to embrace religion per se.

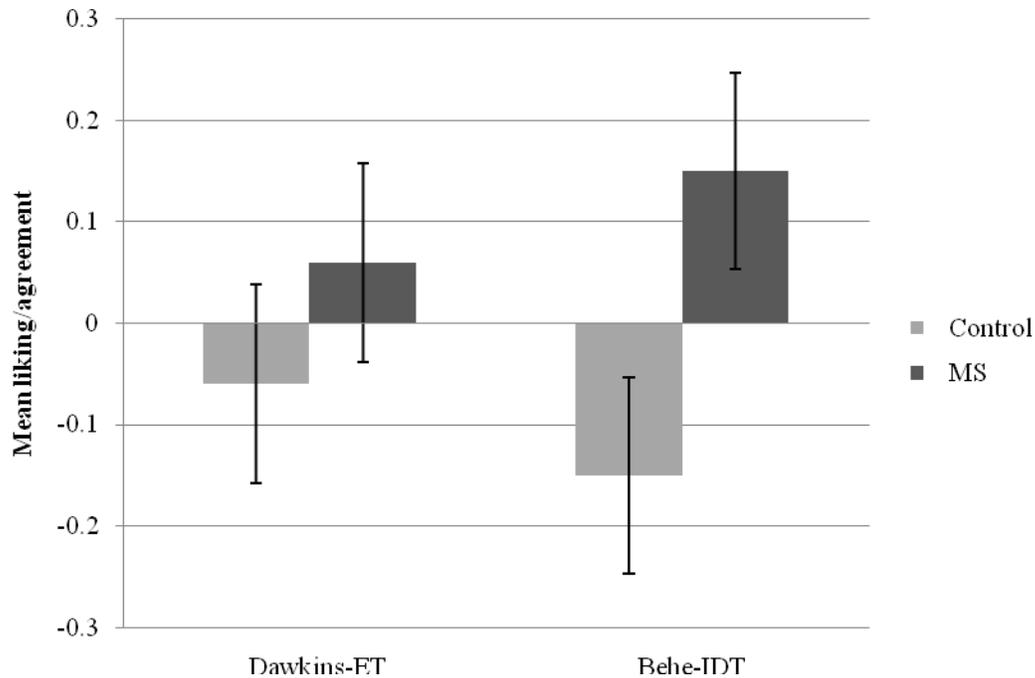
### **Measures**

Each passage was followed by a 7-item scale assessing participants’ liking and respect for the author and acceptance of the theory (based on Greenberg, Pyszczynski, Solomon, Simon, & Breus, 1994). Specifically, participants were asked to rate each author, using a 9-point scale ranging from 1 (“the least possible”) to 9 (“the most possible”), on how much they liked him, how intelligent they thought him to be, how knowledgeable they thought he was, how much they agreed with his view, and how true they thought his opinion was. They then were asked to rate, on a 5-point scale ranging from 1 (“strongly disagree”) to 5 (“strongly agree”), their level of agreement with two statements: “Evolutionary theory [intelligent design theory] is a solid theory supported by a great deal of evidence” and “Evolutionary theory [Intelligent design theory] is the best explanation we have of life’s origins.” The resulting 7-item scales (see Appendix A), computed using standard scores, were reliable;  $\alpha$ s = .86 for Behe-IDT and .87 for Dawkins-ET.<sup>3</sup> The order of the excerpted passages and scales (assessing views of Dawkins and ET, vs. Behe and IDT) was counterbalanced; no order effects emerged.

Finally, we collected demographic information and asked participants to respond to the question, “How religious are you?” using a 10-point scale ranging from 1 (“not at all”) to 10 (“extremely”). They also completed Gorsuch and McPherson’s (1989) intrinsic and extrinsic religiosity scales ( $\alpha$ s = .72 and .79, respectively). They then reported their religious affiliation, by choosing the most appropriate option from those provided, as follows: Buddhist (13%), Catholic (22%), Christian (11%), Christian Orthodox (4%), Hindu (8%), Jewish (2%), Muslim (4%), Protestant (8%), Spiritual but not religious (10%), and none of these (19%). Participants were also given the option to say “Other” and respond in an open-ended fashion; none did so.

## **Results and Discussion**

We first examined whether the experimental manipulation had a different effect on views of ET and Dawkins versus views of IDT and Behe. A mixed measures analysis of variance (ANOVA) showed no interaction between the author-theory scale and the manipulation,  $F(1,118) = .74$ , *ns*, indicating that the manipulation did not promote different responses toward the two theories and authors. However, as predicted, a main effect of experimental condition emerged on the Behe-IDT scale, indicating that participants in the MS condition expressed more positive views of Behe and IDT compared to participants in the control condition,  $t(119) = 2.23$ ,  $p < .05$ ,  $d = .41$  (see Figure 1). No difference (increase or decrease in positivity) emerged for views of Dawkins and ET. Thus, although the manipulation influenced support for IDT, as predicted, it did not significantly sway views of ET; participants neither embraced it as an accepted cultural worldview to be defended, nor rejected it as an unsatisfactory belief system in the face of existential threat. It is possible that a null effect emerged here because both of these competing forces—a desire to embrace ET and a desire to reject it—came into play.



**Figure 1.** Effects of mortality salience (MS) on liking of Behe and acceptance of intelligent design theory (IDT), and liking of Dawkins and acceptance of evolutionary theory (ET). Values are standard scores, and, given that the two scales were centered around different means, values in the Dawkins-ET and Behe-IDT conditions should not be directly compared to each other. The difference between the control and MS conditions on Behe-IDT was significant,  $p < .05$ .

Religiosity was positively related to views of Behe-IDT,  $r = .24$ , and negatively related to views of Dawkins-ET,  $r = -.30$ , both  $ps < .05$ , suggesting that more religious individuals tend to support IDT and dislike ET. Intrinsic and extrinsic religiosity showed a similar pattern of correlations with the two scales;  $rs = .29$  and  $-.34$  for intrinsic, and  $.21$ ,  $-.17$  ( $p = .07$ ), for extrinsic, on Behe-IDT and Dawkins-ET respectively; all  $ps < .05$  except as noted. However, none of the three religiosity measures were influenced by the MS manipulation,  $t(116) = 0.63$ , and  $ts(118) = 1.38$  and  $0.52$ , for the 10-point scale, intrinsic, and extrinsic religiosity, respectively, all  $ns$ , suggesting that the effect of MS on views of Behe-IDT was not due to any

effect the manipulation might have had on religious belief. Similarly, when religiosity was treated as a covariate, MS still significantly affected views of Behe-IDT,  $F(1,115) = 5.77$  (controlling for the 10-point religiosity scale), and  $F(1,116) = 7.75$  (controlling for intrinsic and extrinsic religiosity), both  $ps < .05$ . Perhaps most important, religiosity scores did not moderate the effect of MS on views of Behe-IDT,  $\beta s = -.09, -.05,$  and  $-.03$  for the 10-point scale, intrinsic, and extrinsic religiosity, all  $ns$ ; nor was there an interaction between religiosity and MS on Dawkins-ET,  $\beta s = -.13, -.05,$  and  $.03$  for the three scales, all  $ns$ .<sup>4</sup>

We also tested whether type of religion moderated the effect of MS on views of IDT or ET. We classified participants into Christian (including self-identified Christians, Christian-Orthodox, Catholics, and Protestants) or not Christian (including self-identified Buddhists, Hindus, Jews, Muslims, Sikhs, Spiritualists, and “None”) groups. Christianity is the religion that should be most supportive of IDT, given conceptual links between IDT and creationism, a central tenet of the Christian Bible, so if IDT is a worldview defence that works in the same manner as religious ideologies, Christians should be most likely to embrace IDT in response to mortality salience. As expected, main effects of Christianity emerged on views of both IDT-Behe,  $F(1,111) = 8.05$ , and ET-Dawkins,  $F(1,111) = 6.88$ , both  $ps < .05$ , indicating that Christians showed greater positivity than non-Christians toward Behe-IDT, and greater negativity toward Dawkins-ET ( $M s = 0.21$  vs.  $-0.16$  for IDT-Behe;  $-0.17$  vs.  $0.19$  for ET-Dawkins). However, there was no interaction between Christianity and the experimental manipulation on views of either Behe-IDT or Dawkins-ET,  $F s(1,111) = 0.10$  and  $1.22$ , both  $ns$ , indicating that the effect of MS on these variables did not differ for Christians versus non-Christians.

Finally, there was no effect of positive or negative mood on views of Behe-IDT or Dawkins-ET ( $|r/s$  ranged from  $.01$  to  $.10$ , all  $ns$ ). MS did not promote negative mood,  $t(119) =$

1.43, *ns*; but positive mood was slightly higher in the MS condition,  $t(119) = 2.00, p < .05$ , consistent with previous research (e.g., DeWall & Baumeister, 2007) and likely due to the fact that positive affect as assessed by the PANAS is largely a measure of high arousal or activation (Feldman Barrett & Russell, 1998).<sup>5</sup>

The findings from Study 1 suggest that acceptance of IDT may represent a “blanket” terror management strategy, utilized by individuals across levels of religiosity and religious affiliation. This implication is particularly likely given that these participants were university-educated psychology students, presumably well-versed in Darwinian evolution, and completing the study to obtain psychology course credit, yet responded to mortality salience by espousing greater support for Behe and IDT. However, the homogenous sample included here is also a limitation of the study; it remains unclear whether a more diverse sample, with students of more varied science backgrounds that better represent the educated public who have come to support IDT, would respond similarly. Study 2 addressed this issue.

## STUDY 2

### Method

#### Participants

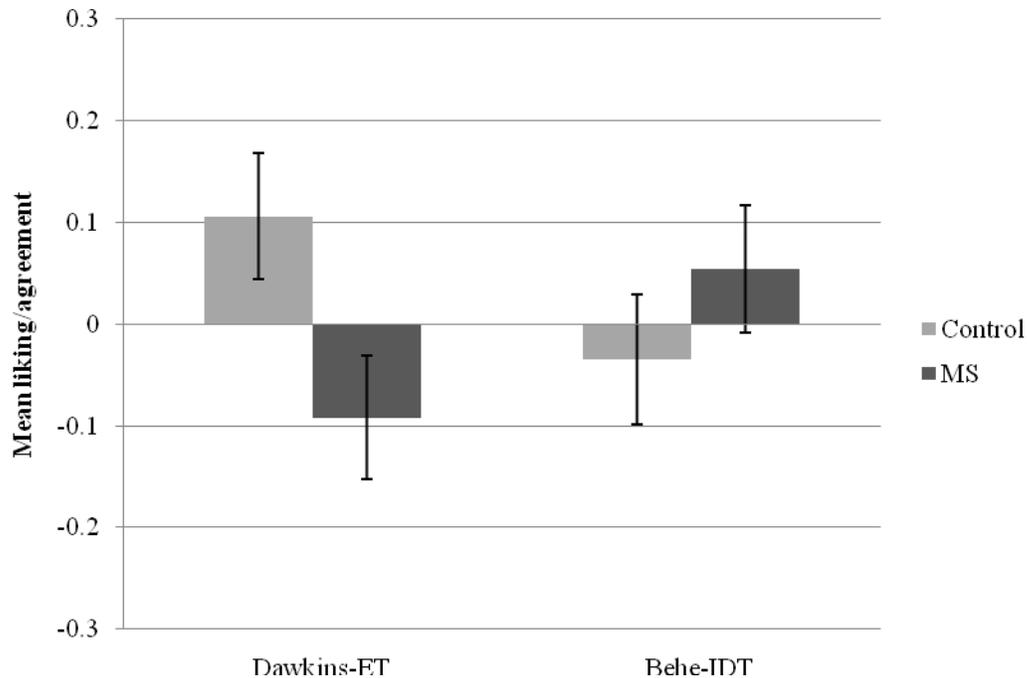
352 undergraduate students (40% female) from 179 universities in 45 U.S. states or Canadian provinces completed paper/pencil or online questionnaires (effects did not vary by university or questionnaire method), either for class credit or online “points” which could be converted to monetary or gift prizes (participants completing the study for online points were recruited by a survey research company).

#### Procedure

The procedure was the same as in Experiment 1, except that, after completing the PANAS, participants completed an additional distracter task assessing daily life events. We included the second distracter to ensure that enough time was provided (especially for participants completing the online version) for implicit motivational processes to take effect. The order of the excerpted passages and scales (assessing beliefs regarding Dawkins and ET, vs. Behe and IDT) was again counterbalanced; no order effects emerged. Scale scores for Dawkins-ET and Behe-IDT, again computed based on standard scores, were reliable; both  $\alpha$ s = .93. Participants rated their religiosity on the 10-point scale that was used in Study 1, and reported the following religious affiliations: Buddhist (3%), Catholic (22%), Christian (25%), Christian Orthodox (2%), Hindu (1%), Jewish (4%), Muslim (2%), Protestant (7%), Sikh (1%), Spiritual but not religious (11%), none of these (21%), and Other (1%).

## Results and Discussion

To determine whether the experimental manipulation had a different effect on views of ET and Dawkins versus IDT and Behe, we again conducted a 2 (Behe-IDT vs. Dawkins-ET) x 2 (MS vs. control) mixed-measures ANOVA on the author-theory scales, and found an interaction between the within-subjects factor of author-theory and the between-subjects factor of experimental condition,  $F(1, 350) = 3.94, p < .05$ , suggesting that the manipulation differentially affected participants' responses to Dawkins and ET versus Behe and IDT. This interaction, shown in Figure 2, indicates that participants showed relatively greater positivity toward Behe and IDT in response to MS [though the difference from the control condition was not significant,  $F(1, 350) = .98, ns$ ], but greater *negativity* toward ET and Dawkins in response to MS,  $F(1, 350) = 5.14, d=.24, p < .05$ .



**Figure 2.** Effects of MS on liking of Behe and acceptance of IDT, and liking of Dawkins and acceptance of ET. Values are standard scores, so values in the Dawkins-ET and Behe-IDT conditions should not be directly compared to each other. The overall interaction and the difference between the control and MS conditions on Dawkins-ET was significant,  $p < .05$ .

As in Study 1, religiosity was related positively to views of Behe-IDT,  $r = .40$ , and negatively to views of Dawkins-ET,  $r = -.40$ , both  $ps < .05$ . However, MS did not increase religiosity,  $t(339) = .43$ ,  $ns$ , and the main effect of MS on Dawkins-ET remained significant when religiosity was entered as a covariate,  $F(1, 338) = 3.91$ ,  $p < .05$ , as did the interaction between experimental condition and author-theory,  $F(1, 338) = 3.36$ ,  $p = .07$ . Thus, the effect of MS on views of IDT and ET could not be accounted for by differences in religiosity. As in Study 1, there was no interaction between religiosity and experimental condition on the Dawkins-ET scale,  $\beta = -.03$ , nor on the Behe-IDT scale,  $\beta = .00$ , both  $ns$ .

We also tested whether type of religion moderated the effect of MS on views of Behe-IDT or Dawkins-ET. Again classifying participants as Christian or non-Christian, we found a large two-way interaction between Christianity and author-theory,  $F(1, 348) = 63.53, p < .05$ , indicating that Christians demonstrated no preference between Behe-IDT and Dawkins-ET,  $F(1, 188) = 0.53, ns$ , but non-Christians preferred Dawkins-ET to Behe-IDT,  $F(1, 162) = 129.97, p < .05$ . However, Christianity did not moderate the interaction between experimental condition and author-theory,  $F(1, 348) = .22, ns$ , indicating that the effects of MS on views of IDT and ET did not differ for Christians compared to non-Christians. Christianity also did not moderate the effect of MS on views of Behe-IDT,  $F(1, 348) = 0.05$ , or Dawkins-ET,  $F(1, 348) = 0.91$ , both *ns*.

In general, the findings from Study 2 replicate those of Study 1. Across studies, MS influenced participants' views of ET and IDT; in Study 1 participants showed greater willingness to support IDT, and in Study 2 greater willingness to reject ET and relatively greater willingness to accept IDT. The differences that emerged between the two studies, regarding whether participants responded to MS largely by rejecting ET or embracing IDT, may be due to a lower baseline level of belief in ET in the more diverse sample of Study 2, or to a reluctance among Study 1's psychology student participants to express disbelief in ET while participating in scientific research, given the importance of ET to the scientific worldview. Nonetheless, both studies converge on the implication that university-educated individuals' views of IDT and ET can be influenced by a motivation to defend against existential concerns.

However, both studies had limitations. First, both were restricted to college students, leaving it unclear whether the widespread support for IDT and skepticism toward ET seen among post-collegiate Americans who constitute the school boards that have moved to teach IDT can be attributed to terror management processes. Similarly, we cannot know whether less educated Americans—adults who have not attended college and may not be well versed in the

scientific cultural worldview—would respond similarly to existential threats. If these individuals do not subscribe to the scientific cultural worldview, they would be unlikely to benefit from defences that allow for the maintenance of an allegiance with this worldview—that is, they may have less need to embrace or reject a scientific theory to cope with existential concerns. Thus, to the extent that the effects found in Studies 1 and 2 were due to the scientific framing of IDT and ET, these effects may not emerge among less educated individuals for whom the scientific cultural worldview is less central. To address this concern, Study 3 included a highly diverse sample of adults who were not college students.

Second, in order to retain some level of ecological validity, in both Studies 1 and 2 we manipulated ET and IDT using actual statements written by two prominent authors; as a result, these studies tested how mortality salience influences views of these theories based on how they are actually encountered by the average science student, teacher, or other well-read individual. However, because of this design choice, it remains possible that the differences found in participants' responses to ET and IDT were due not to the relative merits of the respective theories, but rather to something unique about the writing of two excerpted passages. To address this concern, in Study 3 we exposed participants to each theory using excerpts that were made to be identical except for the name of the theory they described, and thereby controlled for any stylistic differences between the passages.

## STUDY 3

### Method

#### Participants

832 individuals (55% female), ranging in age from 18 to 75 years (*Median* = 37 years), living in the U.S., completed an online questionnaire in exchange for on-line “points” which could be converted to monetary or gift prizes (all participants were recruited by a survey research company).

#### Procedure

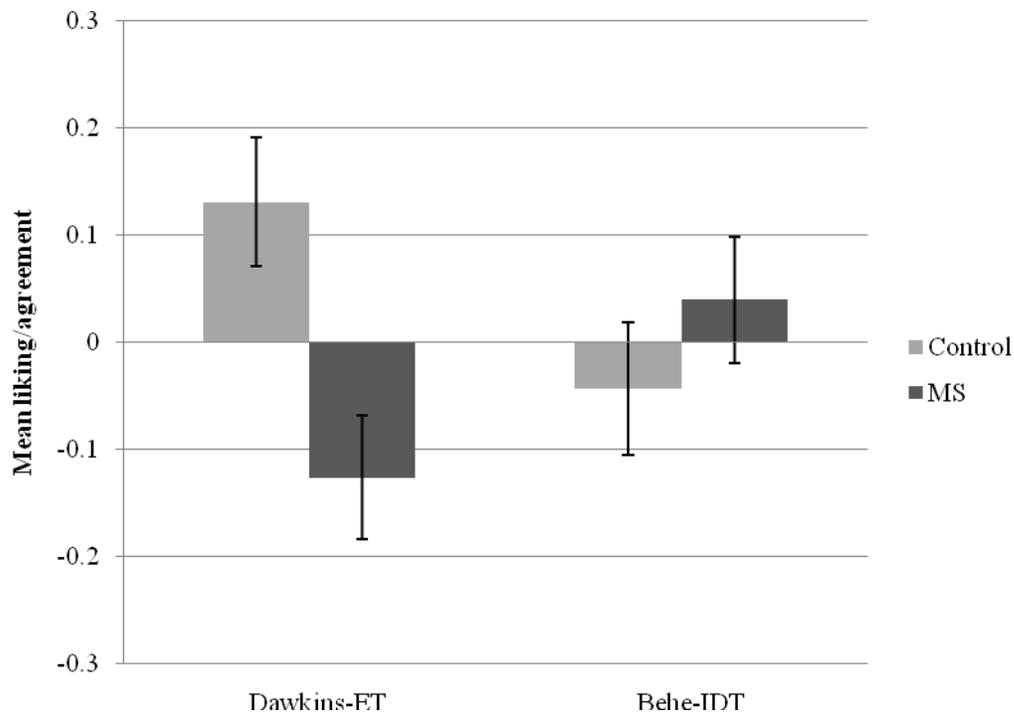
The same procedure as in Study 1 was used, except that participants viewed only one excerpt (arguing for either IDT or ET), and, in addition to assessing religious affiliation and degree of religiosity (using the 10-point rating scale), we also asked participants to report their education level, income bracket, social class, and field of work. Participants’ reported religious affiliations were as follows: Buddhist (1%), Catholic (20%), Christian (32%), Christian Orthodox (1%), Hindu (1%), Jewish (3%), Protestant (14%), Spiritual but not religious (10%), none of these (12%), and Other (6%). They were also diverse in terms of educational background and socio-economic status: 3% reported attending “some high school,” 23% had only a high-school diploma, 33% attended “some college,” 32% had a college degree, and 9% had a post-graduate degree; 24% identified as “working class,” 19% as “lower-middle class,” 44% “middle class,” 12% “upper-middle class,” and less than 1% reported being “upper class.” Consistent with these ratings, 12% reported an annual income of under \$20,000, 25% of \$20,001-40,000, 20% of \$40,001-60,000, 11% of \$60,001-80,000, 8% of \$80,001-100,000, and 9% of over \$100,000 (15% reported either not knowing their income or not wishing to report it).

We changed the excerpts describing IDT and ET so that the passages were identical except that one referred to IDT and the other to ET. We retained approximately equal numbers of sentences from each of the original excerpts so that these composite passages contained statements actually written by Dawkins (which, in the IDT condition, were changed to refer to IDT) and statements actually written by Behe (which, in the ET condition, were changed to refer to ET). Both passages are presented in Appendix C. As in Studies 1 and 2, participants were told that these passages were written by “Professor Dawkins, a famous evolutionary theorist” (in the ET condition), or by “Professor Behe, a famous scientist who argues for intelligent design” (in the IDT condition). We also followed these sentences with a definition of evolution, as “the natural process of change in inherited traits from generation to generation by mutation, natural selection, and genetic drift,” in the ET condition, or of intelligent design, as “the belief that physical and biological systems observed in the universe result from purposeful design by an intelligent being rather than from chance or undirected natural processes,” in the IDT condition. These definitions were added to ensure that participants were at least familiar with the basic idea of the theory they were reading about. In another change from Studies 1 and 2, we manipulated author-theory between subjects, because the artificiality of the IDT and ET passages would be obvious to participants if they read both (as they were almost identical). We again computed an author-theory scale, based on standard scores, which represented participants’ liking and belief in Dawkins and ET (for those in the ET condition;  $\alpha = .95$ ) or their liking and belief in Behe and IDT (for those in the IDT condition;  $\alpha = .94$ ).

## **Results and Discussion**

To examine whether MS led to greater acceptance of IDT and rejection of ET, we conducted a 2 (MS vs. control) x 2 (Behe-IDT vs. Dawkins-ET) between-subjects ANOVA on

the author-theory scale. There was an interaction between author-theory and experimental condition,  $F(1, 828) = 8.04, p < .05$ , indicating that, consistent with predictions, participants showed relatively greater positivity toward Behe-IDT in response to MS [though the difference from control was not significant;  $t(402) = 0.98, ns$ ], and greater negativity toward Dawkins-ET,  $t(424) = 3.05, d=.30, p < .05$ , replicating the findings from Study 2 (see Figure 3). In addition, comparing full-scale scores (using sums instead of means, given the different scales used for items within each measure), we found that although participants showed no preference between the two theories in the control condition,  $F(1, 401) = 0.30, ns$ , in response to MS they evidenced a clear preference for Behe-IDT over Dawkins-ET,  $F(1, 427) = 12.12, p < .05$ .



**Figure 3.** Effects of MS on liking of Behe and acceptance of IDT, and liking of Dawkins and acceptance of ET. Values are standard scores, so values in the Dawkins-ET and Behe-IDT conditions should not be directly compared to each other. The overall interaction and the difference between the control and MS conditions on Dawkins-ET was significant,  $p < .05$ . In addition, participants in the MS condition showed a significant preference for Behe-IDT over Dawkins-ET,  $p < .05$ .

Once again, religiosity was related positively to views of Behe-IDT and negatively to views of Dawkins-ET,  $r_s = .21$  and  $-.53$ , respectively, both  $p_s < .05$ ; but, as in Studies 1 and 2, MS did not affect religiosity,  $t(828) = .85$ ,  $ns$ , and the interaction between author-theory and experimental condition held when religiosity was entered as a covariate,  $F(1, 825) = 7.70$ ,  $p < .05$ , as did the main effect on Dawkins-ET,  $F(1, 423) = 8.70$ ,  $p < .05$ . Neither religiosity,  $\beta = .02$ , nor Christianity,  $F(1, 824) = 1.00$ , moderated the interaction between author-theory and MS, nor the main effect on Dawkins-ET,  $\beta = -.00$  for religiosity, and  $F(1, 424) = 0.27$  for Christianity, all

*ns*; there also were no interactions between these religion variables and MS on Behe-IDT,  $\beta = .03$ , for religiosity, and  $F(1, 400) = .80$  for Christianity, both *ns*.

To examine whether participants' educational background—which may be taken as a rough indicator of the extent to which they are familiar with science and subscribe to the scientific cultural worldview—moderated these effects, we converted the categorical education variable to a dichotomous variable based on a median split, and tested whether high versus low education (college graduates vs. “some college” or less) moderated the effects. There was no three-way interaction,  $F(1, 821) = 0.08$ , nor was there using the full categorical education variable,  $F(5, 802) = 0.25$ , nor when education was treated as continuous,  $\beta = -.02$ , all *ns*. Education also did not moderate the effect of MS on Dawkins-ET, regardless of whether it was treated as dichotomous,  $F(1, 421) = 0.67$ , categorical,  $F(5, 412) = 0.25$ , or continuous,  $\beta = .04$ , all *ns*; no interactions emerged on the Behe-IDT scale, either,  $F(1, 400) = 1.45$  (dichotomous),  $F(6, 390) = 0.90$  (categorical), and  $\beta = -.03$  (continuous), all *ns*. Controlling for education, the interaction between author-theory and experimental condition remained significant,  $F(1, 824) = 8.00$ ,  $p < .05$ , as did the main effect of MS on Dawkins-ET,  $F(1, 422) = 8.91$ , both  $ps < .05$ .

These findings suggest that the effect of MS on views of IDT and ET is not driven by individuals with a strong educational background who might be particularly likely to subscribe to the scientific cultural worldview. Rather, rejection of ET and acceptance of IDT seems to be a terror management strategy utilized regardless of one's educational background. This finding is also informative for the distinction that emerged between Studies 1 and 2, regarding whether participants were more likely to espouse support for IDT or disavow ET in response to MS. Given that the specific effects found in Study 3 mirrored those of Study 2, and in both studies participants were not social-science students participating in psychological research (as they were in Study 1), these findings support our interpretation of the difference between studies as

related to individuals' longstanding beliefs about ET. That is, individuals who are not necessarily psychology students, may or may not have strong educational backgrounds, and tend to believe less strongly in ET than do psychology students, appear more willing to shift their views of ET in response to MS compared to psychology students participating in psychological research.

Together, then, the combined results of these three studies suggest that individuals ranging in age from late adolescence to late adulthood, from a diverse range of socioeconomic, regional, and educational backgrounds, tend to respond to MS by showing increased support for IDT or decreased support for ET. Although these responses are superficially slightly different, at an underlying conceptual level they are coherent; in both cases, participants seem to be responding to existential concerns by increasing their relative preference for an apparently “scientific” theory (i.e., IDT) that can provide a sense of existential meaning and purpose to the human endeavour, and/or decreasing their support for the theory that fails to do so. The present studies thus suggest that embracing IDT and rejecting ET are functionally similar in terms of managing the potential for existential anxiety.

One critical question raised by all three studies is whether the effects that emerged were, as we surmise, due to participants' seeking to believe in a purportedly scientific theory that provides a sense of transcendent meaning and purpose to human life, or disbelieve in one that does not, as a way of managing existential threat. Given the consistent pattern of results—in all three studies, participants rejected the scientific theory that suggests that human life is meaningless and/or embraced the theory suggesting life is meaningful—this seems likely. However, few previous studies have established a motivational causal process (at least not one more specific than the general need to avoid death-related anxiety) underlying the effects of MS on worldview defences. Fritsche, Jonas, and Fankhanel (2008) demonstrated that a motivation to increase one's sense of *control* can account for MS effects on in-group support (another

worldview defence), but the defence examined here is unlikely to be related to control, because both ET and IDT depict humans as being at the mercy of external forces. Thus, to more directly address this issue, both to increase our understanding of how views of IDT and ET are influenced by existential concerns and to address the relative dearth of evidence on the processes underlying effects related to terror management, we conducted a fourth study examining whether a search for meaning in human life might account for the present effects.

Another limitation of Studies 1-3 is that religious belief was assessed during the same session as the experimental procedure, and stable attitudes about evolution could not be assessed separately from the dependent variable (given that these attitudes *were* the dependent variable), so we had no baseline measure of religion or belief in ET. This prevented us from assessing whether participants' responses varied on the basis of these stable beliefs. Thus, Study 4 included a follow-up study measuring stable religious and evolution beliefs several months after the initial experiment, on a subset of the sample. The addition of this follow-up study allowed us to test whether experimental effects held controlling for stable religious views and attitudes about evolution, and whether these views moderated any results.

## STUDY 4

If participants in Studies 1, 2, and 3 responded to heightened awareness of their mortality by evidencing discomfort with ET, a scientific theory that may be taken to indicate the meaninglessness of human existence, or embracing IDT, a seemingly scientific theory that may be taken to indicate a sense of greater meaning in human life, *because* existential concerns promote the acceptance of seemingly scientific theories that provide a sense of symbolic immortality and the rejection of those that do not, then framing ET as having the potential to provide symbolic immortality should remove or reverse these effects. In other words, if participants are encouraged to view naturalism as a source of transcendent meaning—a view held by many scientists—then ET may not be seen as necessarily indicative of the meaninglessness of human life, given that it is a naturalist perspective. Furthermore, under such conditions, individuals steeped in the scientific worldview (i.e., psychology students) should not need to embrace IDT in the face of existential threat, as they did in Study 1, because the more accepted, normative theory associated with their Western scientific cultural worldview would no longer be inconsistent with a desire to find greater meaning and purpose in human life.

In Study 4, we tested this account by assigning half of the participants to a condition in which they read an excerpted passage by cosmologist and science writer Carl Sagan, arguing that humans can attain greater meaning and purpose by seeking to understand the natural origins of life (Sagan, 2006). In this passage, Sagan explicitly states that even if humans are “merely matter,” and even if “there’s nothing in here but atoms,” we still can find purpose and meaning, but it must be a purpose and meaning that we work out for ourselves. The passage articulates a way in which transcendent meaning can be found from embracing naturalism, so if the findings

from Studies 1, 2, and 3 were due to the apparent absence of such meaning in ET compared to IDT, reading this passage should weaken or even reverse those effects.

## **Method**

### **Participants**

269 undergraduate psychology students at the University of British Columbia (77% female) completed on-line questionnaires in exchange for course credit.

### **Procedure**

The procedure was the same as in Study 1, except that immediately after receiving the MS or control induction, half of the participants viewed a passage excerpted from Carl Sagan. They were instructed to “Please read the paragraph below, written by Dr. Carl Sagan, one of the world’s most famous scientists.” They were also told that they would later be asked “several questions assessing your understanding of this paragraph, so please read it carefully and try to remember and think about what Dr. Sagan is saying.” We did not, in fact, quiz participants on their understanding of the passage, but told them this in order to ensure that they read the passage carefully and thought about its meaning. The passage is based on excerpted statements from Sagan’s writings (Sagan, 2006), and is presented in Appendix D (see Appendix E for validation of the Sagan passage).

After reading the Sagan passage, participants in the Sagan conditions proceeded to complete the PANAS. Participants in the no-Sagan conditions did not read anything immediately after the MS or control prime; they instead proceeded directly to completing the PANAS. All participants then read either the Behe-IDT or the Dawkins-ET passage used in Studies 1 and 2 ),<sup>6</sup>

followed by the same Behe-IDT or Dawkins-ET assessment items as were included in all three previous studies ( $\alpha$ s, based on standard scores, were .87 for Dawkins-ET and .88 for Behe-IDT).

A subset of 104 participants (80% female), roughly equally distributed across the 8 cells, agreed to participate in a follow-up study 4-6 months later, in which they completed Lombrozo, Thanukos, and Weisberg's (2008) 5-item measure of evolution acceptance ( $\alpha=.85$ ), our 10-point single-item religiosity measure, intrinsic and extrinsic religiosity ( $\alpha$ s=.80 and .82), and Altemeyer and Hunsberger's (2004) measure of religious fundamentalism ( $\alpha=.85$ ).<sup>7</sup> Given the delay between this follow-up study and the original experimental session, we felt confident in concluding that any effects found in the original session that held in this subsample when controlling for these measures are unlikely to be due to stable individual differences in religiosity or views of evolution. Furthermore, by testing whether scores on these measures moderate effects of MS in the follow-up sample, we can further probe whether shifting views of ET and IDT in response to MS is a terror-management strategy utilized only by individuals with certain religious beliefs, or who do not believe in ET.

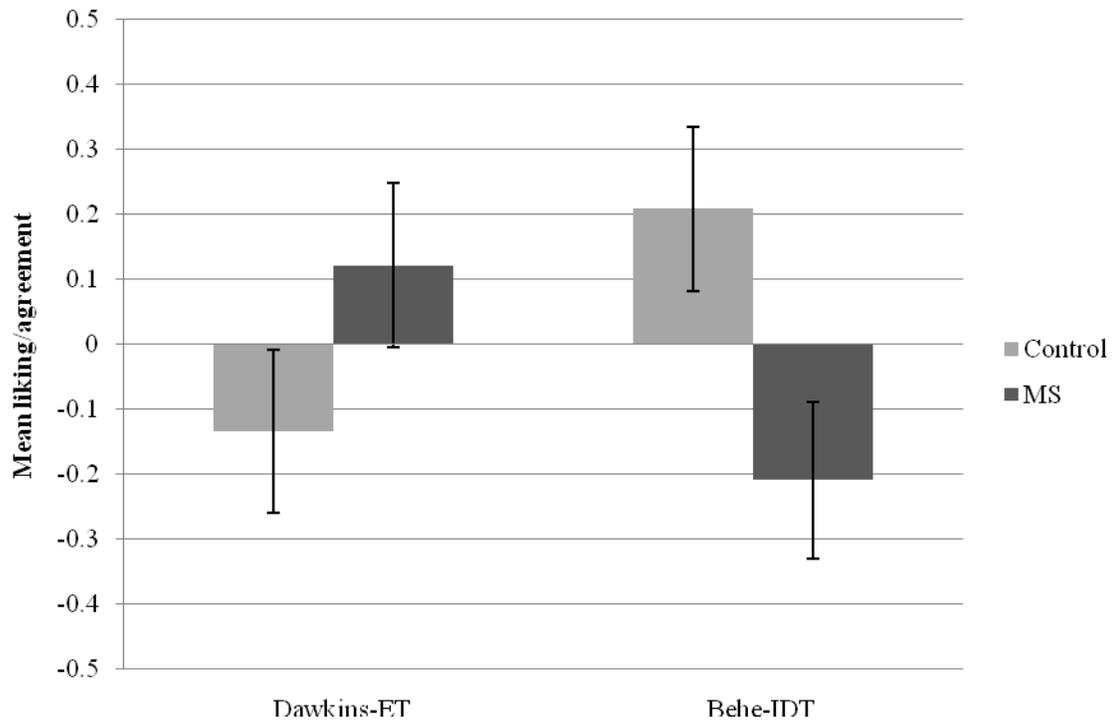
## **Results and Discussion**

### **Main study**

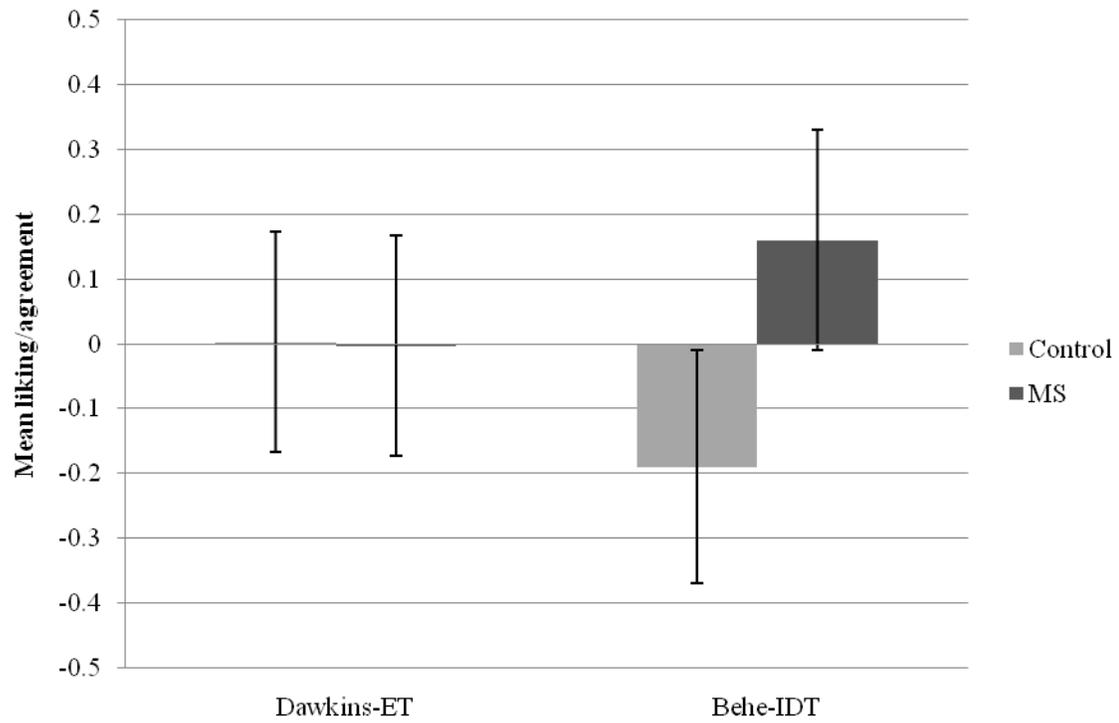
To determine whether reading the Sagan passage had a different impact on participants' views of Behe-IDT versus Dawkins-ET in response to MS, we conducted a 2 (Sagan vs. no-Sagan) x 2 (MS vs. control) x 2 (Dawkins-ET vs. Behe-IDT) between-subjects ANOVA, and found the predicted three-way interaction,  $F(1, 257) = 5.69, p < .05$  (see Figure 4). To interpret this interaction, we conducted two 2 (MS vs. control) x 2 (Dawkins-ET vs. Behe-IDT) between-subjects ANOVAs, separately for participants in the Sagan and no-Sagan conditions. In the no-Sagan condition, the two-way interaction was not significant,  $F(1, 126) = 0.98, ns$ , but, as can be

seen from Figure 4, participants trended toward showing increased positivity toward Behe -IDT in response to MS, as was the case in Study 1, though here the difference from control was not significant,  $t(61) = 1.37$ ,  $d=.35$ ,  $p=.18$ . In contrast, in the Sagan condition, a significant two-way interaction emerged,  $F(1, 131) = 7.31$ ,  $p < .05$ , revealing the reverse pattern from the no-Sagan condition (see Figure 4). When participants read Sagan's passage suggesting that naturalism can be a source of meaning, they responded to MS with *decreased* positivity toward Behe-IDT, and relatively increased positivity toward Dawkins-ET. Although the simple effect on Dawkins-ET was not significant,  $F(1, 67) = 2.00$ , *ns*, the simple effect on Behe-IDT was,  $F(1, 64) = 6.02$ ,  $d=.61$ ,  $p < .05$ . Importantly, this effect represents a full reversal of the effect found in Study 1, where MS led to significantly increased positivity toward Behe-IDT compared to the control condition (in addition, although the main effect of MS on Behe-IDT in the no-Sagan condition here did not reach significance, it did in the subsample of participants included in the follow-up, as detailed below).

### Panel A: Sagan Condition



### Panel B: No-Sagan Condition



**Figure 4.** Effects of MS on liking of Behe and acceptance of IDT, and liking of Dawkins and acceptance of ET, for participants who read Sagan’s excerpt about naturalism (Panel A) and those who did not (Panel B). Values are standard scores, so values in the Dawkins-ET and Behe-IDT conditions should not be directly compared to each other. The overall three-way interaction, the two-way interaction in Panel A, and the differences between the control and MS conditions on Behe-IDT in Panel A were significant,  $ps < .05$ .

Religiosity was again correlated with Behe-IDT and Dawkins-ET,  $r_s = .22$  and  $-.32$ , respectively, both  $ps < .05$ , and a two-way interaction between Christianity and author-theory emerged,  $F(1, 249) = 22.16$ ,  $p < .05$ , indicating that Christians tended to prefer between Behe-IDT, non-Christians tended to prefer Dawkins-ET [ $M_s$  using the full scales summed = 29.85 vs. 28.73,  $t(98) = 3.45$ ,  $p < .05$ , for Christians; and  $M_s = 34.81$  vs. 25.11,  $t(163) = 3.06$ ,  $p < .05$ , for non-Christians]. However, as in previous studies, MS did not affect religiosity,  $t(260) = 1.05$ ,  $ns$ , and the three-way interaction between Sagan, MS, and author-theory remained significant when religiosity was entered as a covariate,  $F(1, 253) = 5.53$ ,  $p < .05$ , as did the interaction between MS and author-theory in the Sagan condition,  $F(1, 128) = 8.11$ , and the main effect on Behe-IDT in this condition,  $F(1, 62) = 6.54$ , both  $ps < .05$ . Neither religiosity,  $\beta = .15$ , nor Christianity,  $F(1, 249) = .45$ , moderated the three-way interaction, nor the two-way interaction in the Sagan condition,  $\beta = .01$  for religiosity and  $F(1, 127) = .46$  for Christianity; all  $ns$ . Religiosity also did not moderate the main effect of MS on Behe-IDT in the Sagan condition,  $\beta = .13$ ,  $ns$ , but there was a Christianity x MS interaction on Behe-IDT in this condition,  $F(1, 62) = 4.03$ ,  $p < .05$ , indicating that non-Christians who read the Sagan passage showed a stronger negative response to Behe-IDT in the MS condition (compared to control) than did Christians, although for both groups effects were in the predicted direction ( $M_s = -0.42$  vs. 0.30 for non-Christians and 0.04 vs. 0.08 for Christians, in the MS and control conditions, respectively). There was no interaction

between religiosity and MS on Dawkins-ET,  $\beta_s = .11$  and  $.21$  in the Sagan and no-Sagan conditions, nor between Christianity and MS on Dawkins-ET in either condition,  $F(1, 65) = 0.91$  and  $F(1, 63) = 0.26$ ; all *ns*.

### **Follow-up study**

The follow-up study was conducted 4-6 months later to assess stable religious and evolution beliefs, to determine whether these views moderate or otherwise account for effects. In this subsample, the same three-way interaction between MS, Sagan/no Sagan, and author-theory emerged,  $F(1,92) = 9.06$ , and held controlling for scores on all four measures of stable religious views,  $F(1,83) = 8.45$ , and the acceptance of evolution scale,  $F(1,91) = 8.85$ , all  $ps < .05$ . As in the full sample, a two-way interaction between MS and author-theory emerged in the Sagan condition,  $F(1,47) = 5.81$ ,  $p < .05$ . In addition, there was a marginally significant interaction in the no-Sagan condition,  $F(1,45) = 3.44$ ,  $p = .07$ . In both the Sagan and no-Sagan conditions, simple effects emerged on views of Behe-IDT, in opposite directions, such that MS increased positivity in the no-Sagan condition, replicating Study 1, and decreased positivity in the Sagan condition,  $F_s(1, 24) = 4.81$  and  $5.40$ ,  $d_s = .88$  and  $.91$ , respectively, both  $ps < .05$ . Both of these effects held controlling for scores on all four religion measures and the ET acceptance measure,  $F(1,19) = 7.84$ , in the Sagan, and  $F(1,17) = 6.07$ , in the no-Sagan condition, both  $ps < .05$ .

Finally, with only one exception, none of the four measures of stable religious views or the ET acceptance measure moderated any of the interactions or main effects that emerged in this subsample. The one exception was an extrinsic religiosity x MS interaction on Behe-IDT in the no-Sagan condition,  $\beta = .57$ ,  $p < .05$ , indicating that the effect of MS on Behe-IDT was weaker among individuals high in extrinsic religiosity. Given that similar effects did not emerge with any of the other religion measures, and this particular effect could not be theoretically

predicted, it is unlikely to be meaningful. Thus, these findings indicate that the present results are not due to stable individual differences in religious belief, religious fundamentalism, or views of evolution, and they do not vary depending on participants' stable beliefs on these issues. It is also noteworthy that, consistent with our expectation that ET may be threatening to religious or spiritual worldviews which provide a sense of purpose or meaning in life, the follow-up data also revealed negative correlations between the evolution acceptance measure and all four measures of religiosity: intrinsic ( $r = -.42$ ), extrinsic ( $r = -.40$ ), religious fundamentalism ( $r = -.49$ ), and the single-item measure ( $r = -.27$ ), all  $ps < .05$ .

### **Summary and limitations**

One potential limitation of this study is that we opted against including a neutral control passage in the no-Sagan condition, given that even a seemingly neutral passage might have elicited unexpected priming effects. This decision resulted in an approximately 2-minute additional delay following the MS manipulation in the Sagan condition. However, it is unlikely that this delay-length difference accounts for effects, because: (a) in Studies 1 and 2, participants read counterbalanced passages by Dawkins *and* Behe, and completed each measure immediately after each passage, yet no order effects emerged despite the varying delay lengths across conditions; and (b) if the additional delay influenced results, previous research suggests that it would either increase the effect (Burke, Martens, & Faucher, 2010), if the delay heightened the defensive response, or decrease the effect, if the delay allowed defensive processes to wane (Pyszczynski et al., 1999). There is no indication, conceptual or empirical, that an additional delay would completely *reverse* effects. Thus, it seems considerably more likely that the strong differences found between the Sagan and no-Sagan conditions resulted from the substantive content of the Sagan manipulation.

In addition, although the effects of the Sagan passage could be attributed to an increased desire to reject IDT as a way of embracing a positively framed worldview (Jonas et al., 2008), this also seems unlikely. If participants' responses were guided by this desire, MS participants in all studies should have shown greater positivity toward both IDT *and* ET, since both were framed positively; supporting this assumption, individuals who read the Sagan and Dawkins passages without being primed with MS rated both authors equally positively, as was reported in Appendix E. Thus, given the totality of results, the most parsimonious explanation for the findings of Study 4 is that MS-condition participants sought to embrace the perspective closest to their scientific worldview that also allowed for transcendent meaning.

The findings of Study 4 converge with those of Studies 1, 2, and 3, but add a new dimension to our conceptual understanding of the previous results. Specifically, the finding that reading Sagan's excerpt moderated the interaction between MS and attitudes toward ET versus IDT suggests that a desire to see human life and the universe as having transcendent meaning likely underlies our previous effects. Reading the Sagan excerpt apparently dissuaded participants from using IDT as a defence against existential concerns, and in fact made participants facing existential threat more antagonistic toward IDT, presumably because it represented a threat to the scientific theory that is the true mainstay of their scientific cultural worldview and that could now be seen as providing transcendent meaning. This result is important because it addresses the process underlying the causal link between mortality awareness and scientific beliefs.

Previous studies suggest that when individuals face existential threats, or threats to psychologically protective mechanisms (e.g., self-esteem), they respond by seeking greater psychological security (e.g., Hart, Shaver, & Goldenberg, 2005). The present research suggests that scientific (or seemingly scientific) ideologies can serve as one source of such security, and

they can do so *because* they provide a sense of greater meaning and purpose to human life. In fact, scientific theories that are bereft of such transcendent meaning do not appear to provide any equanimity to existential concerns, even for social-science students participating in scientific research. For these individuals, the cultural worldview associations of ET are, apparently, not enough to make it a viable worldview defence that individuals will affirm over and above IDT, *unless* it is invested with transcendent meaning and purpose by a reminder that naturalism can be existentially meaningful. This finding not only points to the causal process underlying the present effects, but also may have implications for the processes underlying other TMT effects; a search for existential meaning and purpose in human life may mediate some of the previously found outcomes of mortality salience.

Given these findings, it is possible that certain individuals who are more deeply invested in the scientific worldview (e.g., scientists) would embrace ET as a defensive worldview in the face of existential threat, even without reading a passage about how naturalism can be meaningful. Although we found no evidence of moderation by educational background in Study 3, very few participants in that study worked in scientific fields (only 15% reported working in technical or health related fields), so even if such individuals responded differently to the MS prime, their responses would be unlikely to have had a large enough impact to produce a significant interaction. Thus, to address the question of how individuals deeply invested in the scientific worldview would respond to MS, in Study 5 we sampled undergraduate natural science students. For these individuals, ET is not simply a theory they have learned in some of their courses, it is the cornerstone of their academic interests, and an identity-defining worldview. Thus, we expected that these participants would not reject ET in the face of existential threat, but rather would more staunchly support the theory, given that, like Carl Sagan, they may view naturalism as providing human life with meaning and purpose.

## STUDY 5

### Method

#### Participants

99 undergraduate students at the University of British Columbia (50% female) were recruited from natural science courses and a natural science library to complete an online questionnaire in exchange for being entered into a draw for a monetary prize.

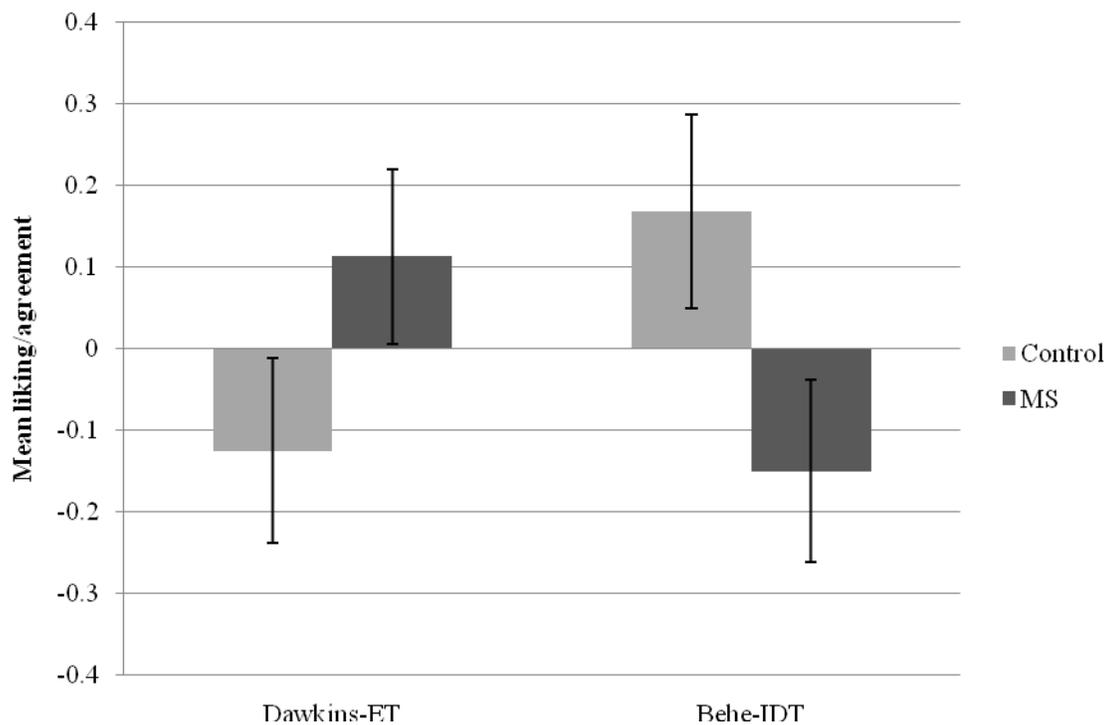
#### Procedure

The same procedure as in Study 1 was used, and, in addition to assessing religious affiliation and degree of religiosity (using the single-item scale), we also asked participants to report the number of university-level biology, physics, and chemistry courses they had taken. The order of the excerpted passages and scales (assessing acceptance of Dawkins and ET, vs. Behe and IDT) was counterbalanced; as in Studies 1 and 2, no order effects emerged. Scale scores for Dawkins-ET and Behe-IDT, based on standard scores, were reliable;  $\alpha$ s = .88 for Dawkins-ET and .90 for Behe-IDT. Participants' reported religious affiliations were as follows: Buddhist (3%), Catholic (22%), Christian (16%), Christian Orthodox (2%), Hindu (2%), Jewish (5%), Protestant (6%), Spiritual but not religious (8%), none of these (17%), and Other (3%). All participants reported having taken at least two natural science courses (*Median* number of courses taken = 11).

### Results and Discussion

To determine whether MS had a different effect on views of ET and Dawkins versus IDT and Behe, we again conducted a 2 (Behe-IDT vs. Dawkins-ET) x 2 (MS vs. control) mixed-measures ANOVA on the author-theory scales, and found an interaction between the within-

subjects factor of author-theory and the between-subjects factor of experimental condition,  $F(1, 94) = 4.18, p < .05$ , suggesting that MS differentially affected participants' responses to Dawkins and ET versus Behe and IDT.<sup>8</sup> This interaction, shown in Figure 5, indicates that, in contrast to Studies 1-4, natural-science student participants showed greater *negativity* toward Behe-IDT in response to MS,  $F(1,96) = 4.07, d = .41, p < .05$ , but trended toward greater *positivity* toward Dawkins-ET,  $F(1, 94) = 2.31, d = .31, p = .14$ .



**Figure 5.** Effects of MS on liking of Behe and acceptance of IDT, and liking of Dawkins and acceptance of ET, among a sample of natural science students. Values are standard scores, so values in the Dawkins-ET and Behe-IDT conditions should not be directly compared to each other. The overall interaction and the main effect on Behe-IDT were both significant,  $ps < .05$ .

Religiosity again positively correlated with Behe-IDT, and negatively with Dawkins-ET,  $rs = .33$  and  $-.30$ , respectively, both  $ps < .05$ . As in previous studies, MS had no effect on

religiosity,  $F(1, 94) = .00$ , *ns*, and both the interaction between experimental condition and author-theory, and the simple effect on Behe-IDT held controlling for religiosity,  $F(1, 92) = 4.32$  for the interaction,  $p < .05$ , and  $F(1, 93) = 3.97$  for Behe-IDT,  $p = .05$ . These effects also held controlling for the number of natural science courses participants had taken,  $F(1, 93) = 4.86$ , and  $F(1, 95) = 4.91$ , both  $ps < .05$ . Neither religiosity nor number of natural science courses moderated the interaction between experimental condition and author-theory,  $\beta_s = .10$  and  $.08$ , respectively; nor the main effect of MS on Behe-IDT,  $\beta_s = .02$  and  $.17$ ; all *ns*. These variables also did not interact with MS to produce an effect on Dawkins-ET,  $\beta_s = .20$  and  $.04$ , both *ns*. Christianity also did not moderate the MS x author-theory interaction,  $F(1, 81) = .02$ , nor the effect of MS on views of Behe-IDT,  $F(1, 83) = 0.87$ , both *ns*. There also was no Christianity x MS interaction on Dawkins-ET,  $F(1, 81) = 1.43$ , *ns*.

Thus, Study 5 suggests that there is at least one group of individuals for whom embracing IDT and/or rejecting ET is not a viable terror management defence: individuals currently invested in learning about and conducting natural-science research. For these individuals, heightened existential threat led to the opposite response from that seen among psychology students in Studies 1 and 4, the diverse sample of students in Study 2, and the highly diverse sample of adults in Study 3. The natural-science students' responses were, however, similar to those of the psychology students in Study 4 who learned that naturalism can be a source of transcendent meaning. Together, Studies 4 and 5 thus suggest that individuals who can find greater meaning in a naturalist view of the universe respond to existential threat by embracing ET and rejecting IDT. Presumably, shifting their views on these scientific or seemingly scientific theories in response to MS allows these students to enhance their sense of symbolic immortality by reaffirming the scientific perspective that is a major part of their cultural worldview *and* provides them with transcendent meaning. These findings thus support our account of the causal

process underlying the tendency, found in Studies 1-4, to respond to existential concerns with increased support for IDT and/or discomfort toward ET. The present findings also delineate an important boundary condition for this effect.

Study 5 examined those with strong views in support of science, but what remains unclear is how those highly invested in Christianity would respond to mortality salience on their acceptance of Dawkins-ET and Behe-IDT. Individuals with strong Christian religious views are likely to find IDT appealing since it is consistent with their religious ideology, and given the inherent conflict between science and religion (Preston & Epley, 2009), they likely find ET threatening. Although religion, religiosity, and Christianity did not moderate the effects in the previous studies, the lack of interaction with these variables and the manipulation may have resulted from having an inadequate sample size of individuals highly invested in their Christian beliefs. We conducted Study 6 to address this possibility; we selectively sampled individuals highly invested in their Christian faith (i.e., Christian religious club members) in order to obtain a highly religious sample. We expected individuals highly invested in their Christian beliefs to show the same effect found in studies 1-4 (i.e., increased support for IDT and decreased support for ET after mortality salience), and, given that these individuals hold their Christian beliefs as a core part of their identity, we expected stronger effects to emerge than those found in the previous Studies.

## STUDY 6

### Method

#### Participants

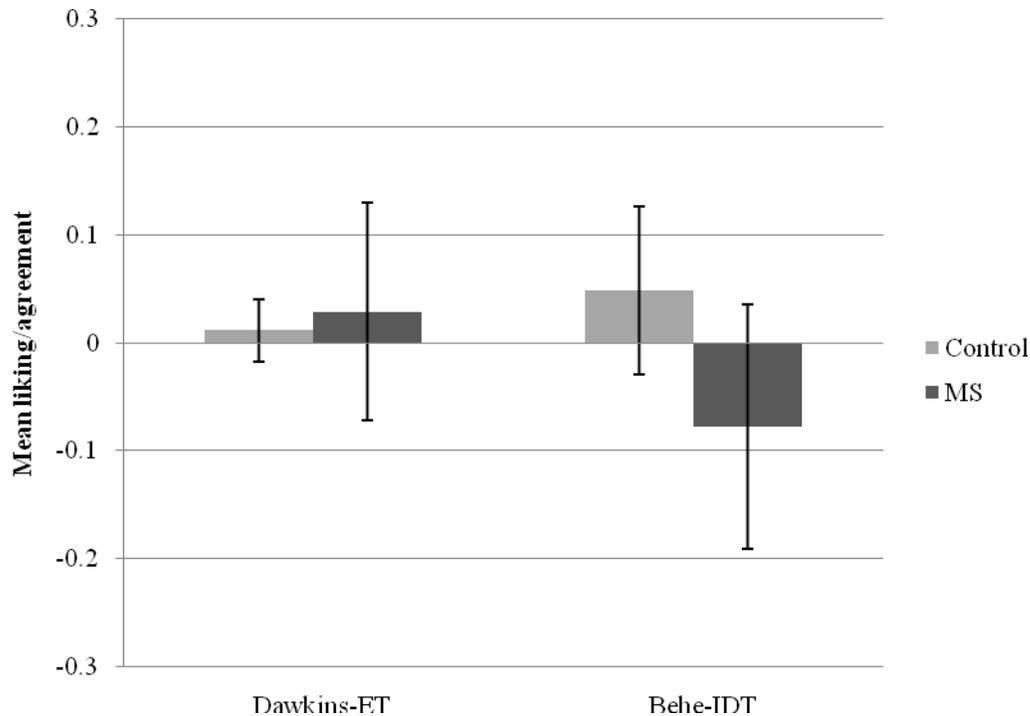
87 undergraduate students at the University of British Columbia (41% female) were recruited from various UBC Christian clubs (results did not vary based on what clubs individuals were members of) to complete a paper/pen or online questionnaire in exchange for a monetary prize for their club.

#### Procedure

The same procedure as in Study 1 was used, and, as previously found, no order effects emerged. Scale scores for Dawkins-ET and Behe-IDT, based on standard scores, were reliable;  $\alpha$ s = .83 for Dawkins-ET and .89 for Behe-IDT.

### Results and Discussion

To determine whether MS had a different effect on views of ET and Dawkins versus IDT and Behe, we again conducted a 2 (Behe-IDT vs. Dawkins-ET) x 2 (MS vs. control) mixed-measures ANOVA on the author-theory scales. There was no significant interaction between the author-theory scale and the manipulation,  $F(1,85) = .31, ns$ , indicating that the manipulation did not promote different responses toward the two theories and authors (see Figure 6). In addition, the difference between MS and control on views of Dawkins-ET and Behe-IDT were both *ns*. These null results, shown in Figure 6, indicate that, in contrast to Studies 1-5, Christian club members did not show change in their views of either author or theory in response to MS.



**Figure 6.** Effects of MS on liking of Behe and acceptance of IDT, and liking of Dawkins and acceptance of ET, among a sample of religious club members. Values are standard scores, so values in the Dawkins-ET and Behe-IDT conditions should not be directly compared to each other.

Religiosity again positively correlated with Behe-IDT, and negatively with Dawkins-ET,  $r_s = .33$  and  $-.45$ , respectively, both  $p_s < .05$ . Intrinsic religiosity and extrinsic religiosity were both positively correlated with Behe-IDT,  $r_s = .68$  and  $.47$ , respectively, both  $p_s < .05$ , and intrinsic religiosity correlated negatively with views of Dawkins-ET,  $r = -.51$ ,  $p < .05$ , extrinsic was *ns*. As in previous studies, MS had no effect on religiosity,  $F(1, 79) = .01$ , *ns*, nor did it have an effect on intrinsic or extrinsic religiosity,  $F_s(1, 47) = 1.36, 1.15$ , respectively, both *ns*. Consistent with our expectation that this sample holds particularly strong religious views, Study 6 participants scored higher on the single-item religiosity measure than participants in Studies 1 through 5<sup>9</sup>, and significantly higher on intrinsic religiosity than Studies 1 and 4<sup>10</sup>, but the same

on extrinsic religiosity as Studies 1 and 4.<sup>11</sup> In addition, in contrast to Studies 1-5, support for IDT was higher than support for ET in the control conditions (see Table 1). Given that IDT allows for belief in a world created by God, this difference is expected. However, it is somewhat surprising that the findings of Studies 1-4 were not replicated among the sample of highly religious Christians in Study 6. One possible explanation is that individuals who hold strong religious views do not need to use IDT as a defence against mortality salience, presumably because they already have a viable defence in their religious beliefs, and do not need to use a seemingly scientific theory to provide resolution to existential concerns (Norenzayan et al, 2009).

**Table 1.** Mean levels of support for ET and IDT in the control conditions for Studies 1, 2, 3, 4, 5, and 6.

Source	Means for pro-ET items in control conditions	Means for pro-IDT items in control conditions
Study 1 - psychology students <sup>a</sup>	3.68	2.38
Study 2 - students <sup>a</sup>	3.70	2.57
Study 3 - non-students <sup>b</sup>	3.11	2.97
Study 4 - psychology students <sup>a</sup>	3.47	2.01
Study 5 - natural science students <sup>a</sup>	3.66	2.73
Study 6 - religious club members <sup>a</sup>	2.48	3.84

<sup>a</sup> The difference between pro-ET and pro-IDT items is significant at the .05 level. Studies 1, 2, 4, 5, and 6,  $t(119)=7.77$ ,  $t(346)=9.25$ ,  $t(59)=4.58$ ,  $t(89)=3.86$ ,  $t(98)=5.78$ , respectively.

<sup>b</sup> Study 3 scores were transformed from a 7-point scale to a 5-point scale to make these comparisons. The difference between pro-ET and pro-IDT items is *ns*,  $t(401)=1.14$ .

Note. Stable attitudes about evolution could not be assessed separately from the dependent variable (given that these attitudes *were* the dependent variable), so caution is in order while interpreting these results.

## GENERAL DISCUSSION

The findings from the present research demonstrate that heightened awareness of one's own mortality promotes relative support for intelligent design theory and admiration of its major proponent, Michael Behe, and relative skepticism toward evolutionary theory and dislike of its major proponent, Richard Dawkins. In other words, individuals respond to existential threat by becoming more accepting of a theory that allows for the possibility of symbolic immortality (by appearing to be consistent with the scientific worldview and depicting human life as having some ultimate purpose), *and* becoming less supportive of the theory that is the true mainstay of the scientific worldview but which seems to offer little in the way of immortality. These findings also suggest that a desire to find transcendent meaning and purpose in human life through science accounts for this effect, because it is reversed by making ET more meaningful, and among natural science students for whom ET is presumably already more meaningful. The findings are notable because (a) they explain why people are motivated to believe in IDT and doubt ET in terms of fundamental psychological drives, and (b) they point to the causal process underlying this effect – IDT offers greater psychological comfort than ET because it imbues human life with greater transcendent meaning.

Importantly, all effects held controlling for religiosity, religion, and Christianity, and, with only two exceptions, none of the effects were moderated by religiosity (overall, intrinsic, or extrinsic), religious fundamentalism, or Christianity. The two exceptions, which emerged in Study 4, were not theoretically predictable or consistent with any of the other findings that emerged in this research, and thus are unlikely to be meaningful. In general, given that there was no difference in religiosity between MS and control conditions in any of the five studies, nor any effect that held only for those associated with a particular religious group or ideology, it is

unlikely that the effects of MS on views of Behe and IDT, or Dawkins and ET, are due to any change in religiosity, or to responses specific to religious believers. Thus, these findings suggest that although religion influences individuals' baseline preferences toward IDT and ET, religious ideology cannot account for the impact of existential concerns on these views.

In Study 4 we also assessed participants' stable views of evolution 4-6 months after the initial study, using a previously validated measure of evolution belief, and found that all effects held controlling for scores on this measure, and these scores did not moderate any effects. Thus, the tendency to embrace IDT or reject ET in the face of existential threat is a terror management response utilized by a broad range of individuals regardless of their pre-existing stance on the question of life's origins. This contrasts with previous research suggesting that many mortality salience effects occur only among individuals with certain pre-existing belief systems or cultural affiliations. That this was not the case in the present research suggests that IDT may be a unique, broadly appealing worldview that addresses the existential concerns of religious and more scientifically oriented individuals alike. The combination of IDT's scientific framing and provision of existential meaning may be responsible for this broad appeal. In contrast, explicitly religious ideologies tend to be fairly parochial, thus limiting their appeal and making them viable terror-management defence systems only for those who already have some degree of belief in a supernatural God (Norenzayan & Hansen, 2006).

Yet, one important exception emerged in Study 5, where individuals whose life goals require strong belief in ET showed the opposite pattern of responses. Like those explicitly taught to view naturalism as a source of transcendent meaning, natural science students responded to activated existential concerns by showing stronger support for ET and antagonism toward IDT. This finding provides confirmatory support for the causal process found to underlie effects in Study 4, and suggests that embracing ET or rejecting IDT can be a source of comfort in the face

of threat for a very limited population of individuals. It is noteworthy that these individuals are not simply those steeped in the scientific cultural worldview—since presumably psychology undergraduates fall into that category—but rather must more specifically view evolution as a major part of their understanding of the world and thus a source of meaning and purpose.

### **Specificity of the Effect**

Studies 1 and 4 used an undergraduate psychology sample, and showed the most movement on views of Behe-IDT. Studies 2 and 3 used more broad samples (i.e., undergraduate students and non-Student adults from across North America, respectively), and these participants showed the most movement on Dawkins-ET. Differences in the nature of the samples are likely responsible for whether the effect manifested as increased support of Behe/IDT or rejection of Dawkins/ET under mortality salience. This interpretation is supported by the fact that the same patterns of results were observed in the samples that most closely resembled each other, demographically. In Studies 1 and 4, where participants showed a greater effect on views of Behe-IDT, participants were drawn from psychology department subject pools, comprising individuals who are largely middle-to-upper class and as social-science students, are well-versed in the scientific cultural worldview and in ET. These individuals appeared to be largely unmovable in their views of ET and Dawkins. Instead, these individuals modified their more malleable attitudes—those related to IDT, a theory with which they are almost certainly less familiar.

In contrast, in Studies 2 and 3, the effect of mortality salience emerged most strongly as decreased belief in ET. These studies used participants drawn from a much broader community than university psychology departments; most were recruited by a national survey company and either attended a wide variety of universities across the U.S. and Canada (in Study 2) or were

adults whose age and socioeconomic status levels represented almost the entire spectrum of the U.S. population (in Study 3). Although these individuals are likely to be at least nominally familiar with ET, the theory is unlikely to be as important to their understanding of the world as it is for psychology undergraduates. As a result, they were willing to espouse more negativity toward ET in order to defend against death reminders. Indeed, the highly diverse Study 3 sample showed the strongest control-condition positivity toward Behe-IDT and negativity toward Dawkins-ET.<sup>12</sup>

If this account is correct, we would expect participants in Studies 1 and 4 to show significantly higher baseline acceptance of evolution compared to participants in Studies 2 and 3. The means of the pro-ET items in the control conditions of these studies roughly support this account (see Table 1), but given that these items are the dependent variable, we collected additional data from participants drawn from the same populations, who did not complete the experimental study (see Appendix F). Results supported this claim; specifically, those drawn from the same sample as Studies 1 and 4 showed significantly higher acceptance of evolution compared to those drawn from the same sample as Studies 2 and 3. Thus, the more varied participants' educational and SES backgrounds, the stronger their baseline belief in IDT over ET, and the more willing they were to shift their views of ET in response to MS.

This interpretation of sampling differences influencing the results is further supported by the differences in effects observed in Studies 5 and 6, which were based on samples of participants specifically selected because of relevant, predetermined differences. In Study 5, participants were recruited based on the likelihood they would hold strong positive views toward ET, and that ET is a core part of their primary cultural worldview. These individuals were found to show greater support for Dawkins-ET after a death reminder. This pattern of results is similar to that found in the Sagan condition of Study 4, where participants read a passage that suggested

that naturalism could be a source of transcendent meaning. The similarity between these two studies suggests that natural science students view naturalism as a perspective that provides their life with meaning and purpose.

In addition, in Study 6, participants were selected based on their strong religious views. These participants were members of Christian religious clubs, making Christianity a core aspect of their primary cultural worldviews. They showed no change in their views of Dawkins-ET and Behe-IDT in response to mortality salience. Although we expected these participants to show increased support for Behe-IDT in response to mortality salience, these null results here may be due to the fact that these participants do not find scientific arguments to be compelling mortality salience defences, presumably because they already have God as a defence. Consequently, religious club members do not feel the need to embrace IDT, a seemingly scientific theory, under mortality salience.

More broadly, the fact that a consistent pattern emerged across all four studies, but with differences in the specific nature of the pattern depending on sample characteristics, suggests that embracing IDT and rejecting ET may be functionally similar in terms of regulating the potential for existential anxiety. This finding may have implications for instructors who would like to “teach the controversy” by teaching both IDT and ET in science classes (Bumiller, 2005; McGrath, 2009). If existential concerns are active, students are unlikely to embrace both theories, and even students who would normally be inclined to accept ET and reject IDT may show the opposite response. Furthermore, in practice it is not particularly important whether individuals respond to MS by increasing support of IDT or decreasing support of ET, because IDT proponents tend to argue for both the merits of IDT and the limitations of ET (Meyer & Campbell, 2005).

## Causal Process

The present research also addresses critical questions about the process underlying the effects found. Thus far, TMT research has demonstrated that the effects of mortality salience may be mediated by death-thought accessibility (e.g., Schimel et al., 2007) and the potential for anxiety (Greenberg et al., 2003), but there is little evidence regarding the specific motivational nature of different terror management defences; that is, few studies have directly tested assumptions about *why* particular worldviews might assuage death-related anxiety. Study 4 of the present research demonstrates that the impact of MS on views of IDT and ET are likely due to a desire to believe in a scientific, or seemingly scientific, theory that provides a sense of meaning and purpose to human life as a way of managing concerns about death. They further imply that when individuals are prompted to think about naturalism and evolution in meaningful terms—at least individuals with a strong educational background—they become more likely to embrace ET and reject IDT as a defence against existential angst. The results of Study 5 provide confirmatory support for these findings and our interpretation of them; among individuals who likely already view ET as a source of meaning and purpose, responses to MS were identical to the responses of psychology students who read the Sagan passage. However, future studies are needed to probe the specific causal process underlying *these* individuals' responses to MS, to determine whether it is the same as that of the psychology students in Study 4 who read the Sagan passage.

The findings from Studies 4 and 5 not only point to the causal process underlying the present results, but also may have implications for processes underlying other MS effects, such as gravitation toward religious ideas (e.g., Norenzayan & Hansen, 2006). It could be the case that a search for transcendent meaning mediates gravitation toward religious ideas. These findings also pinpoint the problem with ET for individuals seeking security in the face of existential

threat. ET is typically presented as the highly materialist and utilitarian process that evolution is; as Dawkins explains in the excerpted passage we used, “unordered atoms... group themselves into ever more complex patterns until they end up manufacturing people.” Only when individuals are told, “If there's nothing in here but atoms, does that make us less, or does that make matter more?”—implying that naturalism can reveal purpose in human life—do individuals reject IDT in response to heightened mortality awareness.

### **Terror Management or Meaning Maintenance?**

The present research is framed within Terror Management Theory, and used TMT established methodology; however, these findings are consistent with the Meaning Maintenance Model (MMM; Heine, Proulx, & Vohs, 2006; Proulx & Heine, 2006; Proulx & Heine, 2008; Proulx & Heine, 2009). On the other hand, they may also present a challenge to the MMM. On the surface, evolutionary theory is just as meaningful (i.e., rational and logical) as intelligent design theory—if not more so—so it is not clear from an MMM perspective why people support IDT (the more existentially satisfying theory, but less rational and logical) over ET (the existentially bleaker but more superficially meaningful theory) after a mortality threat. If meaning is about expected relationships, ET should not be rejected under threat, because it describes clear relationships between events and consequences.

However, it is the violation of *expected* relationships that results in a meaning threat, not any relationship. For instance, it is just as logical (or illogical) to have a deck of cards with a black diamond as a deck of cards with a red diamond, but black diamonds have been found to be a meaning threat because they violate an expected relationship (Proulx & Heine, 2006). Similarly, ET violates expectations about the origins of objects. In support of this claim, children who have not learned about ET show a preference for teleological explanations for the origins of

objects (Evans, 2001)<sup>13</sup>, and also tend to interpret the world in terms of design and purpose (Kelemen, 1999). Children also naturally believe in dualism: that there is 'mental stuff' and 'physical stuff' (Bloom, 2004). In contrast, ET suggests that mental stuff is one result of physical stuff (i.e., the brain), an idea that violates intuitive expectations. Our adult resistance toward ET (when existential concerns are heightened) may be partly explained by these findings among children (Bloom & Weisberg, 2007). That is, our 'default' explanation, and thus expectation, may be one of purpose and design, which runs contrary to ET.

In summary, the present findings are consistent with both TMT and the MMM. Future research should examine whether the underlying motive for supporting IDT and resisting ET in the face of existential threat is best explained by TMT, MMM, or perhaps a combination of both.

### **Absence of Interaction with Religiosity/Religion**

Because the intelligent design movement is assumed to be a religious movement, it might at first seem puzzling that all effects held controlling for religiosity (with the only exceptions not being theoretically predicted or consistent with the other findings, and are thus unlikely to be meaningful) and none of the effects were moderated by religiosity (overall, intrinsic, or extrinsic), religious fundamentalism, or Christianity. Previous research has found that after death reminders, those who are religious are more likely to affirm supernatural agents (Norenzayan & Hansen, 2006), suggesting that IDT, seemingly a religious theory that suggests the presence of a supernatural designer, would show increased support among religious participants who have been reminded of their mortality. However, the absence of an interaction is consistent with the notion that IDT is not simply about religion. It is framed as a science, written by scientists, and makes no explicit mention of God or religion (see Appendix B). Indeed, someone (lacking a strong science background) who reads about the theory, in one of the numerous published books

by its proponents, might come to believe that it is a valid scientific theory, and not particularly relevant to religiously motivated individuals who seek religious, rather than scientific, answers to existential questions.

The failure to find effects of mortality salience on support for Dawkins-ET or Behe-IDT in Study 6 may be consistent with the claim that religious minded individuals seek religiously based defences. The Study 6 sample of Christian religious club members showed no preference for Dawkins/ET or Behe/IDT after being reminded of their death. A possible explanation for this failure to find any effects, is that individuals who put their religion at the core of their worldview, do not need to resort to secular science (even if it is existentially satisfying) as a defence against existential concerns. Consistent with this account, research has found that after mortality salience, religious participants tend not to reject an author who is critical of a secular institution, whereas the non-religious do show this effect (Norenzayan, et al., 2009), suggesting that the religious and non-religious utilize different defences against existential threat. Consequently, the lack of interactions with religion/religiosity in Studies 1-4 is consistent with the notion that IDT's appeal is not only about its religious implications, and that instead, other underlying psychological motives are also at play.

## CONCLUSIONS AND IMPLICATIONS

The tendency to embrace IDT or reject ET in the face of existential threat is a terror management response utilized by a broad range of individuals regardless of their pre-existing stance on the question of life's origins. Although we found differences among those with strong views in support of ET (Study 5) or their religion (Study 6), this finding contrasts with previous research suggesting that many mortality salience effects occur only among individuals with certain pre-existing belief systems or cultural affiliations (e.g., Rosenblatt et al. 1989). That this was not the case in the present research suggests that IDT may be a unique, broadly appealing worldview that addresses the existential concerns of religious and more scientifically oriented individuals alike. The combination of IDT's scientific framing and provision of existential meaning may be responsible for this broad appeal. These findings are an important addition to TMT research because it shows existential defences can be broadly appealing.

The current studies also add to extant research on the importance of psychological motives to shaping attitudes, often unbeknownst to the individual, and here demonstrate that these motives can influence a current real-world debate, which does not seem to be going away. In a post 9/11 world, it seems particularly likely that existential angst is on the rise in America. Consequently, the current findings are particularly timely. These findings have implications for our understanding of how terror management processes influence views of scientific theories and individuals' willingness to accept these theories, and for the success of the Intelligent Design movement. Although religious ideology certainly plays a major role in the widespread support for IDT, support for IDT among both religious and non-religious individuals may be partly explained by the theory's ability to assuage existential concerns among even individuals familiar with science.

In addition to providing a psychological explanation for the popularity of IDT, the present findings also challenge the conventional wisdom that attitudes toward such theories are determined by factors such as logic, education, and religion. In this way, the present findings are consistent with other recent studies demonstrating the motivational underpinnings of social cognition, which have shown that core insecurities, whether dispositional or situational, regularly influence overt attitudes about ostensibly unrelated sociopolitical issues; and that such beliefs are thus often not objective, rationally derived constructions, but, rather, influenced by fundamental motivations such as the need to protect the self against psychological insecurity (e.g., existential, epistemic, personal, or relational uncertainty; Hart et al., 2005; Jost et al., 2003; McGregor, Zanna, Holmes, & Spencer, 2001; Martin, 1999; Rutjens, van der Pligt, & van Harreveld, 2009; Van den Bos, Poortvliet, Maas, Miedema, & Van den Ham, 2005). The present research builds on and extends these previous findings by showing that such processes generalize to attitudes and beliefs in the scientific domain.

Furthermore, these findings have important implications for science writers and educators. By framing science and scientific findings in existentially meaningful terms (e.g., Sagan, 2006), science writers might make scientific findings more appealing to their audiences, and consequently readers might not resort to believing in baseless pseudoscience. In addition, by framing findings in more existentially meaningful terms, science writers might put science on more even grounds with religion in the inherent conflict between science and religion (Preston & Epley, 2009), with science becoming existentially satisfying as well. In this way, individuals may not need to adopt IDT-like views that modify the definition of science in order to find convergence between their scientific and their more existentially satisfying religious or spiritual views.

Finally, these findings have implications for the success of other, similar theories to IDT that attempt to bridge the gap between religion and science. Theistic evolution is another theory that attempts this reconciliation. Theistic evolution remains consistent with evolutionary findings, yet claims that God is behind the evolutionary process. This part of the theory is necessarily unfalsifiable because it is a supernatural, rather than natural, explanation. However, because theistic evolution is otherwise completely consistent with scientific findings, it may be appealing to those with strong scientific views who also hold strong religious beliefs. For example, biology professor Kenneth Miller of Brown University, who defended ET in the Dover, PA, trial, is a Catholic and a believer in theistic evolution. Future research should examine whether belief in theistic evolution serves the same goal of addressing existential concerns, while also maintaining allegiance to both religion and science.

## FOOTNOTES

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<sup>1</sup> Some degree of *literal* immortality may be inferred from IDT as well, based on the assumption—never directly stated—that a universe with a supernatural creator might allow for life after death.

<sup>2</sup> The first five studies described in this thesis have been submitted for publication to the *Journal for Personality and Social Psychology*. All of these studies were submitted in the same paper, authored by Jessica L. Tracy, Joshua Hart, and Jason P. Martens, under the title "Death and science: the existential underpinnings of belief in intelligent design and discomfort with evolution." None of these studies or the other studies presented in this thesis have been previously used for course credit by the author of the thesis. This thesis is the product of the thesis author.

<sup>3</sup> Scaling was also supported by a varimax-rotated factor analysis, showing that all item loadings ranged from .58-.83 on predicted primary factors, and below .30 on secondary factors. A scree test confirmed a two-factor solution (eigenvalues for the first five components = 5.31, 3.40, 1.24, .79, and .65).

<sup>4</sup> In all studies, except where explicitly noted, all *p* values for null findings on religiosity, religion, and Christianity as moderators were greater than .10; none of these null effects were marginally significant.

<sup>5</sup> MS manipulations tend to have little impact on explicit affect, but significant effects on PA or NA emerge occasionally, as was the case in Studies 1 and 3 here. However, entering PA and NA as covariates in all six studies did not alter any results.

<sup>6</sup> Initially, participants read both the IDT and ET passages, but passage order moderated results,  $F(1,256) = 9.17, p < .05$ , likely due to Sagan-condition participants becoming depleted or fatigued after reading three complex and lengthy academic passages. Thus, following standard experimental procedures (Smith, 2000) to avoid contaminating results with effects driven by error or other sources of order effects, we analyzed results only for responses to the first passage read, making author-theory a between-subjects condition.

<sup>7</sup> Intrinsic religiosity was scored omitting 2 items that had negative item-total correlations (after being reverse-scored, as intended) and lowered the scale alpha to .51. No results changed when the full scale was used instead.

<sup>8</sup> This interaction also emerged when we excluded those students who were not natural-science majors,  $F(1, 75) = 3.93, p = .05$ .

<sup>9</sup> Study 6 single-item religiosity mean,  $M=7.70$ , was significantly higher than Studies 1 through 5,  $M_s=4.10, 4.87, 5.71, 3.47, 3.95, t(197)=9.75, t(420)=7.98, t(909)=6.02, t(341)=10.50, t(189)=10.47$ , respectively,  $ps < .05$ .

<sup>10</sup> Study 6 intrinsic religiosity mean,  $M=4.02$ , was significantly higher than Studies 1 and 4,  $M_s=2.51, 2.63, t(167)=9.01, t(151)=10.90$ , respectively,  $ps < .05$ .

<sup>11</sup> Study 6 extrinsic religiosity mean,  $M=2.47$ , was not significantly different than Studies 1 and 4,  $M_s=2.46, 2.36, t(167)=0.79, t(151)=0.05$ , respectively, all *ns*.

<sup>12</sup> Behe-IDT and Dawkins-ET scale  $M_s$  in Study 3 = 2.97 and 3.11, compared to Study 1  $M_s=2.38$  and 3.68,  $t(252) = 3.73$ , and  $t(268) = 3.13, ps < .05$ ; compared to Study 2  $M_s= 2.57$  and 3.70,  $t(365) = 5.04$  and  $t(382) = 4.59$ ; and Study 4  $M_s = 2.01$  and 3.47,  $t(220) = 4.24, p < .05$ , and

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$t(240)=1.44, p =.15$  (Study 3 scores were transformed from a 7-point to a 5-point scale to make these comparisons).

<sup>13</sup> Adults with Alzheimer's disease, who have forgotten where objects come from, also show a similar preference (Lombrozo, Kelemen, & Zaitchik, 2007).

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## APPENDICES

### Appendix A: Items used as the Dependent Variable

#### *Author Questions*

**Using the scale below, please evaluate the author of the essay you just read, Professor Richard Dawkins/Michael Behe, by writing the number in the space provided.**

1-----2-----3-----4-----5-----6-----7-----8-----9  
The Neutral/Mixed The  
least possible most possible

- 1) How much you like Professor Richard Dawkins/Michael Behe? \_\_\_\_
- 2) How intelligent do you think Professor Richard Dawkins/Michael Behe is? \_\_\_\_
- 3) How knowledgeable do you think Professor Richard Dawkins/Michael Behe is? \_\_\_\_
- 4) How much did you agree with Professor Richard Dawkins'/Michael Behe's view? \_\_\_\_
- 5) From your perspective, how true do you think Professor Richard Dawkins'/Michael Behe's opinion is? \_\_\_\_

#### *Theory Questions*

**Read the following items and rate the extent to which you agree or disagree with each. Write the number in the space provided, using the following rating scale:**

1-----2-----3-----4-----5  
Strongly Disagree Disagree Neither Agree Agree Strongly Agree  
Disagree nor Disagree

- 1) Evolution/Intelligent design is a solid theory supported by a great deal of evidence. \_\_\_\_
- 2) Evolution/Intelligent design is the best explanation we have for life's origins. \_\_\_\_

\* For Study 3, a 7-point scale was used for both author and theory questions.

## **Appendix B: Excerpts Used as Stimuli in Studies 1, 2, 4, and 5**

### ***Dawkins-Evolutionary Theory excerpt:***

Darwin's theory of evolution by natural selection is satisfying because it shows how simplicity could change into complexity, how unordered atoms could group themselves into ever more complex patterns until they ended up manufacturing people. Darwin provides a solution, the only feasible one so far suggested, to the deep problem of our existence. . . Today the theory of evolution is about as much open to doubt as the theory that the earth goes round the sun. Many evolutionary transitions are elegantly documented by more or less continuous series of gradually changing intermediate fossils. Darwinian evolution shatters the illusion of design within the domain of biology, and teaches us to be suspicious of any kind of design hypothesis in physics and cosmology as well. The full implications of Darwin's revolution have yet to be widely realized. Darwinism encompasses all of life—human, animal, plant, and bacterial. Darwinian evolution, as one reviewer has observed, is the most important natural truth that science has yet discovered. No serious biologist doubts the fact that evolution has happened.

### ***Behe-Intelligent Design Theory excerpt:***

Darwinian evolution is being pushed to its limits by discoveries in biochemistry. Over the last fifty years, discoveries in biology, physics, astronomy, and cosmology, suggest that life and the universe manifest signs of real design. Further, many evolutionary biologists have acknowledged fundamental problems with Darwinian evolution as an explanation for the complexity and apparent design of living organisms. As a result of both these developments, many scientists and philosophers now think that the universe and life appear designed because they really were. These scientists advocate an alternative theory of biology and cosmological origins known as the theory of intelligent design, or, simply, design theory. Design theorists believe that scientific evidence actually points to intelligent design. This result, of cumulative efforts to investigate life at the molecular level, is so unambiguous that it must be ranked as one of the greatest achievements in the history of science. The observation of the intelligent design of life is as momentous as the observation that the earth goes around the sun or that disease is caused by bacteria.

## **Appendix C: Excerpts Used as Stimuli in Study 3**

### ***Evolutionary Theory excerpt:***

Although the universe and life appear designed, many scientists and philosophers now agree that they really weren't. These evolutionary theorists believe that scientific evidence clearly points to evolution. This result is so unambiguous that it must be ranked as one of the greatest achievements in the history of science. Darwin's theory of evolution by natural selection is satisfying because it shows how simplicity could change into complexity, how unordered atoms could group themselves into ever more complex patterns until they ended up manufacturing people. Darwin provides a solution, the only feasible one so far suggested, to the deep problem of our existence. The full implications of Darwin's revolution have yet to be widely realized. Darwinism encompasses all of life—human, animal, plant, and bacterial. Darwinian evolution is the most important natural truth that science has yet discovered. The observation of the evolution of life is as momentous as the observation that the earth goes around the sun or that disease is caused by bacteria.

### ***Intelligent Design excerpt:***

People often feel like the universe and life must have been designed, and many scientists and philosophers now agree that this is because they really were. These design theorists believe that scientific evidence clearly points to intelligent design. This result is so unambiguous that it must be ranked as one of the greatest achievements in the history of science. Intelligent design theory is satisfying because it shows how complexity exists, how atoms could group themselves into ever more complex patterns until they form people. Intelligent design provides a solution, the only feasible one so far suggested, to the deep problem of our existence. The full implications of the intelligent design revolution have yet to be widely realized. Intelligent design encompasses all of life—human, animal, plant, and bacterial. Intelligent design is the most important truth that science has yet discovered. The observation of the intelligent design of life is as momentous as the observation that the earth goes around the sun or that disease is caused by bacteria.

## **Appendix D: Excerpt Used as Stimulus in Study 4**

### ***Sagan Excerpt:***

It is very reasonable for humans to want to understand something of our context in a broader universe, awesome and vast. It is also reasonable for us to want to understand something about ourselves. And understanding the nature of the world and the nature of ourselves is, to a very major degree, I believe, what the human enterprise is about. Truth should be pursued, and science helps us pursue it; science gives us meaning. All we have to do is maintain some tolerance for ambiguity, because right now science does not have all the answers. This tolerance goes with the courageous intent to greet the universe as it really is, not to foist our emotional predispositions on it but to courageously accept what our explorations and knowledge tell us. The more likely we are to assume that the solution comes from something outside science, the less likely we are to solve our problems ourselves. If we are merely matter that is intricately assembled, is this really demeaning? If there's nothing in here but atoms, does that make us less, or does that make matter more? We make our purpose. And we have to work out what that is, for ourselves.

## Appendix E: Validation of the Sagan Passage

To ensure that the Sagan passage was interpreted as providing a greater sense of meaning in life than ET as described by Dawkins, we asked 120 participants (64% female) from the same population as the main study participants to read both the Dawkins and Sagan passages (order was counterbalanced; no order effects emerged) and, immediately after each, respond to the five items included in all studies assessing their general positivity toward the author. After completing these five items, participants responded to a sixth item asking them to “Rate the extent to which this passage makes you feel like life is meaningful.” An interaction between the aspect of passage assessed (positivity vs. meaning) and author (Dawkins vs. Sagan),  $F(1, 119) = 15.21, p < .05$ , indicated that although participants did not differ in how positively they viewed the two authors ( $M_s = 4.83$  and  $4.75$ , for Dawkins and Sagan, respectively), they found the Sagan passage to provide a greater sense of meaning [ $M_s = 3.88$  vs.  $4.28$  for Dawkins and Sagan, respectively,  $t(119) = 2.48, p < .05$ ]. Thus, as was intended, participants not primed with MS viewed Sagan’s passage as providing greater transcendent meaning than evolutionary theory as described by Dawkins, but felt equally positively about both passages.

## **Appendix F: Support for Evolution**

Further supporting the presumed difference in evolution beliefs between the samples used in Studies 1 and 4 versus 2 and 3, we collected additional data on 2,266 students drawn from the same population as those in Studies 1 and 4. Rating their agreement with the statement, “Evolution provides the best explanation of the origin of life on Earth”, 65% of these individuals agreed or strongly agreed with the statement, and only 18% disagreed. Although we cannot directly compare these attitudes with those of the highly diverse samples from Studies 2 and 3, we can compare them with estimates of what those samples’ attitudes are likely to be, based on surveys conducted among similar samples. A February, 2009, Gallup poll on 1,018 U.S. adults found that only 39% believed in evolution, and 25% did not. Based on a *t*-test comparing the proportions of individuals who believe in evolution (or agree that it provides the best explanation of life’s origins) across the Gallup sample and the undergraduate psychology student sample, the difference (26%) is significant ( $p < .000001$ ) and quite substantial.

## Appendix G: UBC Behavioural Research Ethics Board Certificate of Approval



The University of British Columbia  
Office of Research Services  
**Behavioural Research Ethics Board**  
Suite 102, 6190 Agronomy Road, Vancouver, B.C. V6T 1Z3

### CERTIFICATE OF APPROVAL - MINIMAL RISK AMENDMENT

<b>PRINCIPAL INVESTIGATOR:</b> Jessica Tracy	<b>DEPARTMENT:</b> UBC/Arts/Psychology, Department of	<b>UBC BREB NUMBER:</b> H07-01902
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**INSTITUTION(S) WHERE RESEARCH WILL BE CARRIED OUT:**

Institution	Site
UBC	Vancouver (excludes UBC Hospital)

**Other locations where the research will be conducted:**  
Research will be completed in the PI's lab, and participants will also be able to complete the study on-line wherever they can access the internet (e.g., in their homes, at on-campus workstations, etc.). Various UBC clubs will be contacted to participate, and research for them will be carried out where their meetings take place (e.g., locations at UBC, their homes, etc.).

**CO-INVESTIGATOR(S):**

Jason Martens

**SPONSORING AGENCIES:**

N/A

**PROJECT TITLE:**

Life Attitudes Study  
Attitudes about Life

**Expiry Date - Approval of an amendment does not change the expiry date on the current UBC BREB approval of this study. An application for renewal is required on or before: July 31, 2010**

<b>AMENDMENT(S):</b>	<b>AMENDMENT APPROVAL DATE:</b> October 1, 2009	
<b>Document Name</b>	<b>Version</b>	<b>Date</b>
<b>Consent Forms:</b> consent for revised for patriot act	N/A	September 23, 2009
<b>Other:</b> <a href="http://www.surveymonkey.com/s.aspx?sm=h_2bTRYgCMiFMfSn78yWFiiQ_3d_3d">http://www.surveymonkey.com/s.aspx?sm=h_2bTRYgCMiFMfSn78yWFiiQ_3d_3d</a>		

The amendment(s) and the document(s) listed above have been reviewed and the procedures were found to be acceptable on ethical grounds for research involving human subjects.

**Approval is issued on behalf of the Behavioural Research Ethics Board  
and signed electronically by one of the following:**

Dr. M. Judith Lynam, Chair  
Dr. Ken Craig, Chair  
Dr. Jim Rupert, Associate Chair  
Dr. Laurie Ford, Associate Chair  
Dr. Anita Ho, Associate Chair