THE USE OF INOCULATION TECHNIQUES IN INTELLIGENT DESIGN COMMUNICATION STRATEGIES

By

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ABSTRACT

The experiment reported herein tested the effectiveness of inoculation strategies used by the intelligent design movement and the effectiveness of metainoculation, the use of interventions to prevent inoculation, against those strategies. The experiment had a three condition (control, inoculation, metainoculation), pretest/posttest design with 113 participants. Inoculation and metainoculation treatments were given in different combinations to each condition to test the effects of those treatments on participants' strengths of attitude. Hypotheses stated that inoculation group members would have a more positive attitude toward ID than others and metainoculation group members would have a more negative attitude toward ID than others. An episode of *Cosmos: A Spacetime Odyssey* was used to refute ID and trigger inoculation effects. Findings indicate that the inoculation treatment did not significantly impart more positive feelings toward ID and the metainoculation did not make participants more likely to reject ID. *Cosmos: A Spacetime Odyssey* was shown to be an extremely successful persuasive message, perhaps blocking the inoculation and metainoculation effects.

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TABLE OF CONTENTS

CHAPTER 1. INTRODUCTION

Persuasion is a powerful tool for movements, organizations, and individuals. The ability to affect attitudes through communication is especially important in an era of divided attention where information comes from a staggering number of potential sources. Perhaps, for this reason, among others, the inoculation theory of persuasion proliferated in the last half of the 20th century (McGuire, 1961a; 1961b). Inoculation has been tested across many contexts and findings have been generally consistent: it is possible to use it to confer strong resistance to actual attacks against attitudes and beliefs (Compton & Pfau, 2005).

The metaphor between viral inoculation and its persuasive offspring remains strong. A vaccine provides a weakened sample of the virus that prepares the body to resist that virus if it ever returns. In persuasive inoculation, an individual is exposed to a weak attack on their attitudes in order to build resistance to legitimate future attacks. Certainly, inoculation would be a useful addition to any communications tool box, especially in a world where an individual can access any information they choose on demand. The idea on deploying inoculation strategically takes on a new life in such a world. This research identifies intelligent design (ID) as one movement that appears to use inoculation.

The natural sciences were forever changed with the publication of *On the Origin of Species* (Darwin, 1859). Darwin's research was the first step toward evolutionary theory's development into the most-widely accepted scientific explanation for the development of life on Earth (Goodman, 2010). In Darwin's time and in ours, many challenges are lobbed at evolutionary theory. These challenges often come from religious movements with central tenets of belief that may be shaken by scientific advances or skeptical inquiry (Meyer, 2009; Goodman,

2010; Johnson, 2010). Over the past three decades, intelligent design has arisen as the movement in most direct contention with evolutionary theory (Ravitch, 2011; Scott & Branch, 2006).

The simplest principle of ID is that an intelligent cause is the best *scientific* explanation for natural phenomena (Discovery Institute, 2014). ID advocacy groups have promoted this idea in the media, political, and cultural spheres and actively sought the inclusion of ID in public school curricula in the United States. While ID proponents would stress that the movement is not tied to a particular religious ideology or divine being (Behe, 2006; Meyer, 2009), courts have found this not to be true, as the movement was born largely from Christian creationist teachings. Literature on ID fails to establish its credibility as a valid scientific theory (Forest & Gross, 2004; Scott & Branch, 2006). The movement has positioned itself as an alternative scientific discipline without offering testable data, but, as has been said many times, perhaps most famously by Carl Sagan, astronomer, science popularizer, and noted skeptic, "extraordinary claims require extraordinary evidence" (Sagan, 1980).

ID does not hold up to scientific scrutiny, but it exhibits a tremendous staying power in the public imagination (Pennock, 2003). In a recent national poll, it was discovered that 73% of Americans believed that a deity had some hand in creating the natural world, whether through designing the process of evolution or simply creating the world as is (Gallup, 2014). It is in the interests of ID proponents to encourage this thinking, as these beliefs help perpetuate and support their movement. Still, ID theorists offer no scientific literature or skeptical, evidence-based material to support their claims. How do supporters win hearts and minds when scientists, with decades of evidence, seem to have so much trouble?

The answer may be found in the communication strategies of the ID movement, which often seem to mirror inoculation. The purpose of this research was to determine if an inoculation

message based on the public relations efforts, talking points, and communication strategies of the ID movement, notably outlined in the *wedge strategy*, is effective at inoculating randomly selected receivers exposed to it. The wedge strategy first came to public attention in 1999 in a leaked ten-page white paper published by the Discovery Institute, the primary organizational force behind ID. That paper advanced the position of the organization, and the ID movement by extension, through a public relations campaign centered on three phases of public communication: scientific research, writing, and publication; publicity and opinion-making; and cultural confrontation and renewal (Discovery Institute, 1998; Forrest & Gross, 2004). The goal of the wedge strategy was to develop and persuade the public to support ID. Based on the Discovery Institute's conjuring of threats to ID by the scientific community and specific recommendations for dealing with those threats, the strategy recalls, perhaps unintentionally, inoculation.

The benefit of determining if inoculation occurs when specific aspects of the wedge strategy are employed is ultimately an ethical one. Persuasion is a powerful tool that can be used to raise the involvement of a public and move them from a latent stage to an active one (Grunig, 1997). Inoculation has been shown to change attitudes and beliefs. If inoculation is used to convince a public of the legitimacy of any less-than-forthright movement, organization, or idea, it becomes an ethically fraught means of persuasion. One of the newest developments in the study of inoculation has been metainoculation, first explored in Banas and Miller (2013). Metainoculation is the use of a "second layer" of inoculation to nullify attempts at persuasion. Understanding metainoculation could be useful in devising strategies to counteract potentially unethical uses of inoculation. It is likely that this could become a growth area in practical persuasion applications.

CHAPTER 2. LITERATURE

The experiment at hand explored the effectiveness of inoculation treatments in creating support for intelligent design (ID), a pseudoscientific theory that attributes the creation and development of life on earth to an intelligent force. This chapter will begin with a review of inoculation and metainoculation and then proceed in examining the complex relationships among ID, evolution, creationism, and the scientific method. This background is crucial in building a case for how ID communication strategies have been molded since the movement's inception.

ID is fairly new. Over the past three decades it has emerged as just one of several anti-science movements that attack the findings of the mainstream scientific research. Proponents of ID, like anti-vaccination activists or climate change deniers, often use twisted versions of scientific rhetoric to advance their iconoclasm (Miller, 2008).

The ID movement understands that members of the general public are not trained as scientists (Miller, 2008). A recent poll indicated there are wide gaps between what the American public believes and what scientists have provided evidence for, across a variety of issues, from space exploration to genetically modified foods (Pew, 2015). In that poll there was a 37-percentage point gap between scientists who believe evolution is the cause for the development of life (66%) and American adults (29%). Research into communication strategies used by ID, or, broadly speaking, any pseudo- or anti-scientific movement might offer valuable insight discrepancies like those.

Inoculation Theory

Inoculation theory was first suggested by McGuire (1961a, 1961b; McGuire & Papageorgis, 1961, 1962; Papageorgis & McGuire, 1961) as a framework for understanding effective persuasive communication. As the name implies, inoculation theory draws a comparison with

medical inoculation, wherein a weakened sample of a virus is introduced into the body to shore up viral resistance against potential contraction of a disease in the future. Inoculation in communication works in a similar way. Weakened attacks are provided that assail an individual's beliefs in the hope that when a real attack is made, resistance has been built.

Early inoculation studies examined belief in cultural truisms. Experiments found that attacks on beliefs can be effective at changing attitudes (McGuire, 1961a). However, when subjects in early experiments were given weakened version of attacks on the belief and knowledge on how to refute those attacks, they showed more confidence in their attitudes (McGuire, 1961a; McGuire & Papageorgis, 1961).

Research also determined that, generally, the best way to induce inoculation is to offer messages that threaten beliefs rather than support them and prepare refutational preemptions against the persuasive arguments (Anderson & McGuire, 1965; Kiesler & Kiesler, 1964). Crane (1962) confirmed that refutational preemptions were effective in protecting beliefs, especially if subjects were aware of threats.

Literature on inoculation has proliferated in the intervening half century. Two notable analyses examine of the breadth of the theory. The first, by Compton and Pfau (2005), offers a detailed review of the development of the theory, and confirms that threat and refutational preemption are basic conditions for inoculation. Threat provides the motivation for building, changing, or upholding beliefs in the face of rhetorical attack. Individuals have little motivation to protect their beliefs if there is no credible reason to suspect they are under fire (Anderson & McGuire, 1965; Burgoon & Miller, 1990; McGuire, 1962). A refutational preemption is an argument or material that an individual can use to build a defense against a message attacking their beliefs (McGuire & Papageorgis, 1962). When a refutational preemption is provided, the

recipient can potentially anticipate and prepare for legitimate attacks on a belief. (Banas & Rains, 2010; Benoit, 1991; Compton & Pfau, 2005).

In another meta-analysis, Banas and Rains (2010) analyzed 54 inoculation studies to determine the components essential in creating resistance to persuasion. Banas and Rains also identified threat and refutational preemption. The meta-analysis notes two other moderators that have been studied in relation to inoculation theory: *time decay* and *issue involvement.* Time decay is the period between an inoculation treatment and the attack on an attitude. Much research has assumed that a moderate delay between treatment and attack is most effective. Issue involvement is an individual's pre-inoculation participation in an issue, where low involvement means no participation and high involvement means fervent support. In general, neither of these moderators had a statistically significant effect on the success of inoculation (Banas & Rains, 2010)

Pryor and Steinfatt (1978) expanded McGuire's early work on cultural truisms, which were not, as the pair argued, a reasonable application of inoculation, as it cannot be suggested that any belief is completely sheltered from attack. That study was one of the first to establish a broader base for further research such as studies of inoculation in politics and public policy (An & Pfau, 2004; Infante, 1975; Pfau & Burgoon, 1988), advertising and marketing (Burgoon et al., 1995; Compton & Pfau, 2004; Pashupati, Arpan, & Nikolaev, 2002; Pfau, Haigh, Sims, & Wigley, 2007), values and mood (Bernard, Maio, & Olson, 2003; Bohner, Crow, Erb & Schwarz, 1992) and social action issues (Banerjee & Greene, 2007).

Banas and Miller (2013) examined inoculation in the context of the 9/11 Truth movement. The researchers identified conspiracy theories as the perceived narratives designed to manipulate events from behind the scenes. They also researched counter maneuvers to inoculation, termed

metainoculation, a novel extension of the theory.

Metainoculation

Metainoculation is the application of an inoculation treatment designed not to effect an individual's baseline attitudes and beliefs but to nullify or modify a previous inoculation treatment given to that individual (Banas & Miller, 2013). Metainoculation is a proactive, preventive strategy that can be used as a counterattack on an undesirable inoculation treatment. In the original inoculation metaphor, an inoculation treatment is given to an individual in a one-way transaction by a persuader. Metainoculation complicates the scope of this metaphor and reframes inoculation as a conversation between parties: the individual being persuaded, the would-be inoculator, and a third party with a vested interest in preventing the inoculator's techniques from working.

If inoculation is meant to persuade in the face of attacks, metainoculation is an extra layer added to prevent that persuasion from taking hold. In the Banas and Miller (2013) experiment on 9/11 conspiracies, a metainoculation statement did not refute or support any position on 9/11, but rather explained inoculation to the participants. The results showed that metainoculation did overcome inoculation treatments.

Inoculation is useful to any individual or organization interested in sending persuasive messages. Indeed, the ultimate goal of the proposed study is to test the effect a relatively small organization can potentially have on the national discourse by strategically employing inoculation. Metainoculation may provide a means to combat the effects of inoculation. In the experiment reported herein, the pro-ID inoculation treatment was designed to chip away mainstream scientific credibility in the public discourse. The metainoculation, then, is a means for the mainstream scientific community to build armor around their evidence-based claims.

The Case for Science

Testable, evidence-based inquiry into the nature of the world - or, science - has a profound effect on all facets of life. Even in the face of controversy, the work of scientists increases lifespans, grows better crops, and builds stronger roads and bridges. There are, of course, ghastly technologies. John F. Kennedy (1961) notably called the atomic bomb a "nuclear sword of Damocles." Still, scientific progress likely amounts to a net force for good in the world. After all, just shy of nine years after Kennedy's condemnation of nuclear arms, men walked on the moon.

Science and religion have not always been kind to one another. Both are engaged in a struggle, willful or not, over hearts, minds, and resources. Both have valuable places in public and social life. Many scientists reconcile their work with their own religious beliefs. Similarly, many organized religions have accepted scientific advances and reconcile them with scripture. Perhaps most prominently, the Roman Catholic Church has voiced its acceptance of the underlying processes of evolution (Miller, 2008; Sagan, 1997).

Science has become a powerful tool in the decision making process for governments and organizations the world over. The Establishment Clause of the First Amendment to the United States Constitution - "*Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof..."* - is meant to prevent religious persecution. It also implicitly establishes a precedent that policy should be based on information that will best benefit the common good (Miller, 2008). The scientific method can help provide that information.

Scientists do not have an ironclad claim for how life began on Earth, but in their inquiry into the past, they have come to a consensus on evolution as the answer to how that life

subsequently developed. Evolution is the term used to describe the cumulative changes in a population over time. For life on Earth, this time is on the order of billions of years (Morris, 2001). Evolution's primary process is natural selection, or the passing down of traits to future generations and the resulting success or failure of those generations (Darwin, 1859). Mutations in simple one-celled organisms bore more complex multi-celled organisms, a process repeated slowly, again and again, until eyes, fins, legs, vertebrate, and other familiar features appeared. Populations waxed and waned, advantageous traits won out, and eventually life exploded on to land, proliferating in an uncountable number of forms (Scott, 2009). Selection is a gradual process that is affected by environment, biological conditions, sexual competition and other variables that "reward" mutations that offer organisms a competitive advantage within them. Over time, if populations of organisms become separated from one another by environment, behavior, or time they begin to show differences from one another. This process, speciation, is at the heart of the proliferation of life (Miller, 2008; Morris, 2001; Scott, 2009).

Charles Darwin, already a famous and respected biologist and geologist, published *On the Origin of Species* in 1859. Many of the scientist's contemporaries were coming to similar conclusions about the development of life, but Darwin's book quickly became the foundational text of evolutionary biology, a field that has only grown in the years since (Scott, 2009). Only a half-decade after the publication of *On the Origin of Species*, Gregor Mendel's experiments in heredity introduced classical genetics. Less than a century after the publication, Watson and Crick discovered DNA, unlocking the secrets of molecular biology. In 2003, the Human Genome Project announced completion of its goal. Today, scientists can read nature's genetic codes and understand mutation and selection on an incredibly detailed level (Miller, 2008). Evolutionary biologists still seek answers, but they have, since Darwin, found so much testable and observable

evidence for evolution that they have established its credulity as a scientific theory, the final summation of a scientific idea that combines facts, evidence, and laws into a coherent whole (Morris, 2001; National Academy of Sciences, 2008).

Creationism

Darwin's study of science caused his beliefs to shift over time, ultimately rendering him an agnostic (Darwin, 1879). Still, throughout his life he remained tied to Christianity, through his own hopes and the beliefs of his loved ones. His nuanced relationship with religion has not been indicative of the struggles between religious fundamentalists - those most likely to support creationist doctrines - and the scientific community (Miller, 2008).

Creationism is not a unified movement. There are as many different interpretations for the how the universe began as there are religious denominations. In the United States, the phrase is often used to denote Young Earth Creationism, the biblical literalist tradition that the God of Abrahamic traditions created the Earth in six days no more than 10,000 years ago (Sagan, 1994; Scott, 2009). These dates come from analysis of scripture and counting generations in the Book of Genesis. Not all creationism is literalist. As mentioned previously, the Roman Catholic Church takes a more progressive view, citing God as the creator, but acknowledging that known timescales and natural processes explain how creation developed (Miller, 2008). Scientists themselves currently have no unified theory of creation, despite their handle on geologic history and evolution (Scott, 2009).

Creationism remains as valid a personal belief as any other, but it is inherently religious and not scientifically verifiable. It has also had its day in court. Throughout the twentieth century, creationism lost ground in the political arena (Forrest & Gross, 2004). Repeated permutations of the concept have reached as high as the United States Supreme Court and been

found wanting. While most jurists and justices readily admit that religious belief serves an important role in communities (Condit, 2003; Miller, 2008), the resounding consensus is that faith structures like creationism are not science and cannot be presented as such in government policy or public education (Singham, 2009).

Creationism was most notably put on trial in *The State of Tennessee v. John Thomas Scopes*, or the Scopes Monkey Trial. In 1925, John T. Scopes was tried for violating Tennessee's Butler Act, which prohibited the teaching of any life science view that contradicted the Bible. The trial itself was mostly a farce, carried out to gain publicity for the town in which it took place. Scopes, who did actually break the law by teaching evolution, had his conviction overturned. The trial, however, sparked a national conversation about creation and evolution that continues to this day (Scott & Branch, 2006; Singham, 2009).

Two further Supreme Court cases are important in documenting the shift from creationism to intelligent design: *Epperson v. Arkansas* (1968) and *Edwards v. Aguillard* (1987). *Epperson* dealt with an Arkansas ban on teaching evolution in state schools. The Supreme Court found this to be a violation of the Establishment Clause, as it promoted a single religious viewpoint over others in a government setting (Ravitch, 2011). This precedent was upheld in *Edwards*, a case decided in the midst of ID's early development (Singham, 2009). The *Edwards* ruling overturned the practice of teaching creationism in schools alongside evolution. According the Supreme Court, this violated the Establishment Clause and the precedent set in *Epperson*, as the teaching of creationism as an "alternative theory" to evolution was still intended to advance a specific religious idea (Ravitch, 2011; Scott & Branch, 2006).

Intelligent Design

The ID movement began in the late 1970s or early 1980s as either a politically motivated response to the problems reconciling creationism and science (Campbell & Meyer, 2003; Forrest & Gross, 2004; Ravitch 2011) or an attempt to infer the underlying natural order based on scientific observations and problems in evolutionary theory (Johnson, 2003, Meyer, 2009). The primary difference between ID and creationism cited by proponents of the former is that ID has no specific religious agenda. That is, while both movements recognize a creator or designer, the creationist finds answers in sacred texts, while the ID theorist attempts to use scientific observations to infer the truth about natural order (Goodman, 2010). The ID theorist can look into a microscope, observe a cell, offer the scientific name of that cell, and describe its function, just like any biologist. Indeed, many prominent ID theorists have published peer-reviewed papers that contain measures of rigorous scientific work or analysis, at least in method, if not in conclusions (Axe, 2004; Behe, 2010, Goodman 2010). Where science hesitates to answer, however, ID its theorists are more than willing to infer conclusions from what they accept as evidence (Scott, 2009).

One of the key arguments in ID is that organisms in nature show *irreducible complexity*, or such a complex and specific form and function that removal of one element (like removing the cornea from the eye) will prevent the whole system from working. Such a system, they infer, could not evolve by mere chance (Behe, 2004; Behe, 2006; Meyer, 2009; Ravitch, 2011). Of course many scientists are happy to provide counter-examples to irreducible complexity (Miller, 2008).

ID "founding fathers" Phillip Johnson (2003, 2010) and Stephen C. Meyer (2009) place ID in opposition to *scientific materialism*, a pejorative term used to describe the scientific

community's expectation that theory be grounded in the observable, testable, and evidential realities of the natural world (Pennock, 2003; Sagan, 1994). ID theorists reject materialism for the belief that certain concepts, like irreducible complexity, allow one to infer new theoretical understandings. The identification of a designer as the "best explanation" for the origin of life is a reasonable deduction in ID (Goodman, 2010; Meyer, 2009).

According to Forrest and Gross (2004), ID is a response to the inevitable political failure of creationist policy. Lawyers, social scientists, and lobbyists in the ID movement had an opportunity to rebrand creationist ideas, keeping the battle for their inclusion in public policy and education alive. It was not until *Kitzmiller v. Dover Area School District* (2005) that a case was tried in a federal court about ID. The case was a response to the inclusion of ID in public school curricula as an alternative theory to Darwinian evolution. The ruling determined, as in *Edwards* before it, that ID was promoting a specific religious viewpoint and that there was little to differentiate it from creationism (Scott & Branch, 2006). Since the *Kitzmiller* ruling, ID proponents have stated their withdrawal from attempts to teach ID in public school science courses, but they remain engaged in trying to craft public policy (Scott, 2009).

The heart of the ID movement is the Discovery Institute's Center for Science and Culture (CSC), a Seattle-based think tank that advocates for a variety of issues from a foundation based on Western theistic philosophy (Ravitch, 2011). The CSC lobbies and campaigns using popular science and philosophy literature, scholarly publications, lectures, and media appearances (Discovery Institute, 2014). There often remains a recursive relationship between publications and scholars involved with the institute; for example, the premier peer-reviewed journal that tackles ID, BIO-Complexity, is a publication of the institute itself.

The CSC maintains strategies for communication. In 1999, a ten-page white paper, now termed the *Wedge Document* (Discovery Institute, 1998), was leaked online. The document explained the *wedge strategy* for ID advocacy, a three-phase introduction of the theory into the public conscience. The phases were scientific research, writing, and publication; publicity and opinion-making; and cultural confrontation and renewal (Discovery Institute, 1998; Forrest & Gross, 2004).

The first phase, *scientific research, writing, and publication,* concerns the production of literature that establishes ID in the academic and scientific communities. Thanks to publications like BIO-Complexity, articles tangentially related to ID in other peer-reviewed publications, and popular science and philosophy texts, there is a body of literature on ID, which to the undiscerning reader suggests legitimacy. *Publicity and opinion making* is the placement of ID in the education, media, and political spheres. According to the Wedge Document, the propaganda materials developed in phase one must be introduced to the public consciousness in an effective way. The final phase of the wedge strategy, *cultural confrontation and renewal*, deals with direct challenges to the mainstream scientific community. ID proponents take cases to court, attempt to rewrite school curricula, and engage in open public debate to counteract scientific materialism.

The wedge strategy does not mention the scientific method or experimental underpinning for discovering the nature of design (Discovery Institute, 1998; Forrest & Gross, 2004). The CSC attempted to distance itself from the document (Discovery Institute, 2006). The think tank argued that efforts to promote ID in the public square were never hidden, nor were they intended to dismantle the scientific method and install a theocracy. The strategies in the document have become cornerstones of ID (Forrest & Gross; 2004; Pennock, 2003; Ravitch, 2011).

ID and Communication

Communication is not something that simply happens "in" an organization. Rather, communication processes are the social interactions that shape and define an organization (Cooren, 2004; Taylor, 1993). Communication is therefore the lens through which to examine a movement like ID. The CSC, the organizational home of ID, is highly invested in institutional positioning, the processes taken to interact successfully with outside actors or recipients (McPhee & Zaug, 2000). Organizations and movements need to establish reputation, image, and share in the broader landscape. For the CSC, this means establishing campaigns that position ID as a legitimate alternative to evolution and can grow and change as the organization responds to external pressures or acclaim.

One of the most prominent conduits toward establishment is public relations, which Coombs and Holladay (2011) define as "the management of mutually influential relationships within a web of constituency relationships." For the ID movement, the web of constituents is defined in the wedge strategy as media outlets, academic publications, and Christian supporters of ID (Discovery Institute, 1998). Campaigns to legitimatize ID as an alternative to evolution should therefore focus on appealing to those groups, as they will constitute a public most likely to get involved with the movement (Grunig & Grunig, 1989).

While there is more to a public relations program than simply garnering attention, that remains the first step in the quest for legitimacy (Coombs & Holladay, 2011). One of the governing goals of the ID movement, stated in the Wedge Document (Discovery Institute, 1998), is "to replace materialistic explanations with theistic understanding that nature and human beings are created by God." There is no way for ID to achieve such a position without becoming a widely understood philosophy with instant name recognition. Instead of taking their case to the

courts where they have been rebuffed time and again, the CSC takes ID to the media and the academy, publishing material in friendly journals and online, or organizing public relations or media events. In this capacity, it would seem the movement uses a press agentry model, where information is a form of propaganda (Grunig & Hunt, 1984). The press agentry model is a one-way form of communication, where information is carefully crafted to achieve maximum effect. Below-board businesses and circus promoters were some of the first to adopt press agentry. The more stringent standards of objective reporting or polite discourse typically found in businesses, newspapers or academic journals are irrelevant in press agentry; instead the goal is to stake one's claims at any cost (Brummette, 2012; Grunig & Hunt, 1984). Today, ID specializes in offering a religious message couched in the language of dubious science. This recalls the primitive, but potentially effective public relations tactics of the press agentry era.

Introducing ID to the public consciousness requires that the movement engage in frame building with the media and other opinion leaders that can carry the messages further (Scheufele, 1999). In building the ideal frame - that ID is a legitimate alternative to mainstream scientific ideas - proponents are encouraged to engage in activities such as apologetics training seminars, media appearances on or in friendly programs and publications, and book or research publicity events (Discovery, 1998). The desired result is that ID is presented as a vigorous, active movement engaged in its fully exploring new ideas (Scheufele, 1999). A desirable frame that is adopted by the media is a powerful tool. If positive opinions on ID are held by gatekeepers and influencers, the movement might also benefit from the effects of a multi-step flow system, where opinions from thought leaders might be more readily adopted by the public (Katz & Lazarsfeld, 1955).

One of the great public relations and frame building coups of the ID movement was the

introduction of the "teach the controversy" tagline into the discourse. It first appeared in the late 1990's, around the time the Wedge Document (1998) was written. Over the next few years, ID publications embraced this rhetorical concept and proponents began to advocate teaching the controversy in the media and to ID-friendly politicians and supporters (Campbell & Meyer, 2003). The phrase continued to gain traction through its apparent appeal to fairness and skepticism. The notion of teaching the controversy, however, is disingenuous at best, and intellectually dishonest at worst; there is no significant controversy in the scientific community to teach (Ratliff, 2004). By the time of the *Kitzmiller* (2005) ruling, which effectively neutralized the phrase, "teaching the controversy" had become perhaps the most popular frame through which to discuss ID and evolution (Ceccarelli, 2011). The success of the "teach the controversy" campaign was the CSC's shining example of the effect a one-way press agentry push on constituents could achieve (Ratliff, 2004). The eventual diminishment of the tagline following *Kitzmiller* (2005) is consistent with the historical use of a press agentry campaign to achieve short term goals (Brummette, 2012).

Working from the basis of the wedge strategy, the CSC and other ID supporters have worked hard to establish *threat* (that scientific materialists, or the mainstream scientific community, will suppress alternative thinking) and *refutational preemptions* (that literature and evidence support ID claims). They have approximated inoculation.

Inoculation theory has been used to explore persuasion in contexts that have similar social, political, and cultural ramifications as ID. The Wedge Document itself reads like a how-to guide on inoculation. It places mainstream scientific thought as the central impediment to new understanding about the natural world, claiming that scientists' "materialistic conception of reality eventually infected virtually every area of our culture, from politics and economics to

literature and art" (Discovery Institute, 1998). This threat identification runs throughout materials published by ID supporters. The strategy also advocated for the creation of refutational preemptions in the form of research and writing on ID, popular writing, teaching conferences, training seminars, and media productions. The Wedge Document calls for preemptions to be constructed as "vital writing and research at the sites most likely to crack the materialist edifice" (Discovery Institute, 1998). Theory suggests that a treatment based on these threats and preemptions could potentially build resistance against attacks on ID.

Banas and Miller (2013) provided a foundation for the study of ID efforts to inoculate without knowing it. Critically speaking, conspiracies are thought to be detrimental to societal discourse because they challenge reason and evidence-based conclusions (Douglas & Sutton, 2008; Hellinger, 2003). This conceptualization of conspiracy thinking is in line with what is known about ID, a movement where proponents use emotional appeals to direct attention away from the dearth of evidence-based literature. The connections to conspiracy thinking, like that of the 9/11 truthers, are apparent.

The reported experiment merged many of the methodological underpinnings of that conspiracy study with content about ID and evolution. The controversies that arise over this issue are emblematic of the relationship between the scientific community and certain political and social subcultures. The degree to which inoculation can be employed could be a telling look at those interactions.

Hypotheses

Inoculation theory has a large body of literature supporting its principles. Applying it to ID, however, will be a new context of study. Despite being a pseudoscientific movement, ID has been successful at gaining coverage and promotion. The wedge strategy is structured quite

similarly to an inoculation treatment, as it establishes threats against ID and hints at strategies for refutation of those threats. Therefore, application of the strategy likely inoculates receivers against attacks on the ID position.

H1: Participants who receive an inoculation treatment based on the wedge strategy will be have a more positive attitude towards ID after viewing a refutation of its principles than those who did not receive the treatment.

The research will also branch expand on the large body of traditional inoculation theory by testing metainoculation. This experiment is expected to show that a metainoculation message can prevent participants from being swayed to believe in ID, despite the application of the wedge strategy.

H2: Participants who receive a metainoculation treatment will have a less positive attitude toward ID than both those who received an inoculation treatment in favor of ID and those who received no treatment.

CHAPTER 3. METHODS

There were two components to this research program, a pilot study and the main experiment. The pilot study tested the reliability and validity of scales to be used in the experiment proper. The experiment used a three condition pretest/posttest design with a survey instrument refined in the pilot study. The three conditions in the experiment were each represented by a group: a control group, an inoculation group, and a metainoculation group. The independent variables in this experiment were the inoculation and metainoculation treatments, described later in this chapter, combinations of which varied for each group. The dependent variables were participants' strengths of attitude toward ID and evolution.

Researchers received approval to conduct the pilot study and experiment from the Radford University Institutional Review Board in February 2015. The board determined that the study was of minimal risk to human subjects and exempt from full board review. Researchers conducted the pilot study and experiment during the remainder of the university's spring semester.

Banas and Miller (2013) provided an experimental foundation for this study. Questionnaires provided by those researchers were modified and additional scales were added to address the intelligent design (ID) and science content in the experiment. The messages and scales used on that questionnaire are described in this chapter.

Pilot Study

Participants. Participants for both the pilot study and the experiment were recruited from courses taught by communication faculty and graduate students at Radford University. To avoid a maturation effect, students who participated in the pilot study were not eligible to participate in

the experiment. Researchers checked with all experiment participants at the beginning of each research session to ensure there were no repeated individuals.

To recruit students for the pilot study researchers asked instructors for permission to use class time to explain the research study, the time required of them, and potential benefits or risks to participating. It was left to the discretion of instructors whether to offer credit for completing a pilot study session. The target sample for the pilot study was 40 participants.

The pilot study had 52 participants ranging in age from 18 to 23 (*M = 20, SD = 1.3*). Female participants (64%) outnumbered males (29%). A majority of participants identified themselves as white (69%), followed by African-American or black (14%), Hispanic (4%), Asian or Pacific Islander (4%), and other (2%). The participants were not required to supply some demographic information and an equal number (*n* = 4, 7.7%) did not disclose their sex or ethnicity. More juniors and seniors (59%) took part in the pilot study than freshman and sophomores (41%).

Instrumentation. The instrument used in the experiment was a questionnaire adapted from one used in the Banas and Miller (2013) conspiracy thinking study. The pilot study was conducted to test the borrowed instrument. The pilot study questionnaire, delivered online, included questions, scales, and persuasive messages to be used in the experiment. The first two items were persuasive messages, followed by three questions each. The first persuasive message was a pro-ID inoculation message, written to represent common arguments about ID and structurally based on the outline of the wedge strategy. The intent of the message was to explain and provide support for ID, establish that ID is threatened, and offer strategies for defending ID. Upon completion, participants were asked "Do you think the persuasive message was written in support of intelligent design," "Do you think the persuasive message established the idea that

intelligent design is under attack by the scientific community," and "The persuasive message mentioned several arguments in favor of intelligent design. Was the following argument included in the persuasive message?" For the third question, a direct quote from the persuasive message was restated. A "yes" answer was correct for each question. The format was repeated for the second persuasive message, the metainoculation treatment, which was about "critical thinking," or, the individual's ability to make up his or her own mind about new information. The metainoculation did not mention ID, but was structurally similar to the pro-ID persuasive message. The questions were "Do you think the persuasive message is supportive of critical thinking when faced with new ideas," "Do you think the persuasive message established the idea that there are people who want to manipulate you into thinking their way," and "The persuasive message was about threats to critical thinking. Was the following warning included in the message?" Once again, a direct quote was pulled from the message for the last question. The correct answers remained "yes" for each. These persuasive messages were meant to passively influence readers. The purpose of the questions was to discover if participants could actively identify the threat and refutational preemptions.

The scale to measure strengths of attitude was tested with the two issue statements to be used as pretest/posttest benchmarks in the experiment. For the measure of attitudes, a seven-point semantic differential scale used six attitude pairs. For attitudes toward the issue statement, "The theory of evolution is the best explanation we have for the development of life on our planet," internal consistency was high at α =.94 (M = 24.09, SD = 7.88). For the measure of strength of attitude, a seven-point semantic differential scale used four attitude certainty pairs. Internal consistency in the scale was only α =.79 (M = 19.35, SD = 4.87), suggesting that the scale could be improved. For attitudes toward the issue statement, "There are

flaws with the theory of evolution. It is possible that an intelligent creator is responsible for the development of life on earth," the scale was highly consistent was α =.95 (M = 27.35, SD = 7.88). The scale of strength of attitude again showed lower consistency at α =.89 (M = 18.74, SD = 5.99).

A reliability analysis of the strength of attitude construct suggested that certainty and strength of attitude were in fact two separate constructs. For the experiment, two items were used instead of one. Strength of attitude was reformatted (unimportant/important, not influential/influential, irrelevant/relevant, not interested/interested) and certainty was placed on its own scale (uncertain/certain, unsure/sure, not confident/confident).

A "self-confidence" construct was pilot tested. Participants were asked to rate how self-confident they were on a scale of 1 to 100 for six statements about their general attitudes. The higher the number, the more self-confident the participant was about their attitude. Internal consistency for the construct was α=.81 (M = 408.67, SD = 98.58*).* For each issue statement, participants rated their self-confidence in their attitudes on an issue on scale of 1 to 100. They also used the same scale to respond to six questions about their self-confidence in their attitudes in general. Tests for internal reliability were run to ensure these ratings could be used as a "self-confidence" construct, which, although not necessary to disprove the study's hypotheses, were nonetheless deemed potentially important data for any post-hoc analysis.

Two further scales were tested for reliability. Each was a seven-point semantic differential scale with five item pairs (safe/dangerous, calm/threatening, not intimidating/intimidating, not harmful/harmful, not risky/risky). The first prompted participants to consider their perceived likelihood to be persuaded by new ideas (α = .90, M = 17.96*,* SD =

6.53) and, the second, their perceived likelihood to be persuaded by a charismatic individual (α = .93, M = 19.04, SD = 6.9*)*.

Procedure. The pilot study took place immediately after IRB approval in February 2015. It lasted approximately six weeks. Following recruitment into the pilot study, participants had a choice to attend a research session or to complete the questionnaire on their own.

Recruiters scheduled several dates for in-person research sessions a week. These were provided to potential participants during recruitment. The sessions occurred in a large computer lab on the university campus. Participants could choose when to attend a session. Upon arrival, participants signed a consent form that outlined the expectations of the pilot study. Participants were informed that participation in the pilot study would preclude them from participation in the experiment. Participants began the session by following a web link provided on a slip of paper they received upon arrival, which took them to the online questionnaire. They read the instructions on the questionnaire and then proceeded through each section of the questionnaire. Upon completion of the questionnaire, participants were provided a debriefing text and were allowed to ask any questions about this study. They were then given a voucher signed by a proctor to submit to instructors to prove their participation as well as contact information for the researchers, if they wished, before being dismissed.

Analysis of pilot study results took place in early April, immediately following the acquisition of the target sample. Relevant changes were made to the questionnaires before recruitment for the experiment began.

Data Analysis. Analysis of data took place at both the conclusion of the pilot study and the experiment using the SPSS software package. The purpose of the pilot study was to assess the effectiveness of the persuasive messages and scales used to measure attitude, attitude

strength, and certainty. Mean questionnaire completion times were used to determine if any responses should be disregarded due to unusual completion rates (i.e. those completed too fast or too slow). Acceptable responses were then analyzed for their demographic characteristics.

In order to test the effectiveness of persuasive messages, the researcher sought an approximate 90% success rate for comprehension questions. These nominal, binary data were designed as a very simple test for identifying the necessary components for an inoculation treatment, threat, and refutational preemption. Participants only met the acceptance threshold on two questions. After reading the pro-ID message, participants could identify that the message supported ID (90%), but fewer thought the message established that the scientific community threatened ID (68%). Still fewer (63%) were able to correctly identify if a statement ("intelligent design is highly scientific and many ID researchers work on the cutting edge of their fields") was taken directly from the message. The second message, the metainoculation treatment, was apparently more opaque as a smaller percentage of participants (69%) were able to identify its goal ("pro-critical thinking") than were able to in the first message. The message was perceived to establish a threat (90%), but participants had more trouble identifying a statement from the message ("These people or groups that take the time to warn you sometimes have a sinister agenda") than in other questions (60%).

Both persuasive messages were rewritten with the goal of improving clarity. A class of 13 graduate students was approached to test the rewritten messages. They skewed older in age than the previous pilot study sample ($M = 27$, $SD = 5.3$) and there were more males (62%) than females (38%). Participants again mostly identified as white (85%), and then as either African American or black (8%) or Hispanic (8%). After the persuasive messages were rewritten, all participants were able to identify that the first supported ID (100%). Most also believed that the

message established that intelligent design was threatened (92%). Participants approached the approximate acceptance threshold for the third question (85%). For the second rewritten persuasive message, all participants (100%) were able to identify the topic as "critical thinking." Again, most thought the message established that there are threats to critical thinking (92%) and most were able to correctly identify the excerpt from the message that tested comprehension (92%).

Experiment

Participants. For the main experiment, students were recruited from the university's introductory communication course. A certain amount of research participation was already a course requirement and joining a research session for this experiment met the needs of that assignment. Participation in the experiment, however, was voluntary, and all students had alternate opportunities to meet the research requirement. The target sample of the experiment was set at 120 participants.

The experiment had 113 participants randomly assigned into control (n = 39), inoculation (n = 38), and metainoculation (n = 36) conditions. They ranged in age from 18 to 32 (M = 20, SD = 1.86). There were slightly more female participants (51%) than male (49%). Most participants identifies themselves as white (74%), followed by African American or black (15%), Hispanic (7%), mixed race or other (3%), and Asian or Pacific Islander (2%). More freshman and sophomores (54%) participated than juniors and seniors (46%).

Instrumentation. The experiment employed the scales and persuasive messages tested in the pilot study. Each condition had a slightly modified questionnaire from the others. All three questionnaires were partitioned into three phases.

The first phase of each questionnaire began with the same demographic questions as the

pilot study (age, ethnicity, gender, and grade level). The questionnaires also featured five issue statements to test attitudes about "controversial" popular science issues such as evolution, ID, climate change, and space exploration. Only the evolution and ID questions were relevant to this research, but the other topics were included as decoys (climate change and space exploration), in order to prevent participants from thinking too hard about one issue before any persuasion actually took place. Attitude strength and certainty scales were included for each issue statement.

The second phase of each questionnaire was the divergent point in each condition. In this phase, each questionnaire had a message or message sequence unique to the condition. Control group questionnaires featured a synopsis of *Cosmos: A Spacetime Odyssey*, inoculation group questionnaires featured the pro-ID persuasive message (the inoculation treatment), and the metainoculation group questionnaires had the critical thinking persuasive message (the metainoculation treatment) and the pro-ID message. Phase two concluded with the same two items for each group: a question about perceived susceptibility to persuasive arguments ("a possibility you may come into contact with arguments contrary to your position that are so persuasive that they may cause you to rethink your position") and a question about perceived susceptibility to a charismatic figure ("it is possible that a charismatic speaker or figure might convince you to rethink your position").

In between phases two and three, participants were shown "Some of the Things That Molecules Do," the second episode of *Cosmos: A Space Time Odyssey.* The 44-minute episode narrates the processes that drive evolution, discusses the adaptability of life, threats of extinction, and the possibility of exobiology, and refutes ID talking points.

Phase three of each questionnaire was again the same across conditions. The first items were the same issue statements about ID and evolution from the first phase, along with their

accompanying scales to rank attitude and certainty. All questionnaires ended with items that asked participants to evaluate their attitudes towards the television episode and towards its host, Neil deGrasse Tyson, based on their own perceived susceptibility to persuasion.

Procedure. Researchers scheduled two-hour research sessions throughout April 2015 in a large computer lab on campus. Unlike the pilot study, all experiment sessions had to be conducted in person. Research sessions were held through the end of the university's spring semester in the first week of May.

Upon arrival at a session, participants signed a consent form that outlined the expectations of the experiment and were given a web link to the online questionnaire from a randomly shuffled pile. Three different web links were shuffled into the pile, each leading to the appropriate questionnaire for a particular condition (120 slips, with 40 links to each condition). For researcher administration purposes, each experimental group was assigned a letter: A (control), B (inoculation), and C (metainoculation). There was no replacement to the sample and "used" slips were destroyed after each session. Researchers explained the experiment and took questions. They also checked to ensure that participants had not attended a pilot study session.

Participants began the session by following the web link provided on the slip of paper they received upon arrival, which took them to the online questionnaire for their condition. Participants read the instructions and then proceeded through the three phase questionnaire. At the end of each phase, participants halted until the entire group was finished. These breaks were designed to keep participants on a similar pace because between phases two and three they were all required to view the same episode of *Cosmos: A Spacetime Odyssey*. Participants were asked to stay in the lab during the television episode and were encouraged to give it their full attention. Following the episode, participants completed the final phase of the questionnaire. Upon

completion, participants were provided a debriefing text. Proctors again answered questions about the experiment and offered credit vouchers and contact information for the researchers before being dismissed.

Data Analysis. Unlike in the pilot study, experiment participants were part of a rigorously timed session. The analysis of the duration of their participation was not necessary as a proctor was on hand to ensure proper timing was observed. Frequency tables for demographic characteristics were calculated.

Examples of each scale in the experiment questionnaire were tested in the pilot study, but tests of internal reliability were completed again for each scale in both the pretest and posttest stages. One-way ANOVA tests were conducted in the pretest phase on the two issue statements about ID and evolution to identify any significant differences in strength of attitude among participants in separate conditions and the effectiveness of random sampling. The same reliability and ANOVA tests were conducted in the posttest phase to determine the differences among the three conditions regarding how their attitudes did or did not change.

Paired-sample T-tests were performed on the pretest and posttest answers for both the pro-ID and pro-evolution issue statement scales to determine the changes in attitude among the entire sample.

The hypotheses, however, sought to show different effects among the three conditions of the experiment:

H1: Participants who receive an inoculation treatment based on the wedge strategy will be have a more positive attitude towards ID after viewing a refutation of its principles than those who did not receive the treatment.

H2: Participants who receive a metainoculation treatment will have a less positive attitude toward ID than both those who received an inoculation treatment in favor of ID and those who received no treatment.

Descriptive statistics were calculated to demonstrate mean attitudes about ID and evolution among each group. ANOVA tests were performed on the pretest/posttest change data to determine any significance in attitude difference among the three experimental conditions.

CHAPTER 4. RESULTS

The results of the main experiment are presented in this chapter. All scale results shown herein are taken as an average of the entire scale. Hypotheses were tested by analyzing responses to the issue statements about ID and evolution in participants' questionnaires. While data were collected about other popular science "controversies" (climate change and space exploration) and could be useful in gauging general opinions about those issues, they were ultimately not relevant to the results at hand. The ID and evolution issue statements were tested in pretest and posttest phases of the experiment.

Analysis of the pretest issue statement scales showed random assignment was shown to be successful across conditions. Variance in responses was not significant across groups when asked to respond to the statements "The theory of evolution is the best explanation we have for the development of life on our planet," $F(2,110) = .43$, $p = .65$, and "There are flaws with the theory of evolution. It is possible that an intelligent creator is responsible for the development of life on earth," $F(2,110) = .04$, $p = .96$. Pretest responses established participant support, on a seven-point scale, for evolution ($M = 4.44$, $SD = 1.93$) and the possibility of ID ($M = 4.96$, SD = 1.70). When the issue statements were tested again after viewing the Cosmos episode "Some of the Things That Molecules Do," support for evolution ($M = 4.8$, $SD = 1.80$) significantly increased, $t(112) = -3.36$, $p = .001$, and support for the possibility of ID ($M = 4.72$, $SD = 1.69$) significantly decreased, $t(112) = 2.18$, $p = .03$.

Among conditions, control participants ($M = 5.00$, $SD = 1.96$) showed more support for evolution than either metainoculation ($M = 4.80$, $SD = 1.48$) or inoculation ($M = 4.54$, $SD =$

1.91) participants. Although this trend was implied by the hypotheses the differences among conditions were not statistically significant $F(2, 110) = .62$, $p = .54$.

Although there was more support for evolution across the sample as whole, the first purpose of the experiment was to test the effectiveness of pro-ID inoculation. Responses to the statement "there are flaws with the theory of evolution. It is possible that an intelligent creator is responsible for the development of life on earth" addressed the hypotheses.

> H1: Participants who receive an inoculation treatment based on the wedge strategy will be have a more positive attitude towards ID after viewing a refutation of its principles than those who did not receive the treatment.

Participants exposed to the pro-ID inoculation treatment ($M = 4.71$, $SD = 1.70$) showed more support for ID than members of the control group who received no treatment ($M = 4.59$, $SD = 1.91$), but the differences were not statistically significant, $F(2, 110) = .40$, $p = .67$.

> H2: Participants who receive a metainoculation treatment will have a less positive attitude toward ID than both those who received an inoculation treatment in favor of ID and those who received no treatment.

Participants who received a metainoculation treatment were expected to show the least support for ID in the posttest phase. They, in fact, ended up showing the most support ($M = 4.94$, $SD = 1.44$) for idea among all the groups, but, again, those differences were not statistically significant, as shown in H1.

The scale for testing strength of attitude about evolution was reliable, $\alpha = .95$ ($M = 19.81$, $SD = 7.49$). There were no significant differences among experimental conditions during the pretest, $F(2,109) = 1.89$, $p = .16$. There was, however, a significant change in strength of attitude about evolution following experimental manipulations, $t(111) = -4.32$, $p < .001$ (pretest: $M = 4.98$, $SD = 1.87$; posttest: $M = 5.56$, $SD = 1.55$). This held true across the sample as there

were no significant changes among conditions during the posttest phase, $F(2,110) = 1.71$, P = .16.

The scale for testing strength of attitude toward ID was also found to be reliable, $\alpha = .91$ ($M = 16.38$, $SD = 4.49$). Like with strength of attitude toward evolution, there were no significant differences about ID among experimental conditions during the pretest, $F(2,109) = .33$, p = .72. Unlike the response to evolution issue statement, there was no significant change in strength of attitude about ID following experimental manipulations, $t(111) = .92$, p = .36 and no significant differences in strength of attitude among conditions during the posttest phase, $F(2,110) = .38$, P = .68.

Pretest measures of certainty showed that most participants were fairly certain in their attitudes about evolution, ($\alpha = .96$, $M = 15.48$, $SD = 5.11$) and ID ($\alpha = .91$, $M = 15.73$, $SD = 5.10$). No experimental condition significantly differed from another in terms of attitude certainty in the pretest, in regards to evolution, $F(2,115) = .81$, p = .45, or ID, $F(2,115) = .10$, p = .90, again showing the effectiveness of randomly sorting participants into conditions.

There was no significant change in attitude certainty about evolution, $t(117) = .06$, p = .96, or ID, $t(117) = -.46$, p = .65, following experimental treatments. Again, there were also no significant differences in groups in certainty about evolution, $F(2,115) = 1.5$, p = .23, or ID, $F(2,115) = .118$, p = .89.

In phase one of the questionnaire, participants rated their certainty in their general attitudes, and not those specifically relating to a popular science issue. A six item scale was devised to measure this construct, termed "self-confidence," $\alpha = .85$. For each of the six items, participants rated their self-confidence on a scale of 1 to 100, were a higher rating indicated

greater self-confidence. No results fell outside the range between 13 and 100 on any single item (M = 468. 20, SD = 93.10).

Participant results were sorted into four different self-confidence groups, n = 28, in order to assess whether self-confidence had any effect on attitudes about evolution or ID. Group one was the least self-confident quartile, group two the second least, group three the second most, and group four the most self-confident. In the pretest phase, participants in groups two (M = 4.84, SD = 1.69) and three (M = 5.26, SD = 1.8) were more likely to view evolution favorably than those in groups one (M = 3.92, SD = 1.61) and four (M = 5.26, SD = 2.25). The opposite held true as well, as groups two (M = 4.70, SD = 1.62) and three (M = 4.63, SD = 1.68) viewed intelligent design less favorably than groups one (M = 5.07, SD = 1.51) and four (M = 5.41, SD = 1.92).

This pattern held true in the posttest phase as well. Again participants in groups two (M = 5.05, SD =1.65) and three (M = 5.65, SD = 1.58) were more likely to view evolution favorably than those in groups one (M = 4.51, SD = 1.37) and four (M = 3.94, SD = 2.14). Groups two (M = 4.30, SD = 1.31) and three (M = 4.58, SD = 1.72) viewed intelligent design less favorably than groups one (M = 5.03, SD = 1.34) and four (M = 4.96, SD = 2.21).

There were significant differences in self-confidence group attitudes about evolution before viewing *Cosmos: A Spacetime Odyssey,* $F(3, 108) = 4.11$, $p = .01$, and after viewing it, $F(3,108) = 5.24$, $p = .002$. The most significant change occurred in members of self-confidence group one, the least self-confident of all participants in their general attitudes. Attitudes toward evolution increased from M = 3.92, SD = 1.61 to M = 4.51, SD = 1.37 ($t(27) = -2.25$, p = .33). A Tukey test showed group one participants to be significantly different from group three in their self-confidence in the pretest phase ($p = .04$), but not in the posttest ($p = .10$). Group four was

also significantly different from group three in both pretest (p = .02) and posttest (p = .001) No other groups showed significant differences in attitude about evolution the pretest/posttest phases. There were no significant differences among groups in the pretest or posttest phases regarding attitudes toward ID.

Participants were asked to respond to two scales dealing with their susceptibility to persuasion. These questions came after experimental treatments had been delivered, but before the viewing of the television episode. The first scale specifically asked how likely they thought it that a new idea could be so compelling that it persuaded them to change their attitude, α = .91, M = 15.93, SD = 6.97. Across the sample, participants were generally slightly comfortable with the idea, but there were significant differences among groups, $F(2,110) = 4.96$, p = .009. A post hoc Tukey HSD revealed the participants in the control group (M = 2.66), who had only been exposed to the *Cosmos: A Spacetime Odyssey* synopsis and no other persuasive messages, were more accepting of being persuaded by ideas than both the inoculation (M = 3.54, p =.01) and metainoculation (M = 3.45, p = .034) groups.

The second scale asked how likely participants thought it that a charismatic figure could persuade them to change their attitude, α = .94, M = 17.49, SD = 7.98. Again, sample-wide, participants were generally comfortable with the idea, but did not differ significantly on the possibility that a charismatic figure could persuade them, $F(2,110) = 2.09$, p = .129.

Modified versions of these scales were added to the experiment shortly following the pilot test to collect exit data from participants about the effectiveness of *Cosmos: A Spacetime Odyssey* as an example of popular science communication. On this seven point semantic differential scale, a higher number indicated that the subject was more persuasive. The first scale asked if the ideas in *Cosmos: A Spacetime Odyssey* were generally persuasive (α = .92, M

=27.39, *SD* = 7.34). Average scores from each scale item only ranged from 5.35 to 5.83 (*M* = 5.48, *SD* = 0.20). The second scale asked participants to rate the persuasiveness of the show's host, Neil deGrasse Tyson. Again, participants generally though Tyson was persuasive (α = .93, *M* =27.72, *SD* = 7.31). Average scores for his performance as a persuader were between 5.32 and 5.73 (*M* = 5.54, *SD* = 0.18). None of the three participant groups were significantly different from one another in regards to estimations of persuasive ideas in the show, $F(2,110) = 1.40$, $p = .25$, or messages from Tyson, $F(2,110) = 1.36$, $p = .26$.

CHAPTER 5. DISCUSSION

The experiment was meant to test if a persuasive material based on the wedge strategy would inoculate a sample against mainstream scientific views. Indeed, if that had turned out to be the case, it would have had a clear, if modest impact in increasing understanding as to how pseudo- or anti-scientific movements gain share in the marketplace of ideas. Furthermore, a metainoculation component was added to potentially provide insight on how to combat pseudo- or anti-scientific campaigns.

The wedge strategy was originally written in opposition to the mainstream scientific community and productions like *Cosmos: A Spacetime Odyssey*. It identifies threats to ID and broad strategies to combat them. This "almost inoculation" was crucial in formulating the first hypothesis of this research, which sought to determine whether a persuasive treatment about ID could prevent a mainstream scientific message about evolution from winning out.

The data from this experiment were not statistically significant enough to support that hypothesis, although it did very slightly trend that way. While some participants might have been affected by the pro-ID inoculation treatment, *Cosmos: A Spacetime Odyssey* was simply a much stronger persuasive message.

During the initial research for this experiment, the Banas and Miller (2013) study was the only test of metainoculation. The second hypothesis of this study was included to contribute to the new research directions surrounding metainoculation. Specifically, the metainoculation was meant to prevent the pro-ID message from influencing participants. The experiment did not bear a significant result, but had surprising data on this point. Metainoculation participants actually supported ID the most during the posttest, instead of the least, as predicted. In retrospect, the

metainoculation used in this study was a more abstract version of that used by Banas and Miller. This experiment framed the metainoculation around critical thinking, asking participants to connect the dots, instead of simply explaining inoculation as in the foundational study. Again, while not significant, the slight data trends suggest that "critical thinking" led a few participants to reject *Cosmos: A Spacetime Odyssey* instead of the inoculation treatment. Metainoculation remains an incredibly valid direction of inoculation research, and a potential boon to science communicators, despite the growing pains it encountered in this experiment.

The research had one significant finding, although it was tangential to the hypotheses. *Cosmos: A Spacetime Odyssey,* specifically the second episode, "Some of the Things That Molecules Do," is an effective piece of science communication. Across the entire sample, it instilled more positive attitudes towards to the topics it presented, particularly evolution and natural design. Attitudes went the other way as well. "Some of the Things That Molecules Do" refutes intelligent design and creationism by letting the naturalistic observation speak for itself. Not only did positive attitudes towards the ideas in the show increase, the strength of those attitudes did as well, across the entire sample. Speaking broadly, there was something in the design of the episode was too strong for the inoculation or metainoculation treatments to overcome as written. Even without resorting to sustained attacks on the ID movement, participants found intelligent design to be a less likely explanation for the development of life than they did prior to screening the show. The significant changes in attitude certainly suggest that *Cosmos: A Spacetime Odyssey* is a good example of science communication done right.

Post hoc analyses offered promising results. The measurement of participants' self-confidence in particular produced some of the most intriguing results of the experiment. The scale gave participants the opportunity to reflectively rate how they felt about their attitudes. It

also allowed for the opportunity to analyze attitude change in individuals with different confidence levels. These levels were divided by quartile, so the least self-confident quarter of the sample were self-confidence group one, and so on.

As discussed, *Cosmos* was the most effective material in this experiment. Data show that there were significant changes in positive attitudes (i.e. an increase) toward evolution across the sample, but the increase is greatest in the quarter of participants who rated themselves as the least self-confident. These individuals were heavily impacted by the television episode. Throughout the experiment they were also more likely to doubt evolution and support ID. In an odd twist, they shared this trait with the most self-confident quarter of participants. While the least self-confident participants were swayed by the inoculation treatments and the episode, the most self-confident participants' attitudes did not significantly change.

While it would be premature to speculate on why the most self-confident individuals were more likely to support ID over evolution, data suggests that there is a relationship between self-confidence level and potential change in attitude. Compared to their fellows, the most self-confident participants were surer of their attitudes and they tended to favor the faith-based explanation over the skeptical scientific one. Future research into this issue could provide valuable insight for science communicators and any other persuaders who attempt to tackle a murky, belief-related issue like ID.

Limitations

The success of *Cosmos: A Spacetime Odyssey* is heartening for popular science supporters, but it may have set too high a bar for inoculation against. While ID concerns have bubbled into the mass public consciousness, notably in the *Kitzmiller* (2005) case, nothing they have produced can match the 4.95 million viewers who tuned into “Some of the Things That

Molecules Do" when it aired in 2014 (Bibel, 2014), presenting an interesting question of ecological validity. Banas and Miller (2013) found that a print inoculation message could indeed hold up against a longer multimedia piece, an idea borrowed from earlier research (Compton & Pfau, 2005). This experiment failed to replicate that success. A "small, but strong" text is the typical product one would likely see about ID in the real world. While it remains unlikely that there is a mainstream scientific conspiracy to hide ID evidence, it must be said that the scientific community does have more cachet on a macro level. Unless the ID movement can produce a strong, ubiquitous material, like *Cosmos: A Spacetime Odyssey*, inoculation might not be useful in swaying large groups to the cause (Brewer, 2000).

The researcher created the treatments used in this experiment after studying typical ID texts from the web and other publications. During the pilot study, undergraduate participants did not meet the acceptance threshold for identification of inoculation in either persuasive message when prompted. When the messages were rewritten, they were given to a class of graduate students, who were able to identify inoculation in the new messages. Limitations were introduced during this process. Because the same message was not tested with both undergraduates and graduates there is no way to tell whether the original persuasive messages would have been more effective or not. Furthermore, giving the rewritten persuasive messages to graduate students, done out of concerns for convenience and time, did not account for possible knowledge or maturity differences between an undergraduate and graduate population. Of course, given the success of *Cosmos: A Spacetime Odyssey* as a persuasive material, it is possible that none of the crafted treatments could have matched it anyway.

Another apparent issue in this study lies in the sample population. The assumption that a group with similar education backgrounds, like college students, would provide some amount of

control was valid. The issue, however, essentially boils down to that very same background and their shared scientific literacy. The majority of college students have been exposed to at least the idea of evolution. In a recent study on attitudes about science, it was determined that 67% of Americans with "some college" - current enrollment and otherwise - support the theory of evolution, slightly above the U.S. average (Pew, 2015). In fact, that study showed Americans ages 18-29 are the most likely to support evolution (73%), further underlining the sampling limitation. In comparison, only 56% of high school students support evolution. The numbers suggest that college students are not likely going to be the bread and butter of the ID movement.

Future Research

When Banas and Miller (2013) introduced metainoculation, they contributed a novel avenue of research into inoculation and persuasive communication in general. This remains an area with great promise. While this study did not see the expected metainoculation results, the idea of a communicator adding a "layer of defense" against persuasive attacks is surely compelling in a landscape where communication can often seem like gamesmanship. It is perhaps early too early to be clever about inoculation. A hallmark of McBride's early inoculation work was his commitment to examining cultural truisms, or the "little things" like brushing one's teeth. Once theory had been grounded by these truisms, more stable research avenues opened. Banas and Miller's metainoculation was simply an explanation of inoculation theory; this experiment modified the metainoculation away from that base by highlighting "critical thinking" and was not successful.

As mentioned there was a discrepancy of ecological validity between the inoculation treatment and *Cosmos: A Spacetime Odyssey.* Despite the continuing presence of ID in the discourse, a person is more likely to see a well-produced popular science message than one about

irreducible complexity or scientific materialism. Research into actual events surrounding the topic might illuminate much more about communication from scientists and pseudoscientists alike. For instance, the Bill Nye and Ken Ham debate (2014) about the nature of creation was a high profile event that was streamed globally and remains accessible for viewing. A rhetorical analysis of such an event could be useful in determining how each camp persuades. Taking things further, an experiment could be designed to determine effects of messages involved. Mock trials and political simulations are hallmarks of ecological validity studies. Communication events, like debates, could very well be instructive as well (Brewer, 2000).

Implications

The chief implication of this study is that science communication can have a significant impact when it is presented in an effective way. The charisma shown by Neil deGrasse Tyson as he flies through the universe on his "ship of the imagination" is a tool that allowed the makers of *Cosmos: A Spacetime Odyssey* to bring science to the public. "Edutainment" is not a new concept, but this research may contribute support, however little, to the idea that science communicators can inspire when they bring the technical into the realm of the popular.

One of the chief public relations implications of this research is that supporters of both sides of a public controversy like the one surrounding ID must adopt an issues management worldview. Issues management is essentially the process an organization takes to organize its platforms and interact and navigate with publics, both supportive and antagonistic (Heath, 2002). In practical terms, if ID truly wants to win the fight for the public's imagination, it is going to have to proactively anticipate and match the "next" *Cosmos: A Spacetime Odyssey.* From an issues management perspective of public relations, reactionary press releases and media

appearances after a major blow by the science community will not be as useful for ID supporters as getting out ahead of the message with their own major contribution.

The agencies representing the mainstream scientific community could take an object lesson from *Cosmos: A Spacetime Odyssey.* The television show left viewers with positive feelings about good science. It was not the first pop culture phenomenon to show that science is a topic the public is hungry for, as Sagan's (1994, 1997) body of work attests, but it should serve as a salient reminder that scientists have an audience and a duty to bring their findings to it.

The wedge strategy was devised in an era before near-universal access to the Internet and the proliferation of social media (Discovery Institute, 1998). In today's media landscape, opportunities for publics to discover sources to confirm their attitudes abound. Both the ID movement and the mainstream scientific community will be forced to stake their claims in this space. Intelligent design is just one instance of a pseudo- or anti-scientific movement in conflict with mainstream scientific thinking. These movements have gained traction on the Internet, especially since social media's ascendancy. The web provides a space where they can live and grow, unimpeded by broadcast standards or journalistic ethics (Lim & Ki, 2007). Fortunately, belief in ID one way or another is not usually a threat to personal or community safety. What happens when it is?

Nearly two thirds of U.S. adults believe that vaccines should not be required (Pew, 2015). A lackadaisical or antagonistic attitude to a tried and true public health intervention is a very slippery slope, especially when anti-vaccination supporters often congregate around urban or suburban centers; if a disease appears, the chance for an outbreak in these enclaves greatly rises (Dub, Vivion, & MacDonald, 2015; Tafuri, Gallone, Cappelli, Martinelli et al., 2014)

A quarter of U.S. adults do not believe there is evidence for global warming. As of the writing of this paper, a high profile former presidential candidate - and ID supporter - has been in the news for criticizing the Catholic Church's recent acknowledgement of the dangers of global warming, insisting the Vatican leave the matter to scientists. Of course, in a recent poll, 96% of American Association for the Advancement Science (AAAS) members believe global warming to be a paramount threat (Giordano & Santorum, 2015; Pew, 2015; Ratliff, 2004).

Science, by definition, has room for improvement. But it also has much to say about how to build a healthy, sustainable, and intellectually robust world. Advancing science through method and observation is productive. But belief is also crucial in the health of a society. What must be weighed are the benefits of skeptical inquiry against active protest against the solutions that such inquiry offers. The answer to that question is beyond the scope of this experiment, but supporters of the scientific method can be assured that when you understand the power of a message's medium, there are people who are ready to listen.

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APPENDICES

Appendix A - Questionnaires

Pilot study

You are invited to participate in pretest for a research survey, titled "The use of inoculation techniques in intelligent design communication strategies." The study is being conducted by Dr. Scott Dunn, assistant professor of communication, and Dan Waidelich, graduate student, of Radford University.

Your participation in this pretest will help researchers assess the effectiveness of questionnaire items and messages to be used in a later experiment about a communication strategy used by the intelligent design (ID) movement. We estimate that it will take about one hour of your time to complete the survey.

Risks to participants are considered minimal. You may receive credit from instructors for participation in this survey. No identifying information will be recorded, including IP addresses and computer login information.

Your participation in this survey is voluntary. You may decline to answer any question and you have the right to withdraw from participation at any time without penalty. If you wish to withdraw from the study or have any questions, contact a researcher listed above.

If you agree to participate, please press the arrow button at the bottom right of the screen. Thank you.

First, you will be asked for some demographic data. This data will assist researchers in analyzing how people of different backgrounds process popular science messages. It will not be used to identify you personally in any way.

1. Gender Identity: _____.

2. Ethnicity:_____.

3. Age: _____.

4. Class (choose one): Freshman Sophomore Junior Senior Graduate

Thank you. Please continue on to the next page.

The purpose of the next items are to test the effectiveness of a persuasive message about the intelligent design movement. According to supporters, intelligent design is a theory that states "certain features of the universe and of living things are best explained by an intelligent cause, not an undirected process such as natural selection."

Please read the persuasive message on the next page carefully. You are not permitted to make notes on the text. When you have finished carefully reading the persuasive message will be asked to click to the next page to answer questions about what you read. You will not be able to go back to reread the message.

Inoculation Treatment

Do you think the persuasive message was written in support of intelligent design?

Yes No

Do you think the persuasive message established the idea that intelligent design is under attack by the scientific community?

Yes No

The persuasive message mentioned several arguments in favor of intelligent design. Was the following argument included in the persuasive message?

"Intelligent design is highly scientific and many ID researchers work on the cutting edge of their fields."

Yes No

Thank you for your responses.

The purpose of the next items are to test the effectiveness of a persuasive message about the importance of critical thinking in communication.

Please read the persuasive message on the next page carefully. You are not permitted to make notes on the text. When you have finished carefully reading the persuasive message will be asked

to click to the next page to answer questions about what you read. You will not be able to go back to reread the message.

The purpose of this survey is to test the effectiveness of a persuasive message about critical thinking, or the ability to make up one's mind based on experience, reason, and evidence.

Please read the persuasive message on the next page carefully. You are not permitted to make notes on the text. When you have finished carefully reading the persuasive message will be asked to click to the next page to answer questions about what you read. You will not be able to go back to reread the message.

Metainoculation message

Do you think the persuasive message is supportive of critical thinking when faced with new ideas?

Yes No

Do you think the persuasive message established the idea that there are people who want to manipulate you into thinking their way?

Yes No

The persuasive message was about threats to critical thinking. Was the following warning included in the message?

"These people or groups that take the time to warn you sometimes have a sinister agenda."

Yes No

Thank you for your responses.

The researchers are preparing to conduct a experiment about communication strategies used by evolution and intelligent design supporters. Your answers to the following questions will help the

researchers fine tune the survey that will be used during this experiment.

Please read each set of following instructions carefully and respond to each item as accurately as possible.

The next items concern specific issues in popular science. Read each of the issue statements, and then complete the items that follow. The first block of items is designed to determine your overall attitude toward the specific statement. Items consist of pairs of adjective opposites. Each of the pairs of adjective opposites is separated by the numbers 1, 2, 3, 4, 5, 6, and 7. Read each of the adjective opposite pairs, and then circle a number that best describes your response to the issue statement.

ISSUE STATEMENT:

THE THEORY OF EVOLUTION IS THE BEST EXPLANATION WE HAVE FOR THE DEVELOPMENT OF LIFE ON OUR PLANET.

Attitude toward the Issue Statement

Negative	1	2	3	4	5	6	7	Positive
Bad	1	2	3	4	5	6	7	Good
Unfavorable	1	2	3	4	5	6	7	Favorable
Unacceptable	1	2	3	4	5	6	7	Acceptable
Wrong	1	2	3	4	5	6	7	Right
Foolish	1	2	3	4	5	6	7	Wise

The next items are designed to measure the strength of your attitude. Items consist of pairs of adjective opposites. Each of the pairs of adjective opposites is separated by the numbers 1, 2, 3, 4, 5, 6 and 7. Read each of the adjective opposite pairs, and then circle a number that best describes the strength of your attitude.

Unimportant	1	2	3	4	5	6	7	Important
Uncertain	1	2	3	4	5	6	7	Certain
Irrelevant	1	2	3	4	5	6	7	Relevant
No interest	1	2	3	4	5	6	7	Great Interest

Estimate the certainty of your attitude on this issue on a scale from 0 to 100, where 0 represents no certainty and 100 indicates absolute certainty: _____.

ISSUE STATEMENT:

THERE ARE FLAWS WITH THE THEORY OF EVOLUTION. IT IS POSSIBLE THAT AN INTELLIGENT CREATOR IS RESPONSIBLE FOR THE DEVELOPMENT OF LIFE ON EARTH.

Attitude toward the Issue Statement

Negative	1	2	3	4	5	6	7	Positive
Bad	1	2	3	4	5	6	7	Good
Unfavorable	1	2	3	4	5	6	7	Favorable
Unacceptable	1	2	3	4	5	6	7	Acceptable
Wrong	1	2	3	4	5	6	7	Right
Foolish	1	2	3	4	5	6	7	Wise

The next items are designed to measure the strength of your attitude. Items consist of pairs of adjective opposites. Each of the pairs of adjective opposites is separated by the numbers 1, 2, 3, 4, 5, 6 and 7. Read each of the adjective opposite pairs, and then circle a number that best describes the strength of your attitude.

Unimportant	1	2	3	4	5	6	7	Important
Uncertain	1	2	3	4	5	6	7	Certain
Irrelevant	1	2	3	4	5	6	7	Relevant
No interest	1	2	3	4	5	6	7	Great Interest

Estimate the certainty of your attitude on this issue on a scale from 0 to 100, where 0 represents no certainty and 100 indicates absolute certainty: _____.

Next, we would like to know, in general, how confident you are about your general attitudes (NOT THOSE ABOUT THE PREVIOUS ISSUES). Using a 0-100 probability scale, where 0 indicates no confidence and 100 indicates extreme confidence, place a number in the space beside each of the items below:

_____ My attitudes are very firm.
[0 indicates no confidence; 100 indicates extreme confidence]

_____ I hold the correct attitudes.

_____ My attitudes will not change even if I find out that most people disagree with me.

_____ I can defend my positions on issues that I hold attitudes about if they are attacked.

_____ I can maintain my position on issues that I hold attitudes about even if I encounter strong arguments against them.

_____ I would defend my positions on issues that I hold attitudes about in speaking with someone who disagrees with me.

Thank you. Please continue on to the next page.

The initial set of items is designed to help us to understand how you feel about issues you come in contact with.

Despite your opinion on issues, there is a possibility you may come into contact with arguments contrary to your position that are so persuasive that they may cause you to rethink your position.

I find this possibility:

Safe	1	2	3	4	5	6	7	Dangerous
Nonthreatening	1	2	3	4	5	6	7	Threatening
Calming	1	2	3	4	5	6	7	Anxious
Not Intimidating	1	2	3	4	5	6	7	Intimidating
Not Harmful	1	2	3	4	5	6	7	Harmful
Not Risky	1	2	3	4	5	6	7	Risky

<u>Despite your opinion on issues</u>, it is possible that a charismatic speaker or figure might convince you to rethink your position.

I find this possibility:

Safe	1	2	3	4	5	6	7	Dangerous
Nonthreatening	1	2	3	4	5	6	7	Threatening
Calming	1	2	3	4	5	6	7	Anxious
Not Intimidating	1	2	3	4	5	6	7	Intimidating
Not Harmful	1	2	3	4	5	6	7	Harmful
Not Risky	1	2	3	4	5	6	7	Risky

The questionnaire is now complete. Thank you for your participation in this pretest.

During this questionnaire you encountered information about evolution and intelligent design. This study was meant to test if a certain persuasive method was successful at communicating those ideas.

Over the past 150 years, the theory of natural selection has been tested and retested, leading to the acceptance of evolution as the best explanation for the origin of life.

Although proponents of ID have successfully used communication tactics to advance their cause, they have not contributed testable evidence to the body of literature on the development of life.

Experiment

You are invited to participate in a research survey, titled "The use of inoculation techniques in intelligent design communication strategies." The study is being conducted by Dr. Scott Dunn, assistant professor of communication, and Dan Waidelich, graduate student, of Radford University.

Your participation in this study will help researchers assess the effectiveness of a communication strategy used by the intelligent design (ID) movement. We estimate that it will take no more than two hours to complete this study.

Risks to participants are considered minimal. You may receive credit from instructors for participation in this survey. No personal identifying information, such as your name, IP addresses or computer login information, will be recorded.

Your participation in this survey is voluntary. You may decline to answer any question and you have the right to withdraw from participation at any time without penalty. If you wish to withdraw from the study or have any questions, contact a researcher listed above.

This survey has three phases. You will be asked to stop at the end of each phase of the survey and wait for further instructions from the moderator(s).

We ask that you read each set of instructions carefully, and respond to each of the survey items as accurately as possible.

Please click through to the next page to begin.

PHASE ONE

First, you will be asked for some demographic data. This data will assist researchers in analyzing how people of different backgrounds process popular science messages. It will not be used to identify you personally in any way.

1. Gender Identity: _____.

2. Ethnicity:_____.

3. Age: _____.

4. Class (choose one): Freshman Sophomore Junior Senior Graduate

Thank you. Please continue on to the next page.

The next items concern specific issues in popular science. Read each of the issue statements, and then complete the items that follow. The items are designed to determine your overall attitude toward the specific statement. Items consist of pairs of adjective opposites. Each of the pairs of adjective opposites is separated by the numbers 1, 2, 3, 4, 5, 6, and 7. Read each of the adjective opposite pairs, and then choose the number that best describes your response to the issue statement.

ISSUE STATEMENT:

GLOBAL WARMING AND CLIMATE CHANGE ARE SERIOUS PROBLEMS THAT AFFECT THE NATURAL WORLD.

Attitude toward the Issue Statement

Negative	1	2	3	4	5	6	7	Positive
Bad	1	2	3	4	5	6	7	Good
Unfavorable	1	2	3	4	5	6	7	Favorable
Unacceptable	1	2	3	4	5	6	7	Acceptable
Wrong	1	2	3	4	5	6	7	Right
Foolish	1	2	3	4	5	6	7	Wise

The next items are designed to measure the strength of your attitude. Items consist of pairs of adjective opposites. Each of the pairs of adjective opposites is separated by the numbers 1, 2, 3, 4, 5, 6 and 7. Read each of the adjective opposite pairs, and then circle a number that best describes the strength of your attitude.

Unimportant	1	2	3	4	5	6	7	Important
Not influential	1	2	3	4	5	6	7	Influential
Irrelevant	1	2	3	4	5	6	7	Relevant
Not interested	1	2	3	4	5	6	7	Interested

The next items are designed to measure how certain you think you are about this issue. Items consist of pairs of adjective opposites. Each of the pairs of adjective opposites is separated by the numbers 1, 2, 3, 4, 5, 6, and 7. Read each of the adjective opposite pairs, and then circle a number that best describes the strength of your attitude.

Uncertain	1	2	3	4	5	6	7	Certain
Unsure	1	2	3	4	5	6	7	Sure
Not Confident	1	2	3	4	5	6	7	Confident

Estimate the certainty of your attitude on this issue on a scale from 0 to 100, where 0 represents no certainty and 100 indicates absolute certainty: _____.

ISSUE STATEMENT:

HUMANS HAVE EXPLORED MANY PARTS OF OUR SOLAR SYSTEM, INCLUDING SENDING ASTRONAUTS TO THE MOON.

Attitude toward the Issue Statement

Negative	1	2	3	4	5	6	7	Positive
Bad	1	2	3	4	5	6	7	Good
Unfavorable	1	2	3	4	5	6	7	Favorable
Unacceptable	1	2	3	4	5	6	7	Acceptable
Wrong	1	2	3	4	5	6	7	Right
Foolish	1	2	3	4	5	6	7	Wise

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Unimportant	1	2	3	4	5	6	7	Important
Not influential	1	2	3	4	5	6	7	Influential
Irrelevant	1	2	3	4	5	6	7	Relevant
Not interested	1	2	3	4	5	6	7	Interested

The next items are designed to measure how certain you think you are about this issue. Items consist of pairs of adjective opposites. Each of the pairs of adjective opposites is separated by the numbers 1, 2, 3, 4, 5, 6, and 7. Read each of the adjective opposite pairs, and then circle a number that best describes the strength of your attitude.

Uncertain	1	2	3	4	5	6	7	Certain
Unsure	1	2	3	4	5	6	7	Sure
Not Confident	1	2	3	4	5	6	7	Confident

Estimate the certainty of your attitude on this issue on a scale from 0 to 100, where 0 represents no certainty and 100 indicates absolute certainty: _____.

ISSUE STATEMENT:

THE THEORY OF EVOLUTION IS THE BEST EXPLANATION WE HAVE FOR THE DEVELOPMENT OF LIFE ON OUR PLANET.

Attitude toward the Issue Statement

Negative	1	2	3	4	5	6	7	Positive
Bad	1	2	3	4	5	6	7	Good
Unfavorable	1	2	3	4	5	6	7	Favorable
Unacceptable	1	2	3	4	5	6	7	Acceptable
Wrong	1	2	3	4	5	6	7	Right
Foolish	1	2	3	4	5	6	7	Wise

The next items are designed to measure the strength of your attitude. Items consist of pairs of adjective opposites. Each of the pairs of adjective opposites is separated by the numbers 1, 2, 3, 4, 5, 6 and 7. Read each of the adjective opposite pairs, and then circle a number that best describes the strength of your attitude.

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Not influential	1	2	3	4	5	6	7	Influential
Irrelevant	1	2	3	4	5	6	7	Relevant
Not interested	1	2	3	4	5	6	7	Interested

The next items are designed to measure how certain you think you are about this issue. Items consist of pairs of adjective opposites. Each of the pairs of adjective opposites is separated by the numbers 1, 2, 3, 4, 5, 6, and 7. Read each of the adjective opposite pairs, and then circle a number that best describes the strength of your attitude.

Uncertain	1	2	3	4	5	6	7	Certain
Unsure	1	2	3	4	5	6	7	Sure
Not Confident	1	2	3	4	5	6	7	Confident

Estimate the certainty of your attitude on this issue on a scale from 0 to 100, where 0 represents no certainty and 100 indicates absolute certainty: _____.

ISSUE STATEMENT:

THERE IS LITTLE CONVINCING EVIDENCE THAT GLOBAL WARMING OR CLIMATE CHANGE ARE SERIOUSLY EFFECTING THE NATURAL WORLD.

Attitude toward the Issue Statement

Negative	1	2	3	4	5	6	7	Positive
Bad	1	2	3	4	5	6	7	Good
Unfavorable	1	2	3	4	5	6	7	Favorable
Unacceptable	1	2	3	4	5	6	7	Acceptable
Wrong	1	2	3	4	5	6	7	Right
Foolish	1	2	3	4	5	6	7	Wise

The next items are designed to measure the strength of your attitude. Items consist of pairs of adjective opposites. Each of the pairs of adjective opposites is separated by the numbers 1, 2, 3, 4, 5, 6 and 7. Read each of the adjective opposite pairs, and then circle a number that best describes the strength of your attitude.

Unimportant	1	2	3	4	5	6	7	Important
Not influential	1	2	3	4	5	6	7	Influential
Irrelevant	1	2	3	4	5	6	7	Relevant
Not interested	1	2	3	4	5	6	7	Interested

The next items are designed to measure how certain you think you are about this issue. Items consist of pairs of adjective opposites. Each of the pairs of adjective opposites is separated by the numbers 1, 2, 3, 4, 5, 6, and 7. Read each of the adjective opposite pairs, and then circle a number that best describes the strength of your attitude.

Uncertain	1	2	3	4	5	6	7	Certain
Unsure	1	2	3	4	5	6	7	Sure
Not Confident	1	2	3	4	5	6	7	Confident

Estimate the certainty of your attitude on this issue on a scale from 0 to 100, where 0 represents no certainty and 100 indicates absolute certainty: _____.

ISSUE STATEMENT:

THERE ARE FLAWS WITH THE THEORY OF EVOLUTION. IT IS POSSIBLE THAT AN INTELLIGENT CREATOR IS RESPONSIBLE FOR THE DEVELOPMENT OF LIFE ON EARTH.

Attitude toward the Issue Statement

Negative	1	2	3	4	5	6	7	Positive
Bad	1	2	3	4	5	6	7	Good
Unfavorable	1	2	3	4	5	6	7	Favorable
Unacceptable	1	2	3	4	5	6	7	Acceptable
Wrong	1	2	3	4	5	6	7	Right
Foolish	1	2	3	4	5	6	7	Wise

The next items are designed to measure the strength of your attitude. Items consist of pairs of adjective opposites. Each of the pairs of adjective opposites is separated by the numbers 1, 2, 3, 4, 5, 6 and 7. Read each of the adjective opposite pairs, and then circle a number that best describes the strength of your attitude.

Unimportant	1	2	3	4	5	6	7	Important
Not influential	1	2	3	4	5	6	7	Influential
Irrelevant	1	2	3	4	5	6	7	Relevant
Not interested	1	2	3	4	5	6	7	Interested

The next items are designed to measure how certain you think you are about this issue. Items consist of pairs of adjective opposites. Each of the pairs of adjective opposites is separated by the numbers 1, 2, 3, 4, 5, 6, and 7. Read each of the adjective opposite pairs, and then circle a number that best describes the strength of your attitude.

Uncertain	1	2	3	4	5	6	7	Certain
Unsure	1	2	3	4	5	6	7	Sure
Not Confident	1	2	3	4	5	6	7	Confident

Estimate the certainty of your attitude on this issue on a scale from 0 to 100, where 0 represents no certainty and 100 indicates absolute certainty: _____.

Thank you. Please continue on to the next page.

Next, we would like to know, in general, how confident you are about your general attitudes (NOT THOSE ABOUT THE PREVIOUS ISSUES). Using a 0-100 probability scale, where 0 indicates no confidence and 100 indicates extreme confidence, place a number in the space beside each of the items below:

_____ My attitudes are very firm.
[0 indicates no confidence; 100 indicates extreme confidence]

_____ I hold the correct attitudes.

_____ My attitudes will not change even if I find out that most people disagree with me.

_____ I can defend my positions on issues that I hold attitudes about if they are attacked.

_____ I can maintain my position on issues that I hold attitudes about even if I encounter strong arguments against them.

_____ I would defend my positions on issues that I hold attitudes about in speaking with someone who disagrees with me.

Thank you. Please continue on to the next page.

STOP - END OF PHASE ONE

Please wait for the moderator's prompt to continue.

We appreciate your continued participation in this study of how people process popular science messages. Please continue to read the instructions at the start of each set of survey items and complete them as accurately as possible.

You are now in phase two. On the next page of this questionnaire you will read a synopsis of a popular science television program, which is followed by exercises and scales concerning the message.

Please read the message carefully and then continue on when you are ready.

SEE PERSUASIVE MESSAGES IN APPENDIX B)

CONTROL (*COSMOS SYNOPSIS)*

INOCULATION (THE *COSMOS* PROBLEM)

METAINOCULATION (THINK FOR YOURSELF!, THE *COSMOS* PROBLEM)

The initial set of items is designed to help us to understand how you feel about issues you come in contact with.

Despite your opinion on issues, there is a possibility you may come into contact with arguments contrary to your position that are so persuasive that they may cause you to rethink your position.

I find this possibility:

Safe	1	2	3	4	5	6	7	Dangerous
Not threatening	1	2	3	4	5	6	7	Threatening
Not Intimidating	1	2	3	4	5	6	7	Intimidating
Not Harmful	1	2	3	4	5	6	7	Harmful
Not Risky	1	2	3	4	5	6	7	Risky

Despite your opinion on issues, it is possible that a charismatic speaker or figure might convince you to rethink your position.

I find this possibility:

Safe	1	2	3	4	5	6	7	Dangerous
Not threatening	1	2	3	4	5	6	7	Threatening
Not Intimidating	1	2	3	4	5	6	7	Intimidating
Not Harmful	1	2	3	4	5	6	7	Harmful
Not Risky	1	2	3	4	5	6	7	Risky

Thank you. Please continue on to the next page.

STOP - END OF PHASE TWO

Please wait for the moderator's prompt to continue

PHASE THREE

We appreciate your continued participation in this study of how people process popular science messages.

You have now seen an episode of a popular science television show. In phase three, you will be asked about your attitudes and beliefs about popular science issues.

Please read the instructions at the start of each item and complete the items as accurately as possible.

ISSUE STATEMENT:

THE THEORY OF EVOLUTION IS THE BEST EXPLANATION WE HAVE FOR THE DEVELOPMENT OF LIFE ON OUR PLANET.

Attitude toward the Issue Statement

Negative	1	2	3	4	5	6	7	Positive
Bad	1	2	3	4	5	6	7	Good
Unfavorable	1	2	3	4	5	6	7	Favorable
Unacceptable	1	2	3	4	5	6	7	Acceptable
Wrong	1	2	3	4	5	6	7	Right
Foolish	1	2	3	4	5	6	7	Wise

The next items are designed to measure the strength of your attitude. Items consist of pairs of adjective opposites. Each of the pairs of adjective opposites is separated by the numbers 1, 2, 3, 4, 5, 6 and 7. Read each of the adjective opposite pairs, and then circle a number that best describes the strength of your attitude.

Unimportant	1	2	3	4	5	6	7	Important
Not influential	1	2	3	4	5	6	7	Influential
Irrelevant	1	2	3	4	5	6	7	Relevant
Not interested	1	2	3	4	5	6	7	Interested

The next items are designed to measure how certain you think you are about this issue. Items consist of pairs of adjective opposites. Each of the pairs of adjective opposites is separated by the numbers 1, 2, 3, 4, 5, 6, and 7. Read each of the adjective opposite pairs, and then circle a number that best describes the strength of your attitude.

Uncertain	1	2	3	4	5	6	7	Certain
Unsure	1	2	3	4	5	6	7	Sure
Not Confident	1	2	3	4	5	6	7	Confident

Estimate the certainty of your attitude on this issue on a scale from 0 to 100, where 0 represents no certainty and 100 indicates absolute certainty: _____.

ISSUE STATEMENT:

THERE ARE FLAWS WITH THE THEORY OF EVOLUTION. IT IS POSSIBLE THAT AN INTELLIGENT CREATOR IS RESPONSIBLE FOR THE DEVELOPMENT OF LIFE ON EARTH.

Attitude toward the Issue Statement

Negative	1	2	3	4	5	6	7	Positive
Bad	1	2	3	4	5	6	7	Good
Unfavorable	1	2	3	4	5	6	7	Favorable
Unacceptable	1	2	3	4	5	6	7	Acceptable
Wrong	1	2	3	4	5	6	7	Right
Foolish	1	2	3	4	5	6	7	Wise

The next items are designed to measure the strength of your attitude. Items consist of pairs of adjective opposites. Each of the pairs of adjective opposites is separated by the numbers 1, 2, 3, 4, 5, 6 and 7. Read each of the adjective opposite pairs, and then circle a number that best describes the strength of your attitude.

Unimportant	1	2	3	4	5	6	7	Important
Not influential	1	2	3	4	5	6	7	Influential
Irrelevant	1	2	3	4	5	6	7	Relevant
Not interested	1	2	3	4	5	6	7	Interested

The next items are designed to measure how certain you think you are about this issue. Items consist of pairs of adjective opposites. Each of the pairs of adjective opposites is separated by the numbers 1, 2, 3, 4, 5, 6, and 7. Read each of the adjective opposite pairs, and then circle a number that best describes the strength of your attitude.

Uncertain	1	2	3	4	5	6	7	Certain
Unsure	1	2	3	4	5	6	7	Sure
Not Confident	1	2	3	4	5	6	7	Confident

Estimate the certainty of your attitude on this issue on a scale from 0 to 100, where 0 represents no certainty and 100 indicates absolute certainty: _____.

Thank you. Please continue on to the next page.

The next set of items is designed to **measure your opinion of the scientific arguments presented in *Cosmos.***

The arguments were:

Not persuasive	1	2	3	4	5	6	7	Persuasive
Irrelevant	1	2	3	4	5	6	7	Relevant
Unscientific	1	2	3	4	5	6	7	Scientific
Unfair	1	2	3	4	5	6	7	Fair
Insignificant	1	2	3	4	5	6	7	Significant

The next set of items is designed to **measure your opinion of Neil DeGrasse Tyson, host of *Cosmos.***

The host was:

Not persuasive	1	2	3	4	5	6	7	Persuasive
Irrelevant	1	2	3	4	5	6	7	Relevant
Unscientific	1	2	3	4	5	6	7	Scientific
Unfair	1	2	3	4	5	6	7	Fair
Unlikable	1	2	3	4	5	6	7	Likable

Thank you. Please continue on to the next page.

The questionnaire is now complete. Thank you for your participation in this study.

During this questionnaire you encountered information about evolution and intelligent design.

This study was meant to test if a certain persuasive method was successful at communicating those ideas.

The views presented in *Cosmos: A Spacetime Odyssey* do reflect the scientific community's current understanding of the origins of life on Earth. Over the past 150 years, the theory of natural selection has been tested and retested, leading to the acceptance of evolution as the best explanation for the origin of life.

Although proponents of ID have successfully used communication tactics to advance their cause, they have not contributed testable evidence to the body of literature on the development of life.

Please wait for further instructions from proctors before leaving the session.

Appendix B - Persuasive Messages

The *Cosmos* Problem (pilot)

Cosmos: A Spacetime Odyssey is the latest effort by scientists and the mainstream media to purportedly show viewers the "laws" of nature. In the show, the host Neil deGrasse Tyson offers his opinions on topics like evolution, global warming, the solar system, and more. What he doesn't offer is a critical perspective on those ideas. Viewers are meant to merely accept his view of science as fact.

In the second episode, "Some of the Things That Molecules Do," Tyson shows his close-mindedness to critical thinking when he dismisses intelligent design, calling the idea unscientific. Cosmos is interested in suppressing alternative scientific theories that might threaten mainstream Darwinist ideas.

According to the Center for Science and Culture, "Intelligent design holds that certain features of the universe and of living things are best explained by an intelligent cause."

As it happens, the intelligent design (ID) movement is highly scientific. Many supporters of ID work on the cutting edge of fields like paleontology and molecular biology. Often, they are affiliated with research institutions. ID supporters are also prolific publishers of books and peer-reviewed articles, in national journals like BIO-Complexity.

ID is often barred from mainstream scientific conferences. There is no way for the movement to present the ideas in many professional avenues. Despite being unfairly suppressed by the mainstream science community, ID supporters host legitimate scientific conferences and training programs, open to all who would like to learn more. They attempt to fairly bring their ideas into

the public square with media productions and appearances, but shows like *Cosmos* are given free reign while ID programs are dismissed.

ID supporters are often engaged in the public sphere as well. Scientists, the media, and even the government have made sure that ID cannot be discussed in schools, insisting that it is a religious movement that will force theocracy on Americans. This is not true. The fact is that the evidence for ID is as valid as the evidence for evolution. ID is not a religion.

The mainstream science community loves programs like *Cosmos* because they don't ask viewers to think critically. All they ask is that you believe the same flawed science messages that have become stale and oppressive. ID supporters would ask you to think critically about the world instead.

Think for Yourself! (Pilot)

There are many people out there with agendas about what you should believe; they want you thinking their way about things. So, no matter how unbelievable their cause seems, they make claims about how their ideas represent interesting new ways of thinking.

They say things like ‘’just because an idea is mainstream doesn't mean it is correct.’’ They will also tell you that the mainstream will send threatening message your way about new ideas. These “new idea” people often offer several examples of why mainstream messages are wrong.

So, you put your guard up, ready to dismiss anything you're told “must be true.” Sometimes that’s a good thing; but, have you ever thought that you could be manipulated this way?

These people or groups that take the time to warn you sometimes have a sinister agenda: making sure you believe what they want you to believe. They want to entice you to their alternative way of thinking. But you are a smart person. You can discern fact from fiction. You know that evidence and sensibility are important in understanding issues.

Next time some group or person ‘‘warns’’ you that believing a commonly accepted idea makes you ignorant, ignore them. You know that you hold your beliefs for a reason. You’re an independent thinker who makes up their own mind after hearing both sides of an argument.

The *Cosmos* Problem (final)

Intelligent design is an exciting, highly scientific new field. Researchers say intelligent design shows that the influence of an intelligent designer best explains some features of the universe and of living things.

Many supporters of intelligent design work on the cutting edge of fields like paleontology and molecular biology. Often, they are affiliated with research institutions. Intelligent design supporters often publish books and articles in national journals like BIO-Complexity.

Still, intelligent design is under attack!

Cosmos: A Spacetime Odyssey is the latest effort by scientists and the mainstream media to purportedly show viewers the "flaws" in intelligent design. In the show, the host Neil deGrasse Tyson offers his opinions on topics like evolution, global warming, the solar system, and more. What he doesn't offer is other perspectives on those ideas. Viewers are meant to merely accept his view of science as fact.

In the second episode, "Some of the Things That Molecules Do," Tyson shows his close-mindedness when he dismisses intelligent design, calling the idea unscientific. *Cosmos* is interested in suppressing alternative scientific theories that might threaten mainstream Darwinist ideas.

Intelligent design scholars are often barred from mainstream scientific conferences. All they want to do is to fairly bring their ideas into the public square with media productions and appearances. Why are shows like *Cosmos* given free reign while intelligent design programs are dismissed?

Intelligent design is not religion. Scientists insist that it is a religious movement that will force theocracy on Americans. This is not true. The fact is that the evidence for intelligent design is as valid as the evidence for evolution.

The mainstream science community loves programs like *Cosmos* because they don't ask viewers to think about new ideas. All they ask is that you believe the same flawed science messages that have become stale and oppressive. Intelligent design supporters want you to simply consider every theory.

Think for Yourself! (final)

There are many people out there with agendas about what you should believe. They want you thinking their way about things. So, no matter how unbelievable their cause seems, they make claims about how their ideas represent interesting new ways of thinking.

They say things like ‘’just because an idea is mainstream doesn't mean it is correct.’’ They will also tell you that the mainstream attacks and threatens new ideas. These “new idea” people often offer several examples of why mainstream messages are wrong.

So, you put your guard up, ready to dismiss anything you're told “must be true.” Sometimes that’s a good thing, but have you ever thought that you could be manipulated this way?

These people or groups that take the time to warn you sometimes have a sinister agenda: making sure you believe what they want you to believe. They want to entice you to their alternative way of thinking. But you are a smart person. You can discern fact from fiction. You know that evidence and sensibility are important in understanding issues.

The next time some group or person ‘‘warns’’ you that believing a commonly accepted idea makes you ignorant, ignore them. You know that you hold your beliefs for a reason. You’re an independent thinker who makes up their own mind after hearing both sides of an argument.