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Biblical literalism and the acceptance of biological evolution in Christian university students

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BIBLICAL LITERALISM AND THE ACCEPTANCE OF BIOLOGICAL

EVOLUTION IN CHRISTIAN UNIVERSITY STUDENTS

An Abstract of a Thesis

Submitted

in Partial Fulfillment

of the Requirements for the Degree

Master of Arts

Heather N Chamberlain

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ABSTRACT

Is it possible to accept biological evolution without rejecting God? Understanding student perspectives about religious belief and biological evolution is important to effectively teach science. There are many factors in this complex relationship and this study explored three: differences in Christian denominations, interpretation of scripture, and perspectives of the relationship between religious belief with acceptance of evolution. The participants were freshman elementary education majors at a Midwest university who completed a questionnaire about religious beliefs and the Inventory of Student Evolution Acceptance (I-SEA).

The results indicated no significant difference between Christian denomination and acceptance of evolution. Participants who took the Bible literally differed significantly from their non-literal peers in terms of acceptance of evolution. As expected, those who believed the Bible was the word of God and took it literally had a lower acceptance than those who did not believe the Bible was the word of God and did not take it literally. Finally, there was a high rate of acceptance but students reasoned with both incorrect and correct science.

In conclusion, is a relationship between understanding and acceptance of evolution for this population? The moderate levels of acceptance and understanding found in this population may be due to conflicting support for evolution from authority figures, like churches and instructors. Instructors must know both correct science and student religious perspectives to teach evolution effectively.

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CHAPTER 1

INTRODUCTION

This study sought to find a relationship between a Biblical literalist perspective

and the acceptance of evolution in college freshman. More specifically, is it possible to

accept biological evolution without rejecting God? This is the question many American

students who hold a Creationist perspective have to ask themselves when they encounter

the theory of biological evolution. Biologist Kenneth Miller (1999) best summarizes this

conflict:

> The common assumption, widely shared in academic and intellectual circles, is
> that Darwinism [theory of biological evolution] is a fatal poison to traditional
> religious belief… Incredibly, all too many traditional believers accept this view,
> not realizing that it is based more on humanistic culture of disbelief than on any
> finding of evolutionary science… Religion leads one side to reject the cornerstone
> of the life sciences, while the other delights in telling us that science can
> determine the meaning of life – which of course, that it does not have one. (p. xii)

Is it possible that these two popularly conflicting views of the world are not fully

black and white? Moreover, if the area between religious belief and acceptance of

evolution is truly a spectrum, what factors lean participants one way or another? Several

studies have been conducted which examine the variables affecting student acceptance of

evolution at both the high school and college level (Athanasiou & Papadopoulou, 2012;

Miller, Scott, & Okamoto, 2006; Moore & Cotner, 2009; Rutledge & Warden, 2000;

Sinatra, Southerland, McConaughy, & Demastes, 2003; Woods & Scharmann, 2001).

One aspect explored, religious factors including denomination, has identified lower levels

of acceptance among fundamentalist Christians, Mormons, and Jehovah's Witnesses

(Pew Research Center, 2013a). However, scant research exists on the underlying reason

for Creationist conflict with evolution: the perspective that knowledge about the world ultimately comes from religious text, which creates a worldview in conflict with the theory of biological evolution (Soneson, 2014).

A worldview is a lens in which a person uses to decide what is true or acceptable. Philosopher Immanuel Kant, a philosopher (see Appendix A for Immanual Kant on worldview) coined "worldview." There is a well-established connection between student belief in religious texts and acceptance of evolution. Although, there is a gap in literature regarding student "worldview," as defined by Immanuel Kant, on acceptance of biological evolution. The term *worldview* stems from Immanuel Kant's *weltanschauung*, which means a perception of the world gained empirically (Kant, 1987). Worldview as a term became popular very quickly and Christian and Calvinistic groups utilized worldview to described theological views (Naugle, 2004). Many theological worldviews are a lens to interpret data as being true, or acceptable. While technically, individuals could have a scientific worldview, this study will use the term from a theological or creation point of view. Along those lines, Naugle defines worldview as a way of understanding reality based on symbols found in a narrative (Naugle, 2002). When talking about major belief systems, this narrative includes religious texts. When a religious worldview incorporates a literal interpretation of scripture, conflict can arise when confronted by something without a scriptural basis, such as biological evolution. This "either/or" worldview coincides with W.G. Perry's (1968), developmental schema of which basic dualism precedes the turning point for accepting a different worldview.

There are many complex factors in the relationship between religious perspective and acceptance of evolution. Understanding student perspectives about religious belief and biological evolution is important to effectively teach science. The purpose of this mixed-method survey study is to test how believing in religious text as a literal interpretation of the world relates to the acceptance of evolution, controlling for higher-level biology education in students at a midsized Midwest university.

The focus of my research includes three questions:

- What are the differences in Christian denominations on acceptance of evolution?

- What are the differences on the acceptance of evolution in groups of people that have a literal interpretation of scripture?

- In what ways do students describe the relationship between acceptance of evolution and religious worldview?

CHAPTER 2

LITERATURE REVIEW

<u>Theoretical Framework</u>

When it comes to student perception of biological evolution, Woods and Scharmann (2001) describe some high school students as being in Perry's (1968) position of dualism where a theory is accepted or rejected based on an authority. This position of "either/or" is identified by Sinatra et al. (2003) in a college population regarding intentions and beliefs about acceptance of evolution. The term "worldview" is used to a describe student perception of what is acceptable within religion and science by Shipman, Brickhouse, Dagher, and Letts (2002) and by Hokayem and BouJaoude (2008) in college populations. Although these authors use different populations, each thought it important to include Perry's (1968) theory of dualism and worldview to describe the students' lens regarding science and religion.

For this project, the assumption is that everyone in this study is in Position 1 of Perry's (1968) dualism. According to Perry (1968), dualism is a state of learning in which a student is holding two conflicting schemas of the world. To other fields, dualism is the difference between mind/soul and brain/body. For this research, dualism is the state of conflicting schemas. According to Perry (1968), instruction in college challenges students' perception about what is true or acceptable. In Perry's (1968) developmental schema, there are nine positions of schema acceptance and three alternatives to acceptance (Table 1).

Table 1

Main Line of Development for Perry's Positions

Position	Definition
1	The student sees the world in polar terms of we-right-good vs. other-wrong-bad. Right Answers for everything exist in the Absolute, known to Authority whose role is to mediate (teach) them. Knowledge and goodness are perceived as quantitative accretions of discrete rightnesses to be collected by hard work and obedience (paradigm: a spelling test).
2	The student perceives diversity of opinion, and uncertainty, and accounts for them as unwarranted confusion in poorly qualified Authorities or as mere exercises set by Authority "so we can learn to find The Answer for ourselves"
3	The student accepts diversity and uncertainty as legitimate but still temporary in areas where Authority "hasn't found The Answer yet." He supposes Authority grades him in these areas on "good expression" but remains puzzled as to standards.
4	(a) The student perceives legitimate uncertainty (and therefore diversity of opinion) to be extensive and raises it to the status of an unstructured epistemological realm of its own in which "anyone has a right to his own opinion," a realm which he sets over against Authority's realm where right – wrong still prevails, or (b) The student discovers qualitative contextual relativistic reasoning as a special case of "what They want" with Authority's realm
5	The student perceives all knowledge and values (including authority's) as contextual and relativistic and subordinates dualistic right–wrong functions to the status of a special case, in context.
6	The student apprehends the necessity of orienting himself in a relativistic world through some form of personal Commitment (as distinct from unquestioned or unconsidered commitment to simple belief in certainty).
7	The student makes an initial Commitment in some area.
8	The student experiences the implications of Commitment, and explores the subjective and stylistic issues of responsibility.

Table continues.

Position	_Definition_
9	The student experiences the affirmation of identity among multiple responsibilities and realizes Commitment as an ongoing, unfolding activity through which he expresses his life style.
Temporizing	The student delays in some Position for a year, exploring its implications or explicitly hesitating to take the next step.
Escape	The student exploits the opportunity for detachment offered by the structures of Position 4 and 5 to deny responsibility through passive or opportunistic alienation.
Retreat	The student entrenches in dualistic, absolutistic structures of Position 2 or 3.

Source: (University of Oxford, 2014).

As previously addressed, dualism is the turning point where students start to assimilate new beliefs, ideas, and knowledge. In Perry's (1968) basic duality, assumptions about knowledge and the nature of knowledge are almost child-like. Students in Position 1 base values and knowledge on a black-and-white system that they never before tried to challenge. This makes the student obedient to who they are getting their information from: the Authority (Perry, 1968). We can apply the concept of the Authority to a literal interpretation of the Bible and worldviews inherited from a close relationship with parents and the church community.

Perry states that in college, the Authority often comes in the form of a college instructor (Perry, 1968). In his embedded mixed methods study of 313 freshman, Perry (1968) gave a pre- and post- belief inventory checklist followed by an interview. Administration of a pre-assessment occurred at the beginning of the semester while a post-assessment occurred at the end. At the end of the semester, 31 students participated

in follow-up interview. Based on the interviews, only four students maintained this dualistic worldview during the semester. Transcripts of the interviews indicate that the students' ideas are not novel and are almost a full expression of the Book of Genesis in the Bible.

Because of the obedience to his dualistic expression, one student viewed his college instructor as presenting information as if it was God's word. The student slowly began to realize that the professor was not omniscient. The student then loosened his worldview to assimilate and accommodate those ideas presented by the professor. In the state of basic duality, a student's initial worldview starts to carry ideas of the new information presented. True conceptual change does not happen until Position 5, which may take quite a while.

These positions should be seen as a spectrum in which students progress through the positions. This learning occurs by challenging student's current schema and then encouraging assimilation and accommodation (von Glasersfeld, 1995). Von Glasersfeld (1995) adds that multiple exposures to other authorities and ideas grow conceptual change.

<p style="text-align:center;">Biological Evolution</p>

According to Futuyma and Meagher, (1999) *biological evolution* is a change in hereditary characteristics of populations, or species, over the course of generations. Evolution is "descent, with modification, of different lineages from common ancestors" (Futuyma & Meagher, 1999, p.6). As Theodosius Dobzhansky wrote in his famous 1973 essay, "Nothing in biology makes sense except in the light of evolution." Evolutionary

biology is the core concept of biological science; it is required in state common core

standards and national science standards (Iowa Department of Education, 2012; NGSS

Lead States, 2013). However, this view of change over time meets some resistance due to

literal interpretation of the Bible.

The literature reviewed addresses both the nonreligious and religious factors

concerning acceptance of evolution. Currently, no comprehensive studies exist looking at

more than one variable on the acceptance of evolution in the undergraduate population.

As we have seen, it is possible to "understand evolution and not accept it and accept

evolution and not understand it" (J. Demastes, personal communication, February 18,

2014). When it comes to religious factors, denomination alone can be an indicator but not

a fixed rule. The more important concept to take into consideration is what the religious

beliefs are based on. For many Western religions, that is a type of scripture. This

interpretation of scripture as a worldview can coexist with an acceptance of evolution or

be in conflict with it.

<div align="center">Creationism and Intelligent Design</div>

In the United States, Creationist perspective largely accounts for the controversy

between beliefs and evolution. According to a major Creationist website, *Creationism* is:

> Not an auxiliary belief attached to the Bible; instead, creation is the logical
> conclusion of a clear reading and understanding of Genesis in its intended form—
> that is, as a historical narrative. This historical narrative, which was given to
> humanity by the infallible Creator, is the basis and foundation upon which
> a biblical worldview is based. (Answers in Genesis, 2014)

Creationism is a fundamentalist belief and do not reflect the larger views of

Christian Americans (Alters & Alters, 2001). In addition, Intelligent Design (ID) was

born in the 1990s and based on Creationism ideals. Intelligent Design is a movement to make Creationism more credible with the American public as a whole by appearing to be scientific. Intelligent Design does not directly quote scripture or a deity and gives the appearance of a scientific approach to life created by a higher power. For this reason, ID has been gaining popularity in many countries and political realms (Reiss, 2009). The principles ID is based on are in complete disagreement with any natural scientists and most theologians (Hewlett, 2004). The U.S. legal systems compile ID and Creationism together because of its foundations in the religious and non-scientific political movement (Matsumura & Mead, 2007), and is categorized as such in this study.

<p style="text-align:center;"><u>World and National Context of Teaching Evolution</u></p>

In a survey comparing 34 European countries and Japan to the United States, the U.S. was second to last (Turkey) regarding acceptance of evolution (Miller et al., 2006). Miller and colleagues (2006) looked at multiple factors affecting acceptance of evolution in the U.S. and nine European countries. They found that those who believed in a personal God and prayed frequently were two times more likely to reject evolution in the U.S. than in other countries (Miller et al., 2006).

Additionally, evolution is highly politicized bipartisan issue in the United States. Republicans officially adopted Creationism into their platform during the second half of the 20th century to appeal to Southern and Midwestern states. Part of this adoption included explicit demands to teach "creation science" in public classrooms. Europe and Japan have no major political parties opposing evolution or its teaching (Miller et al., 2006).

A unique characteristic of evolution perspective in the US is that of a cultural problem. Evolution is that it is not common knowledge, such as that of germs or electricity. Because of this, Americans are more resistant to evolution than other developed countries (Miller et al., 2006). This difference between the United States and other countries is mostly its religious views. American Christian fundamentalists diverge from other Protestant denominations in their literal interpretation of scripture. Some Protestants and Catholics in the United States and Europe view the Bible metaphorically and do not believe that Genesis is an inerrant account of the world. In this sense, they agree that Darwinian evolution is not in conflict with their faith (Miller et al., 2006).

Historically, the First Amendment protects evolution teaching when legally challenged. An example is an important case in 1982 where "Creation science" was rejected as being "science" and not qualified to be taught in public schools. According to Matsumura and Mead (2007), there are ten major court cases involving Creationist/s against evolution teaching (Table 2).

The U.S. as a population, accepts evolution while Creationists reject it due to their perspective that it conflicts with a literal view of scripture (Pew Research Center, 2013b). Six in ten Americans accept evolution, although, only 18% accept evolution in its correct form, such as change over time is due to processes like natural selection. Furthermore, 32% of the total population believes that humans have always existed in their present form, which hints at the creation by a Supreme Being. Interestingly, 7% did not know whether they accepted evolution nor whether humans always existed in their current form (Pew Research Center, 2013b).

Table 2

Ten Major Evolution v. Creationism Court Cases

Court Case	Year	Summary
Epperson v. Arkansas	1968	The Supreme Court overturned an Arkansas statue that prohibits evolution teaching due to violation of the First Amendment. This was the major case that brought the battle between Creationism and public teaching of evolution to light.
Segraves v. State of California	1981	Segraves believed class discussion of evolution prohibited his and his student's free exercise of religion. The California State Board of Education's *Science Framework* antidogmatism policy allowed the scientific explanations of origins as "how" but not "ultimate cause." The court ruled that any speculative statements concerning origins presented conditionally, not dogmatically.
McLean v. Arkansas Board of Education	1982	A federal court determined that firstly, "creation-science" is not in fact "science," and secondly, Creationist literature used in the school does not have a secular purpose while evolution does not presuppose the absence of presence of a creator.
Edwards v. Aguillard	1987	The Supreme Court found the Louisiana "Creationism Act" endorsed the religious belief that a supernatural being created humankind. Secondly, a comprehensive science education undermined the idea that equal time to evolution and Creationism is required.
Webster v. New Lenox School District	1990	The Seventh Circuit Court of Appeals found school districts protecting the First Amendment's establishment clause by prohibiting teachers to teaching "creation science." The teacher is not protected in this case because they are teaching a form of religious advocacy.
Peloza v. Capistrano School District	1994	The Ninth Circuit Court of Appeals found that a teacher's First Amendment right of free exercise of religion is not violated when s/he is required to teach evolution within the classroom. The teacher defined evolution as a "religion" but that definition was rejected by the court.

Table continues.

Court Case	Year	Summary
Freiler v. Tangipahoa Parish Board of Education	1997	The U.S. District Court for the Eastern District of Louisiana found the reading of a disclaimer when teaching evolution to promote "critical thinking" about Biblical Creationism and evolution being of religious value and therefore not appropriate for public school.
Rodney LeVake v. Independent School District 656, et al.	2000	The Minnesota State District Court judge dismissed this file brought against the school district by a high school biology teacher. The teacher believed he had a right to free speech to teach the evidence both for and against the theory of evolution. He believed he was facing religious discrimination from the district, which prescribed evolution teaching.
Selman et al. v. Cobb County School District et al.	2005	This school district required all textbooks that include evolution to include a sticker that stated evolution is just a theory, not a fact. The 11th Circuit Court of Appeals found that the warning label violated the Establishment Clause of the First Amendment and the district could not disclaim or denigrate evolution orally or in written form.
Kitzmiller et al. v. Dover	2005	This was the first challenge to teaching "intelligent design" in the public school science classroom where the school Board's ID Policy to treat evolution as "just a theory" and provide ID resources was a violation of the Establishment Clause. When talking about ID as a science, Judge Jones wrote ID "is not science and cannot be adjudged a valid, accepted scientific theory as it has failed to publish in peer-reviewed journals, engage in research and testing, and gain acceptance in the scientific community" *Source:* (Matsumura & Mead, 2007).

Even though Creationists are a minority in the U.S. population, they have a large presence when it comes to challenging the teaching of evolution in our public schools. All ten court cases hint at a misunderstanding of correct science and rights of religious belief in public schools. One topic on Creationist's platform is that humans have always existed in their current form and evolution is not an acceptable lens in which to view

change in nature. If there has been no change over time, there must have been a Creator to bring humans into existence. This is a common belief of Creationists, but also reflected in other denominations and world religions.

According to the Pew Research Center (2014a), 13 states have challenged landmark Supreme Court decisions to separate church and state, and failed. Those who do not want evolution taught in schools, or with equal time, believe students should have "academic freedom" over mandated curriculum (Pew Research Center, 2014b). In such a diverse melting pot that is the U.S., teaching evolution must be done in a way that does not alienate students because of their religious beliefs but bring them closer to understanding.

<div align="center">Teaching Evolution</div>

Childhood Origins of Resistance to Science

One reason cited for the resistance to evolution is the idea that it is not intuitive (Bloom & Weisberg, 2007; Rosengren, Brem, Evans, & Sinatra, 2012). Children are not blank slates and some ideas (e.g. object permanence) create an alternative conceptual framework for scientific phenomena (Bloom & Weisberg, 2007). Children view the world in terms of design and purpose, such as clouds are "for raining" and lions exist so we can "go to the zoo" (Evans, 2001). Children spontaneously tend to prefer Creationist explanations for the origin of animals and people.

Children may not realize that their religious worldview and scientific worldview can coexist if there are misinterpretations about what questions their religion can answer and what science can answer. A way that this confusion can avoided is by churches

making their stance officially known and communicated to their congregation. Churches can also preface that the Bible does not seek to answer scientific questions just as science does not seek to answer religious questions. From Perry's (1968) research, a single authority being the only source of credible information can lead to students continuing to be in Perry's (1968) Position 1. Students need challenging and multiple exposures to other authorities and ideas to grow in conceptual change (von Glasersfeld, 1995).

Process of Learning Evolution

In public school settings, instructors should effectively teach about the Nature of Science and biological evolution (Iowa Department of Education, 2012; NGSS Lead States, 2013). These instructors should know the laws and standards regarding the teaching of evolution and not shy away, but embrace, the challenge of the topic standards. These professionals need to be aware that their personal religious beliefs are separate from science instruction, if it is contradictory. Not only is this illegal according to major Supreme Court Cases, but it is sending the message to students that religious worldview is the *only* worldview with legitimacy (Matsumura & Mead, 2007). Instructors should strive to discuss how biological evolution does not contradict many major religions and is a separate lens: the lens of young scientists. This learning occurs by challenging student's current schema and then encouraging assimilation and accommodation (von Glasersfeld, 1995).

If a student just cannot accommodate and assimilate new ideas, they may resort to temporizing, retreat, and/or escape. In temporizing, the student pauses for a year or more, often quite aware of the problem of accepting new ideas. Retreat involves the student

being entrenched with anger and hatred of dualism, seeing it as an "us versus them" mentality. Escape is settling for a lower position in development by refusing to take responsibility to make the choice to change a worldview (Perry, 1968). A way to prevent this rejection is to become a credible source.

　　Source credibility. According to Bloom and Weisberg (2007), when people talk about evolution, the tone and credibility of the source are important. It is hard to accept a scientific concept when someone speaks tentatively about it, such as "I believe in evolution" where "belief" leaves the concept wanting of factuality. The more appropriate term would be "accept," as in "I accept evolution." In general, people also tend to look at the credibility of the source of their information rather than just being skeptical about the information. For example, a child will believe a parent over a teacher when learning evolutionary theory. Those who do learn about evolution from someone deemed credible might not learn how it works. Initially, they accept evolution and later cannot accurately describe the processes. The credibility of the source is more important than looking at the evidence and the arguments, which many non-scientists are not prepared to do without understanding the nature of science (Bloom & Weisberg, 2007).

Religious Factors Affecting Acceptance of Evolution

　　Many different factors affect acceptance of evolution. These factors can be divided into religious and non-religious. Religious factors include religious worldview, denomination, and literal belief in scripture (Alters & Alters, 2001; Hewlett, 2004; Miller et al., 2006; Pew, 2013a; Pew, 2013b; Pew, 2014b; Robinson, 1995; Reiss, 2009;

Robinson, 1995; Rosengren et al., 2012; Sproul, 1979; Tharoor, 2014; Wilson, 1991;

Woods & Scharmann, 2001).

A study by Rosengren et al. (2012) asked participants about religious views ("I

believe in the existence of God" and "I believe in the existence of souls") and acceptance

of evolution. Not only did these ratings not change as a function of non-religious

instruction, they negatively correlated with mean agreement with the questions regarding

evolutionary content. The conclusion brought by the researchers was that on average,

those holding religious views understood and accepted evolutionary theory less than

those not holding religious views.

According to Woods and Scharmann (2001), religious factors rank at the top of

influences affecting high school students' acceptance of evolution. The most commonly

cited religious variable for acceptance of evolution is denomination (Pew Research

Center, 2013b; Miller et al., 2006). Because Creationists are usually Protestant

Evangelical Christians and/or biblical literalists, they believe the world and its inhabitants

would not exist without divine creation (Alters & Alters, 2001). As we have established,

Creationists are the majority that oppose biological evolution.

Religious affiliation in the United States is extremely diverse by being home to a

variety of cultures. One of the characteristics of the nature of religion according to Reiss

(2009) is the existence of a "narrative or mythical dimension." This narrative creates the

basis for "doctrinal and philosophical dimensions" which incorporates the principles of

the narrative into a worldview (Reiss, 2009, p. 1936). These narratives include the Torah

in Judaism, Qur'an in Islam, and the Vedas in Hinduism. Other Eastern texts are the Guru

Granth in Sikhism, Agamas of Janism, and Tao Te Ching in Taoism (Robinson, 1995). Some eastern religions have multitudes of writings such as Buddhism and Confucianism. Some rely on no scripture at all such as Shinto and other native religions such as traditional African, Native American, and South Pacific. There are also New Age religions springing from traditional ones or branching out entirely.

In Judaism, there is no perceived conflict with the Torah and biological evolution. In Islam, some theologically conservatives believers denounce natural selection while more liberal believers do not see an incompatibility between faith and evolution. Both the conservative and liberal groups believe man created by a Supreme Being, which does not coincide with biological evolution. Most Hindu beliefs are compatible with evolution. In Buddhism, there is no inherent conflict between religious scripture teachings and evolution. Some Buddhists believe aspects of Darwin's theory are consistent with core teachings such as all life is impermanent (Pew, 2014b). In Sikhism, religious teachings indicate a creation of the universe by a Supreme Being but ultimately no other information in the scripture contradicts scientific facts (Robinson, 1995). In Jainism, there is no creator, thus is compatible with the theory of evolution (Sproul, 1979). For many indigenous and New Age religions it is hard to categorize views on evolution because the literature used in each faction is unique or nonexistent (Wilson, 1991).

According to the Pew Research Center (2014b), some Christian denominations have made official statements public regarding evolution. For example, there are official stance statements released on behalf of the Roman Catholic community by the Vatican from Pope Francis (Tharoor, 2014), Benedict XVI, and Pope Pius XIII (Pew, 2014b). The

Catholic Church generally accepts evolution but believes natural selection guided by God. The Episcopal Church passed a resolution stating that God can create in any manner and rejected both "Creationism" and "Intelligent Design." The Evangelical Lutheran Church in America does not have an official stance but feels that the timeline in Genesis is debatable and that God had an active role in creation and evolution. The U.S.A. Presbyterian Church retracted a 1969 statement that evolution and the Bible do not contradict each other and replaced it with a statement saying that the church should refrain from affirming or denying evolution. The United Church of Christ embraces evolution as do the United Methodist Church. The United Methodist Church adds that many references in the Bible are a metaphor to teach religious principles, not to teach science (Pew, 2014b).

Because the origins of human life can be a dropping-off point for many religious people in agreement with evolution, a study done by the Pew Research Center (2013a) regarding acceptance based on human origins and denomination. Of those polled, 35% of Protestants agreed that evolution is the best explanation for the origins of human life while 58% disagreed (7% did not know or refused to answer). It is also worth noting that evangelical and historically black churches have a low level of agreement. On average, those who would categorize themselves as unaffiliated have a high level of agreement.

A common assumption is that fundamentalism is synonymous with antievolution, but in fact, the fundamentalist movement did not address Darwinian evolution directly. Instead, fundamentalists believe that scripture is the inerrant word of God and a record of how the natural world arose it is incompatible with biological evolution (Hewlett, 2004).

Christian Theists believe that the Bible is more or less metaphorical. Theists typically believe God created the world but are not opposed to biological evolution (Alters & Alters, 2001).

Many Creationist students are not biblical scholars and do not have first-hand knowledge of biblical contents. Thus, many Creationist arguments are based on a general understanding of the Bible and do not know the precise biblical reasons for rejection of evolution. Many learn this rejection of evolution based on biblical principles from parents, clergy, and friends, annotations in study Bibles, or Creationist publications, which cite the Bible as the primary source (Alters & Alters, 2001). Perry (1968) would say that this is because they received their information through another party, an authority figure. Actual Bible citations for rejection of evolution spring mostly from Genesis, but span Romans, Job, John, Isaiah, Micah, Malachi, among others (Alters & Alters, 2001). The perspective is that Creationism take can be thought of as a worldview which is a lens through which the see the world, including science (Reiss, 2009).

Interestingly, there is a positive correlation between views about human origins and the role of evolution and the literal interpretation of scripture. For example, those denominations who take scripture as being the word of God, and literally take it word for word also, on average, disagree with evolution being the best explanations for human origins. Those who have a nonliteral view of scripture, such as some Eastern religions and unaffiliated, also have a high agreement rate when it came to human origins (Pew, 2008).

By state, a relationship exists in the adult population between the acceptance of evolution and interpretation of scripture (Pew Research Center, 2013a). In this national survey, the wording of the type of scripture and Supreme Being altered according to the participants' religious affiliation. When looking at two separate surveys, in general, the state with the highest percentage of adults who accept evolution (~70%) Vermont (Pew Research Center, 2013a), also has a low percentage of adults who believe the Bible is the word of God (16%; Pew Research Center, nd). The state with the lowest rate of acceptance, Arkansas (~27%; Pew Research Center, 2013b), also has a high percent of adults who believe the Bible is the word of God (51%; Pew Research Center, nd). The sample population for this study from Iowa, scoring around middle in both acceptance (~40%; Pew Research Center, 2013a) and belief (30%; Pew Research Center, nd).

The most common religious narrative in the States, the Bible, is the one common factor among all Christian Creationists. Literalists believe scripture is an accurate, inerrant account of the world. Within this group are biblical fundamentalists and progressives. Progressives use biblical rationale and scientific arguments for Creationism. Fundamentalists are strict in Biblical interpretation while progressives, while still literalists, are more flexible. Fundamentalists and progressives are at odds with each other because they feel the other's argument allows for acceptance of some form of evolution (Alters & Alters, 2001).

<u>Non-Religious Factors Affecting Acceptance of Evolution</u>

Non-religious factors affecting acceptance of evolution include authority figures, understanding of genetics, understanding scientific theory, student attitude, misconceptions, and what is taught in high school (Athanasiou & Papadopoulou, 2012; Crawford, Zembal-Sual, Munford, & Friedricksen, 2005; Evans, 2001; Miller et al., 2006; Moore & Cotner, 2009; Nadelson & Southerland, 2012; Rosengren et al., 2012; Sinatra et al., 2003; Woods & Scharmann, 2001).

Woods and Scharmann (2001) studied 518 high school students and found the number one factor for not accepting evolution was religious beliefs. The second: guidance from close relationships (parents, friends, etc.). This is the relationship between students and parents, teachers, friends, and other authority figures. Many students aligned their acceptance to that of an authority figure in their life. On an individual level, thinking dispositions, along with religious practice, have a positive correlation with acceptance (Athanasiou & Papadopoulou, 2012). Perry (1968) also identified students defined their by worldviews defined by an authority figure. Sinatra et al. (2003) found similar results with open-minded students with sophisticated epistemological views being more likely to accept evolution. The third factor was the media and presenting evolution facts as flawed.

Another factor affecting acceptance of evolution is a strong understanding of genetics, which leads to higher acceptance (Miller et al., 2006). An understanding of evolutionary mechanism is also important, such as understanding of micro- and macroevolution. "*Microevolution* is biological changes within a population over the short term and define *macroevolution* as essentially the outcome of evolution over the long

term that results in the development of new species or 'broader taxonomic grouping'"

(Nadelson & Southerland, 2012, p.6).

Many instruments used to measure student acceptance of evolution just focus on

microevolution (Nadelson & Southerland, 2012). The public and students tend to accept

microevolution easier than macroevolution and human evolution, which affects the

overall validity of an instrument that assesses acceptance of evolution.

In a study analyzing understanding, Crawford et al. (2005), evaluated 21 pre-

service science teachers used a software program to learn about the nature of science

through the topic of evolution. Pre-tests about evolution and the nature of science showed

naïve, incomplete understandings in both majors and non-majors (two were even

graduate students with research experience). The researchers believed that this lack of

understanding about how to develop theories and solve problems came in part because of

previous learning experiences. This may be because the instructor did not have the

pedagogical knowledge to engage students in investigations like scientists, such as using

an inquiry-based classroom. Teaching in a way similar to how scientific problems

investigate is especially important in teaching evolution. This is because Darwinian

evolution is counter-intuitive, as seen with the Evans (2001) and Rosengren et al. (2012)

studies, and many students end up holding alternative scientific concepts simultaneously

with scientific ones.

Another reason was due to student attitude. Three of the nine non-biology

teaching students did not feel like evolution was relevant to their future teaching career

and did not work to change their misconceptions. In conclusion, this study pushed for a

change in how we teach evolution to all students and the importance of not postponing instruction to upper level science courses (Crawford et al., 2005).

According to a study done by Rosengren et al. (2012), transformational evolutionary concepts taught to 45 high and college age students were to correct misconceptions about evolution. Between a pre- and post-test, 76% of the participants increased their scores by 1 or more point, 49% increase their scores by 5 or more points, and 27% increased their scores by 10 or more points. The tests were scored on a 3-point scale with 30 being the maximum score (actual maximum among participants was 27). A teaching intervention over a 15-week semester targeted common areas of student misconceptions about evolutionary theory such as:

1. "Species are stable and immutable and so can't change

2. Species have sharp boundaries, and so there are no intermediate categories

3. Species members are homogeneous, and so variation either doesn't exist, or exists only with respect to superficial features

4. Causes inherent in individuals, so change must take place within the individual

5. Species have ideal forms, and so evolutionary change progresses in the direction of that ideal" (Rosengren et al., 2012, p. 14)

Although the focus was on microevolution and only touched on macroevolution (speciation and domestication), students were able to apply their knowledge of micro to their preconceived ideas about macro. This spontaneous transfer may be due to the interrelatedness of microevolution to macroevolution.

According to Moore and Cotner (2009), what high school biology teachers present for evolutionary theory has a long-lasting impact on their students. This includes teaching Creationism in lieu of or supplementary to biological evolution. When students reach the college level, they are more likely to align their acceptance of evolution to learning in high school. Based on undergraduate students, just under half of their sample (728) were taught some form of Creationism in high school or neither evolution nor Creationism (Moore & Cotner, 2009). Between 60% and 74% of those exposed to biological evolution accepted evolution according to survey statements (Moore & Cotner, 2009). Those taught Creationism or those lacking prior evolution education scored intermediately on the MATE, indicating a rejection of evolution (Moore & Cotner, 2009). This creates a challenge to college professors when initiating assimilation and accommodating among undergraduates who have had incomplete evolution education.

Factors Not Affecting Acceptance of Evolution

Some commonly researched topics have shown to have no significant relationship include understanding of the nature of science, knowledge and understanding of evolution, race, and sex (Pew Research Center, 2013b; Rutledge & Sadler, 2011; Sinatra et al., 2003; Woods & Scharmann, 2001).

A study administered the Diagnostic Survey of Scientific Thinking (DSST), a 42 item Likert-type instrument followed by the Measure of Acceptance of the Theory of Evolution (MATE) to 172 non-biology-major college students the first day of an evolutionary science course (Rutledge & Sadler, 2011). The results indicate a moderate

understanding of scientific theory and no significant correlation between evolutionary and other major science theories.

A study of 93 non-biology- major undergraduates, employed a 2-tiered method to discerned the relationship between knowledge and understanding of evolution (Sinatra et al., 2003). The first tier included "Understanding Biological Change" (UBC) while the second tier was "What Do you know about Photosynthesis and Respiration?" (P&R, 91 item total). The results indicate no significant relationship between understanding of animal or human evolution and acceptance of biological evolution.

A study by Woods and Scharmann (2001) explored understanding and acceptance as well as demographic factors. In this study, 518 freshman through senior high school students took three instruments: Grouped Assessment of Logical Thought (GALT), the Locus of Control in Science (LOCIS) and the Woods-Scharmann Evolution Inventory (AE) followed by a post-questionnaire interview to explore perceptions of evolutionary theory (Woods & Scharmann, 2001). The data supported the hypothesis that students generally had little understanding of evolution and their perceptions regarding acceptance varied. Most students are in Perry's state of dualism and either reject or accept evolution based on an authority opinion. Furthermore, within this population, race, sex, grade, and teacher were not factors in acceptance of evolution.

Pew Research Center (2013b) explored gender and acceptance of evolution with a larger population in a landline telephone study consisting of 1,983 adults across the nation with a sampling margin of +/-3.0 percentage points and a 95% confidence interval.

According to the study, men are somewhat more likely than woman to accept human evolution. The use of "somewhat" is not a statistical significant in this case.

There was also no significant difference in acceptance of evolution when addressing whether the evolutionary process applied to humans or animals (Pew Research Center, 2013b; Sinatra et al., 2003). Although, studies provide conflicting results as to whether or not acceptance and understanding correlate there are others who have found a correlation between acceptance and understanding with different instruments (Rutledge & Warden, 2000; Nadelson & Sinatra, 2009). These instruments measure acceptance and understanding differently and within different populations.

Student acceptance of evolution is affected by both religious and non-religious factors. Religious factors include worldview, denomination, and belief in scripture (Alters & Alters, 2001; Hewlett, 2004; Miller et al., 2006; Pew, 2013a; Pew, 2013b; Pew, 2014b; Robinson, 1995; Reiss, 2009; Robinson, 1995; Rosengren et al., 2012; Sproul, 1979; Tharoor, 2014; Wilson, 1991; Woods & Scharmann, 2001). Non-religious factors include authority figures, understanding of genetics, understanding of scientific theory, student attitude, misconceptions, and what is taught in high school (Athanasiou & Papadopoulou, 2012; Crawford et al., 2005; Evans, 2001; Miller et al., 2006; Moore & Cotner, 2009; Nadelson & Southerland, 2012; Rosengren et al., 2012; Sinatra et al., 2003; Woods & Scharmann, 2001). Factors that do not affect acceptance of evolution include understanding nature of science, knowledge and understanding of evolution, race, and sex (Pew Research Center, 2013b; Rutledge & Sadler, 2011; Sinatra

et al., 2003; Woods & Scharmann, 2001). These factors should be taken into account when science teachers approach the topic of evolution.

<div align="center">Research Questions</div>

There is a gap in literature about how undergraduate student interpretation in scripture influence acceptance of evolution, controlling for the factors previously addressed (major, race, sex). This study will help science teachers understand factors that affect acceptance of evolution to teach effectively. In the classroom, teaching evolution is important to understanding biology completely (National Science Teachers Association, 2013). It is important to understand student beliefs in order to address them as separate from scientific acceptance. When students to explain how the world works quote scripture, teachers receive a teachable moment to discuss the nature of science and its role in the natural world (Alters & Alters, 2001).

The focus of my research includes three questions:

- What are the differences in Christian denominations on acceptance of evolution?

- What are the differences on the acceptance of evolution in groups of people that have a literal interpretation of scripture?

- In what ways do students describe the relationship between acceptance of evolution and religious worldview?

CHAPTER 3

METHODOLOGY

Question Development

This research came about from an interest in the relationship between religion and science within the classroom. I received an undergraduate degree in biology with a minor in religious studies and later went on to pursue my masters in science education. I noticed from conversations with other students in my science teaching classes that many did not accept biological evolution for religious reasons. How did this religious perspective play a role in the classroom?

Teaching evolution has continued to be a hot button topic and I wanted to find out why. The more research I did about the issue of teaching evolution in the public classroom, the more I realized it was all about perspective and the lens in which you view the world. As science educators, our job is to teach students about the world of science, even the parts that are not easy to accept. As we are taught in our teacher education classes, conceptual change is very hard. As educators, we must have both the knowledge and conviction to teach evolution in its whole and omit our own personal beliefs. By understanding the issues and perspectives associated with teaching evolution, we as educators can better anticipate the hesitations and questions of our students.

Instrument

This study used a mixed methods approach that allows for the comparison of easily quantifiable information (acceptance of evolution) to more non-tangible perspectives (belief in scripture). To answer our research questions, a heavier emphasis is

on the quantitative data. This embedded mixed methodology allows for use of qualitative data to support the quantitative data (Efron & Ravid, 2013).

I created a digital questionnaire through Qualtrics® (Qualtrics, Provo, UT) that students accessed using during class times electronically. The questionnaire began with general demographic questions for a secondary study. This information was collected as part of a larger study and information not pertaining to this study was removed before I received it for analysis. The only identifier that remained was a random code assigned to each participant by the Qualtrics® software to track participant responses.

Respondents answered several questions about their religious affiliation and religious worldview (see Appendix B for demographic questions). These questions were adapted from Pew surveys on religion and literal interpretation of scripture (Pew Research Center, nd). Because I anticipated most of the population to be Christian (Pew Research Center, nd), other world religions were not included in a dropdown menu featuring choices, but participants had the option to write in a religion or worldview. Participants who identified as being atheist, agnostic, or "nothing in particular," had an option of writing an identification. After initially selecting a religion, options to affiliate with a denomination or church came available. One notable exception was if participants originally responded "Roman Catholic." According to Pew, there were no further denomination categories, so those individuals classified as Catholic for the remainder of the study. Again, there was an option to write in "something else" for denomination or to check "nothing in particular."

Following the religious identification questions, participants were asked their views on interpretation of scripture and if they knew and agreed with their religion's official stance on evolution. Finally, participants qualitatively described whether their religious worldview allowed them to accept evolution. These religious demographic questions precede the section measuring acceptance of evolution.

The Inventory of Student Evolution Acceptance (I-SEA) instrument (Appendix C), is a questionnaire designed to measure the degree of acceptance of evolution (Nadelson & Southerland, 2012). The inventory contains 24-items on a Likert-like scale that addresses the level of acceptance of evolution in three categories (microevolution, macroevolution, and human evolution). The total maximum score, when giving Likert-scale responses as 1-5, was 125. By looking at all three areas of evolution, the I-SEA aims to identify the "tipping point" of when individuals start accepting human evolution as a natural act (Nadelson & Southerland, 2012).

The instrument was field tested and validated with high school and undergraduate students. The final instrument has a reliability of Cronbach's alpha of 0.95 (n = 344) overall. For macroevolution, Cronbach's alpha was 0.90, microevolution 0.90 and human evolution was 0.94, which indicates a high level of reliability and item stability. There was a significant positive correlation ($p < 0.01$) between the three subscales. With this instrument added to the religious demographic questions, most students completed the questionnaire between 6 and 12 minutes.

Participants

I chose the participants for this study based on major and convenience. The population included freshman elementary education majors in Inquiry into Science courses at a regional Midwestern university. Initially, 246 participants started the survey. Of those, only 223 completed it. Because my target population was incoming freshman, all students who graduated high school before 2014 were removed, leaving 79 participants. The questionnaire administered within the first week of class.

Ethical Considerations

Because this research involved human participants, ethical treatment included following many guidelines. I obtained permission for the study from the University's IRB department prior to conducting research (see Appendices D, E, and F for IRB approval correspondence). When administering the survey, participants heard a script (Appendix D) about the nature of the study including their participation as optional and that their responses are confidential. Participants digitally signed and read the informed consent (Appendix H) at the beginning of the questionnaire. Participants received a hard copy of the informed consent to contact the research team, if they wished. Although there was no danger to the welfare or wellbeing of participants, subject matter had potential to be uncomfortable to read and reflect on, as stated in the informed consent (Creswell, 2014). In regards to political correctness within the survey, there was non-bias in the wording of the survey to include all major religions and scripture categories.

Because members of the research team had contact with some of the study population, measures were taken to ensure those administering the survey had previous contact with the sample population to exercise any influence. Respect toward the participants included privately answering any questions before, during, and after the study. Additionally, neither punishment nor reward for participation occurred. A step to ensure this was asking the instructor to step out of the room when the study is taking place so they were unaware of who participated.

<div align="center">Instrument Administration</div>

The research team collected data within the first week of class before University evolution education occurred. The team administered data to populations they had no previous contact. After the IRB information was read, distributed, and signed, students took the online survey. Participants had unlimited time, but finished within 20 minutes. The survey responses automatically uploaded into Qualtrics® for coding.

<div align="center">Data Coding</div>

Denominational Acceptance

Because questions 1-11 were for another study, coding started at question 8. Questions 8 and 12 asked: "What is your present religion, if any?" and "As far as your present religion, what denomination or church, if any, do you most identify with? Please specify denomination, church, or branch." For question 8, participants could chose Protestant, Roman Catholic, Something Else, Atheist, Agnostic, or Nothing in Particular. Those who answered Something Else had a follow-up question to write in their affiliation. I removed those who wrote in Protestant denominations because it could have

reflected confusion about religious affiliation over denominational identification. This affected the integrity of the participant's response. Those who identified as Atheist, Agnostic, or Nothing in Particular answered whether they identified as Christian. I removed these participants because of the small sample size. The subgroups in the Protestant category were too small to analyze statistically so comparisons made were between major groups of Protestant and Roman Catholic samples only.

Literalist Acceptance

To ascertain participant perspective on religious text, question 13 asked, "What comes closest to your view?" and gave three options, as seen in the top row of Figure 1. Question 14 asked, "If you believe religious texts are the word of God, would you say that religious texts:" and gave two options as seen in the left column of Figure 1. Combination and coding of Questions 13 and 14 represent participant viewpoint on religious text. For example, those who responded "religious text is the word of God" might also have answered that "religious text should be taken literally, word for word." A coding key combining both answers is in Figure 1.

			Which comes closest to your view?		
			The word of God	Written by humans and is not the word of God	Word of God interpreted by humans
			1	2	3
If you believe religious text is the word of God, would you say religious texts:	Is to be taken literally word for word	1	1	X	4
	Not everything should be taken literally	2	2	3	5

Figure 1. Coding of Answers to Religious Text Interpretation

I removed those who responded "religious text is written by humans and is not the word of God" (3) because they did not receive the follow-up question to explain their reasoning. I also discarded the unexpected responses of "religious text is the word of God interpreted by humans" and "taken literally word for word" (4) because of the small sample size.

Religious Worldview and Acceptance

Answers to question 15 ("Based on your religious worldview, is it possible to accept biological evolution? Please explain") coded into six major themes, which are further broken down into 16 subcategories. After reading a handful of responses, there were two parts within answers: a continuum of agreeing to disagree with whether it is possible followed by reasoning. The categories were then made of "Yes," "Yes, but," "No," "Possibly," and "Depends." Those who were coded as "Yes, but" said they

accepted the possibility of a coexistence but only accepted certain parts of evolution. All of the secondary responses were coded numerically using 16 subcategories based on the frequency of the theme (more than one theme can occur in a narrative):

1. School taught current viewpoint

2. Background knowledge dictates current viewpoint

3. Religious view/faith dictates current viewpoint

4. Bible dictates current viewpoint

5. The two can coexist

6. Human evolution is mentioned

7. God created

8. Earth/humans too complex to be random

9. God created and is actively guiding

10. Science proves God

11. Evidence of change over time

12. Young Earth Creationist reasoning

13. Evolution is logical

14. Not enough evidence for evolution

15. Open to learning about evolution

16. Not sure

After reviewing the narratives several times, it became clear that the frequency of the themes gave valuable insight into participant reasoning. Unfortunately, the large number of subcategories does not qualify for accurate analysis. After independently

coding responses, I met with a committee member for confirmability. We went through each narrative to ensure objectivity and categorized into major themes as they emerged. We discussed differences between categorizations until we came to a similar result.

The agreed themes were "accepting" or "rejecting evolution" based on "correct science" or "incorrect science." Participants who did not mention science became "acceptance based on no science" or "rejection based on no science." If participant rejected any part of evolution, it counted as rejected because it is not possible to accept parts of scientific theory. I discarded answers not fully explained.

I-SEA

The I-SEA was coded according to the Likert scale of 1 = Highly Disagree and 5 = Highly Agree. Some of the questions on the I-SEA were reverse scored (Questions 20, 24, 27, 31, 32, 34, 37, 38, and 41), or negative, to validate the instrument (see Appendix I for reverse coded I-SEA data). The macroevolution scale included seven questions (Q19-26), the microevolution scale included eight questions (Q27-35), and the human evolution scale included seven questions (Q36-43).

Statistical Analysis

Denominational Acceptance

The first research question, "What are the differences in Christian denomination on acceptance of evolution?" was answered by comparing average religious denomination responses (Protestant and Roman Catholic) to average I-SEA scores using a *t*-test (Table 3 explains all questions and analysis).

Table 3

Explanation of Data Sources to Answer Research Questions

Research Question	Data Source 1	Data Source 2	Preformed
What are the differences in Christian denominations on acceptance of evolution?	What is your present religion, if any? Please specify denomination, church, or branch.	I-SEA	*t*-test, Levene's Test for Homogeneity
What are the differences on the acceptance of evolution in groups of people that have a literal interpretation of scripture?	What comes closest to your view? If you believe religious text is the word of God, would you say that say religious text:	I-SEA	ANOVA (3x4), Tukey's Post-Hoc
In what ways do students describe the relationship between acceptance of evolution and religious worldview?	Based on your religious worldview, is it possible to accept biological evolution? Please explain.	N/A	Emergent categories

<u>Literalist Acceptance</u>

Comparing religious text responses with results of the I-SEA answered the second research question, "What are the differences on the acceptance of evolution in groups are of people that have a literal interpretation of scripture?" First, I ran a Levene's test to check remaining responses for homogeneity. Similar amounts of variance occurred within the groups and qualified for statistically comparison.

Respondents that answered at either end of the spectrum were of interest:

- "Religious text is the word of God and is to be taken literally word for word" (1)

- "Religious text is written by humans and is not the word of God and not everything should be taken word for word" (2)

- "Religious text is the word of God interpreted by humans and not everything should be taken literally" (5)

I ran a two-way analysis of variance (ANOVA) comparing the average sum of the I-SEA scores and the mean coded religious text interpretations. A further analysis compared each category of the I-SEA (Macroevolution, Microevolution, and Human Evolution) to the scripture groups using Tukey's post-hoc test.

<u>Religious Worldview and Acceptance</u>

To answer the third research question, "What are the differences on the acceptance of evolution in groups of people that have a literal interpretation of scripture?" the emerging categories were analyzed qualitatively.

I-SEA

        Statistical software, IBM SPSS Statistics for Windows (IBM Corp., 2013), analyzed the I-SEA data. First, a skewness test evaluated the probability in distribution to determine whether the subcategories (Microevolution, Macroevolution, and Human Evolution) would be analyzed using parametric or non-parametric statistics. A Kendall's tau B non-parametric correlation analysis compensated for skewness found in the Microevolution subcategory (Field, 2009).

CHAPTER 4

RESULTS

<u>Denominational Acceptance</u>

The religious demographic from the population was mostly Christian. They were distributed as 46.8% Protestant, 30.4% Catholic, 2.5% atheist, 10.1% nothing in particular and 10.1% something else. Because the atheist, nothing in particular, something else and denominations within the Protestant sample were small, only Protestant or Catholic were included in analysis.

When looking at the unaffiliated, 10.1% identified as both nothing in particular and Christian. None of the atheists identified as being Christian (n = 2). Of those who identified as being something else, four wrote in that they were "Christian," one "Disciples of Christ," one "Evangelist," one "Baptist," and one "Nondenominational." These participants are not categorized Protestant because they did not first choose the Protestant category in the previous question and were too small to analyze by themselves.

Most Protestant denomination or churches identified as being Lutheran (25.3%) or nothing in particular (21.5%). Methodists (11.4%) and Nondenominational affiliates (11.4%) made up the third largest groups. Of those who identified as something else, one said none in particular, two were something else, one was Disciples of Christ, one was Church of God, two were Nondenominational, and one was Baptist. Two wrote in as being Bethany Alliance and Apostolic.

Religious Affiliation and I-SEA, *t*-test

Protestants had a similar mean score on the I-SEA (80.45) to that of Roman

Catholics (81.70). Levene's test for homogeneity revealed similar amounts of variance.

A *t*-test showed that t(75) = -0.444,*p* = 0.658. Breaking the Protestant group into

denominations and/or churches, the differences are observationally noteworthy but were

not analyzed because of the varying sample size within for each category. For example,

Pentecostal had a n = 1 while Lutheran had a n = 20 (See Table 4).

Table 4

Descriptive Statistics for Denomination and I-SEA Mean Scores

	Scores			
	f	*Range*	*Mean*	*SD*
Baptist	2	14.0	70.0	9.9
Methodist	9	25.0	84.3	8.1
Lutheran	20	38.0	84.6	10.6
Presbyterian	3	6.0	85.0	3.0
Pentecostal	1	.0	85.0	.
Church of Christ	5	35.0	80.4	15.3
Disciples of Christ	2	15.0	72.5	10.6
Reformed	1	.0	78.0	.
Church of God	1	.0	66.0	.
Nondenominational	9	33.0	75.4	10.6
Independent Church	2	22.0	77.0	15.6
Something else	7	44.0	75.7	14.6
None in particular	17	57.0	85.4	14.0

Literalist Acceptance

As seen in Table 5, the majority of participants believed that religious texts are the word of God (59.5%) while 32.9% believed religious texts are the word of God interpreted by humans, and 7.6% believed religious texts are written by humans and are not the word of God.

Table 5

Participant Response Regarding Source of Scripture

Question	*f*	*Percentage*
Religious texts (e.g. The Bible, Qur'an, Torah) are the word of God	47	59.5
Religious texts are written by humans and are not the word of God	6	7.6
Religious texts are word of God interpreted by humans	26	32.9
Total	79	100.0

Most participants believed that not everything in religious texts should be taken literally, word for word (74.7%). Only 17.7% believed everything should be taken literally, word for word. Some respondents did not volunteer data (7.6%; Table 6)

Table 6

Participant Response Regarding Interpretation of Scripture

Question	*f*	*Percentage*
Should be taken literally word for word	14	17.7
Not everything in religious texts should be taken literally,word for word	59	74.7
Missing	6	7.6
Total	79	100.0

Scripture Interpretation and I-SEA, ANOVA

I removed two coded groups (3 and 4) from the interpretation of scripture analysis because they were not the focus of the study. The remaining groups include:

- "Religious text is the word of God and is to be taken literally word for word" (1)

- "Religious text is written by humans and is not the word of God and not everything should be taken word for word" (2)

- "Religious text is the word of God interpreted by humans and not everything should be taken literally" (5)

After the interpretation of scripture categories were coded into three groups a test for normalcy looked for skewness. According to a Levene's test for homogeneity, all of the categories were homogeneous. Therefore, I ran a 3x4 ANOVA to compare the I-SEA sum scores across the individual categories. The ANOVA revealed significant results where $F(2,67) = 4.335$, $p = 0.017$. I ran a Tukey's post-hoc test to determine where the differences occurred (Table 7).

Table 7

Tukey's Post-Hoc Test of I-SEA Total and Subcategory Mean Score and Interpretation of Religious Text

Category	Response A	Response B	Mean Difference
Average for Macro	Word of God Literal	Word of God Not Literal	-.3242
		By Humans Not Literal	-.5786[*]
	Word of God Not Literal	Word of God Literal	.3242
Average for Micro	Word of God Literal	Word of God Not Literal	-.1449
		By Humans Not Literal	-.3419
	Word of God Not Literal	Word of God Literal	.1449
Average for Human	Word of God Literal	Word of God Not Literal	-.2629
		By Humans Not Literal	-.5212[*]
	Word of God Not Literal	Word of God Literal	.2629
Sum	Word of God Literal	Word of God Not Literal	-5.8561
		By Humans Not Literal	-11.5336[*]
	Word of God Not Literal	Word of God Literal	5.8561

*The mean difference is significant at the .05 level.

There was a significant difference in the Macro category, with "Religious text is the word of God interpreted by humans and should not be taken literally" being 0.5 points lower than "Religious text is the word of God and should not be taken literally" on a 5 point scale. In the Human category, "Religious text is the word of God interpreted by humans and should not be taken literally" was 0.52 points lower than "Religious text is the word of God and should not be taken literally." With the total mean I-SEA score, "Religious text is the word of God interpreted by humans and should not be taken literally" was significantly lower than "Religious text is the word of God and should not be taken literally," by 11.53 points of a 125 point scale.

Religious Worldview and Acceptance

Frequencies of Acceptance of Evolution Themes

I chose six major themes with only one theme chosen for each narrative (Table 8). Those who did not answer the question by giving a reasoning (e.g., "I guess, I'm not sure" or simply "Yes") were discarded which took the sample size from n = 79 to n = 72. On closer evaluation of this small population, it was possible to see a trend of higher average I-SEA scores (92.8, n = 11) among those who accepted evolution based on correct science than those who accepted evolution based on incorrect science (77.8, n = 15).

Table 8

Frequency of Acceptance and Rejection of Evolution Themes

Theme	f	Example
Reject, Incorrect Science	2	"No because I know that God made everything in six days meaning that dinosaurs and humans lived together."
Reject, Correct Science	1	"Based on my religious view, I believe that things can adapt to their surroundings, but I believe in the creation theory, not evolution."
Reject, No Science	15	"No it is not possible for evolution if I believe in God."
Accept, Correct Science	11	"Yes, I think that evolution has a lot of proof behind it and it is SCIENTIFIC proof, not just faith based."
Accept, Incorrect Science	16	"Yes because if we believe god created us we had to evolve from something, even he himself had to evolve from something"
Accept, No Science	27	"Yes, I think it's possible."

<u>Frequencies of Reasoning Themes</u>

   I categorized the narratives in emerging themes because of the descriptive nature. The items coded according to the frequency of the themes mentioned in the narratives, which means some fit into more than one category. I removed were those with no reasoning or confusing reasoning (Table 9).

Table 9

Frequency of Reasoning Themes

Theme	*f*	Example
School taught current viewpoint	1	"Yes. Being that I was raised in a Catholic school basically my whole life, I have always had been taught that science can come into play. My schools did not say they believed in science, but certain teachers touched base on science being a part of evolution. And, I have always thought that science plays a role in the biological evolution."
Background knowledge dictates current viewpoint	3	"I honestly don't know. I think that some form of evolution is possible but I don't have enough background knowledge to create a strong arguement."
Religious view/faith dictates current viewpoint	16	"I think that it is, but at the same time it isn't possible to accept biological evolution when it comes to certain parts in the religious view."
Bible dictates current viewpoint	10	"I think it could be accepted because, I believe, that there can be a lot of holes in the bible. For example, how are we all here? could a God who can not be seen really create such a place as this?"
The two can coexist	1	"I believe the views of evolution and creationism can coexist and be formed into one viewpoint. In the end it all comes down to putting faith in the unknown."
Human evolution is mentioned	11	"I think it is. Charles Darwin's theory of change I believe is correct, the stronger genes get passed down from generation to generation makes each generation more evolved than the previous one. I dont believe that humans are descendants of Apes but i do believe we are evolving with our genes and immune system."

Table continues.

Theme	_f_	Example
God created Earth/humans too complex to be random	27	"No. I believe that evolution is wrong. There is science to prove that God created the earth. I believe what the bible says in Genesis Chapter 1. God created the earth.""I find it hard to believe in biological evolution because of my faith. How can something like the human body be explained any other way"
God created and is actively guiding	7	"Yes it is possible, but it all evolves from God, who allows it to change. Nothing is possible of change without His guidance and will."
Science proves God	5	"No. I believe that evolution is wrong. There is science to prove that God created the earth. I believe what the bible says in Genesis Chapter 1. God created the earth."
Evidence of change over time	21	"No. I believe that living things can adapt to their enviornment, but I do not believe in evolution."
Young Earth Creationist reasoning	3	"No because I know that God made everything in six days meaning that dinosaurs and humans lived together."
Evolution is logical	5	"Yes, I think that logically it is more plausable that the evolution theory is how it all began rather than a God just creating this Earth and starting the beginning of mankind"
Adam and Eve	2	"Based on my religion, no. According to The Bible God created the man and used parts from man to create the woman."

Theme	f	Example
Big Bang	1	"I believe that it is possible to accept evolution within a species. For example, birds may evolove from having shorter beaks to longer beaks if the birds that are born with slightly longer beaks are the ones that are thriving in the environment and continue to breed with each other making subsequent generations have longer beaks. However I don't believe it is possible for a species to evolve from one to another, like reptiles and amphibians sharing a common ansestor or humans coming from monkeys or wherever they say we came from now. I believe that all of the different animals and people were creating uniquely and specificaly by God, and especially humans were made with great care and love by God, we didn't come from some ansestor or a big bang that gave way into single celled organisms that evolved to where we are today."
Single-Celled organisms	2	"Yes, but also no. Yes in the fact that even if there was a single cell organism in the beginning it had to be created somehow. However, no in the sense that in the beginning God created Adam and Eve."
Genes can evolve	2	"Yes, you get changes from your genes depending on what families you come from. I believe that you change every generation in your family. I do not believe in evolution, animals changing into humans."
Not enough evidence for evolution	1	"Yes, because you really do not know for sure."
Open to learning about evolution	2	"Yes because I don't take everything in the bible word for word and I'm open to learning about the idea of evolution."
Not sure	2	"I am not sure what biological evolution is."

I-SEA

The first two research questions compare I-SEA results, on each category (macro, micro, and human) as well as total average scores. Skewness tests performed on the sample evaluated the probability in distribution to determine whether the sample would be analyzed using parametric or non-parametric statistics (Table 10). A Kendall's tau B non-parametric correlation analysis compensated for skewness found in the Micro subcategory (Field, 2009). The correlation coefficients between Macro and Micro, tau = 0.466 where significance is $p < 0.001$, which is a significant positive correlation. The correlation between Macro and Human was tau = 0.586 where significance is $p < 0.001$, which is a significant positive correlation. Finally, the correlation between Micro and Human was tau = 0.463 where significance is $p < 0.001$, which is a significant positive correlation.

Table 10

Descriptive Statistics of I-SEA Categories

		I-SEA Score		
Questions	*f*	*Mean*	*SD*	*Skewness*
Macro (Q19-26)	7	3.38	0.61	-0.82
Micro (Q27-35)	8	3.88	0.49	-0.46
Human (Q36-43)	2	3.25	0.61	-0.59
Sum (Q19-43)	17	81.48	12.01	-0.43

CHAPTER 5

DISCUSSION

Denominational Acceptance

In response to the first research question (What are the differences in Christian

denominations on acceptance of evolution?), the initial results of the *t*-test showed no

significant difference between the mean scores of Protestants (80.45) and Roman

Catholics (81.70). Although there were notable differences within the Protestant

denomination groups, the small sample size for the subcategories meant inappropriate

statistical comparison to other subcategories (Field, 2009).

In general, fundamentalist Christian groups would have lower acceptance of

evolution, but was not confirmed statistically in this study (Pew Research Center, 2013b).

As an observation, a mean score (66.00) came from one person who identified as being

Church of Christ. The minimum score for the Lutheran category was 62.00 with a mean

of 84.33, but with 20 respondents. The range for the Lutheran category was 38.00 points,

which was the highest for the major denominations. The wide range between each

denomination's scores may support the idea that individual churches either promote,

reject, or do not discuss evolution regardless of official church stance (The Clergy Letter

Project, 2014).

Differences between the denominations may have occurred because of confusion

by what the questions were asking or participants did not identify with a denomination.

Several participants made conflicting responses to the questions about religion and

denomination (being both Catholic and Lutheran, n = 3; Catholic and Baptist, n = 1).

Instead of checking the correct religion some participants identified as "Something else" (n = 4) but wrote in "Christian." When it came to religious denominations, some participants identified as "Something else" and wrote in a response that was an option in the given list (n = 5). This contradiction may have been due to a misunderstanding about the different levels of identification within the Christian religion. Giving participants definitions of religion and denomination may minimize contradiction.

<div align="center">Literalist Acceptance</div>

As for the second question (What are the differences on the acceptance of evolution in groups of people that have a literal interpretation of scripture?), there was a statistically significant difference between the extreme interpretations of religious text. The mean scores for "religious text is the word of God and should be taken literally" compared to "religious text was written by humans and should not be taken literally" reflected that those who took the Bible literally scored lower on the I-SEA than those who did not take the Bible literally. Expectation from research into creationism supports using the Bible as a justification for viewing the science world with a religious lens (Answers in Genesis, 2014). Those who took the Bible literally may be in Position 1 of Perry's framework (1968) where an authority is in regard for answers and the current schema not challenged. The authority in this case would be the Bible or religious instruction based on the Bible that created a religious worldview for the participant. Like acceptance of evolution, views on interpretation of scripture may vary from church to church. In general, God gave humans scripture but it is more a guide than a literal and historical account (Pew, 2014b). Of those surveyed, 17.7% believed that scripture was the

word of God, taken literally, word for word. Some churches provide a literal interpretation of scripture in their mission statement, but that may or may not be reflected in their practices and teachings. As stated in the literature review, the Catholic Church officially accepts evolution while the more fragmented Protestantism churches vary.

For example, Bethany Alliance and Apostolic Church were denomination write-ins. Both Bethany Alliance and Apostolic are Protestant churches whose mission statements reflect a literal interpretation of scripture (Bethany Alliance Church, 2008; The Christian and Missionary Alliance, 2014; Apostolic Christian Church of America, 2014). Contradictory to the church's mission, the respondent from Bethany Alliance believed scripture is the word of God, but not be taken literally. Meanwhile, the respondent from Apostolic church believed that scripture was the word of God interpreted by humans and be taken literally word for word. Similar to acceptance of evolution, it is easy to make assumptions about participants based on their church's mission, but this does not accurately reflect the individual's interpretation of scripture.

<u>Religious Worldview and Acceptance</u>

The final research question (In what ways do students describe the relationship between acceptance of evolution and religious worldview?) incited a variety of responses. Most participants did not fully answer the question and responded with an acceptance or rejection with no reasoning (n = 27 and n = 15, respectively), which could have been due to how the question was worded. An unintended consequence of this question was an informal demonstration of scientific understanding of evolution based on the reasoning given.

There are studies that state understanding and acceptance are not connected and may have created a lens for me when initially viewing this data (Pew Research Center, 2013b; J. Demastes, personal communication, February 18, 2014). On closer evaluation of this small population, it was possible to see a trend of higher average I-SEA scores (92.8, n = 11) among those who accepted evolution based on correct science than those who accepted evolution based on incorrect science (77.8, n = 15). Two respondents accepted evolution without scientific reasoning. Although this observation is anecdotal, it may add to the argument of association between understanding and acceptance (Rutledge & Warden, 2000; Nadelson & Sinatra, 2009; Nadelson & Southerland, 2012).

Of those who accepted evolution based on incorrect scientific reasoning (n = 16), all reflected a Creationist view. There were 24 mentions of God being the Creator of Earth and/or humans, which is a common belief because of its intuitiveness (Evans, 2001). This finding in the study population is also consistent with Alters and Alters (2001) who argued that Creationist perspectives are the minority in the United States and with Miller et al. (2006) who reported that most Protestants' and Catholics' faith is not in conflict with evolution.

Those who cited acceptance due to incorrect science are demonstrating Perry's dualism (1968). For these participants, their religious worldview and scientific worldview can coexist because there is misunderstanding about the science behind evolution that does not contradict the religious worldview. The root of incorrect scientific understanding is unclear and could be a subject of future study.

All but one participant who rejected evolution and did not cite science did so on religious grounds. Interestingly, three Young Earth Creationist-type answers rejected evolution due to no science and incorrect science (e.g., "No because I know that God made everything in six days meaning that dinosaurs and humans lived together."). This religious lens was very strong for these individuals, so much so that one participant expressed that the "bible shouldn't be fit into sciences' timeline, but science should be fit into the bible's timeline." This resistance, consistent with Bloom and Weisberg's (2007) findings, can create a challenge to instructors who teach for understanding of biological evolution.

To understand fully the differences in Christian denominations on acceptance of evolution, participants identified if they knew their religion's official stance and if they agreed. Many did not know their religion's official stance (n=34), but of those who did, most agreed with it (n = 24). Surprisingly, only nine of those participants thought their religion accepted evolution while 15 thought their religion rejected evolution. From the Clergy Letter and other official statements, in general, Roman Catholicism and most Protestant denominations accept biological evolution (The Clergy Letter Project, 2014; Pew Research Center, 2014b). There may be a lack of communication or differences at the church level, which lead participants to believe that their religion officially rejected evolution. There were some contradicting answers such as "I do not know my religion's official stance and I agree with it." Allowing participants to skip the follow-up question about agreement or disagreement could have avoided this.

An anecdotal analysis based on perceptions of their religious worldview broke the population down further. Those who thought their religion rejected evolution and they agreed with it, reasoned their rejection by only using religious and no scientific reasoning (n = 8). Interestingly, four participants who stated they agreed with their religion's rejection reasoned that they accepted evolution based on incorrect science (n = 4). Again, this inconsistency may reflect a struggle between their religious worldview and their misunderstanding of science.

Of those who did not know their religion's official stance, 17 accepted evolution with no scientific reasoning, perhaps they did not have a foundation for a religious or scientific worldview that contradicted the acceptance of evolution. Some participants did not know their religion's official stance but accepted evolution based on incorrect science. In this case, they may not have had a conflicting religious worldview but may have had a misunderstanding about the science behind evolution. Only five of those who did not know their religion's official stance accepted evolution using correct science. These individuals may not have a conflicting religious worldview in which to compete with a scientific worldview based on a correct scientific foundation.

<u>Study Limitations</u>

Limitations of the study include small population size, reason behind student choice, and question wording. The questionnaire is for an average American population, which included world religions. Our small, Midwestern population was almost exclusively Protestants and Catholics. A large population size, such as including those in all freshman-teaching courses, would allow for statistically comparative denominations.

A second limitation entailed no reasoning behind most student choices. The narrative was the only opportunity to explain thinking. This would have been useful in understanding student perception of their denomination and religious teaching. A good questionnaire gives a snapshot into the participants' minds. While I did get a snapshot, a more comprehensive picture would have been helpful.

Finally, the wording of some questions may lead to misunderstanding. Examples include a lack of definition for denomination and evolution as well as incomplete answers within the narrative. The addition of definitions would have clarified what the question was asking. Have a two-part, open-ended, mandatory answer box for the narrative would allow for both agreement and reasoning.

Limitations of the I-SEA

The I-SEA was chosen over the more traditional choice, the MATE, because the MATE conflates understanding of specific content to actual acceptance of evolution. Although the MATE is both reliable and valid to measure acceptance of evolution in general (Rutledge & Sadler, 2007; Rutledge & Warden, 1999), the MATE does not allow for differences in microevolution, macroevolution, and human evolution (Nadelson & Southerland, 2012).

One limitation of the I-SEA is that the student's knowledge of evolution terminology and processes may affect the level of conflation of micro- and macroevolution. For example, language simplification in the questionnaire catered to general use. "Change over time" may mean 100 years to one person and 100,000 years to another, which could easily affect how they accept the construct.

Similar to the questionnaire, a second limitation is that of determining why students answered the way they did. One respondent said they believed in evolution from a single-celled organism that God created. In the I-SEA, the respondent then disagreed that complex organisms evolved from single celled organisms. It is difficult to determine why the respondent made that choice without an interview.

A third limitation is that there was no definite score of acceptance but more of a spectrum. Nadelson and Sutherland (2012) discussed the tipping point, but did not describe in terms of I-SEA score analysis. There are no definite numbers given by Nadelson and Southerland (2012) for when this tipping point occurred. This is because the scores are on a spectrum and not as a pass or fail evaluation. They highlighted that the more difficult to accept subcategories of Macro and Human evolution may be an indicator of the level of acceptance. To put this into perspective, if this were a grading scale from mean scores, Catholics would be at 64% proficiency and Protestants would be at 65% proficiency, which does not give a full picture of acceptance. Even though the mean score between Macro and Human were lower, they were not significantly different. This contradicts Nadelson and Southerland (2012) study in which acceptance of Macro and Human evolution were significantly different than Micro. This may be because the scale is not finely tuned enough to detect the subtle point differences among the categories for a small population. It may also be because understanding is the same for all categories and reflected in acceptance.

CHAPTER 6

CONCLUSION

This study explored the strong influence of a religious worldview on the

acceptance of evolution in a population of elementary education major freshmen at a

Midwestern university. The research is unique to this population but, in general, due to a

literal interpretation of scripture. It is difficult to say what the largest influencing factor of

acceptance was, but from the literature review, this may have come from the church and

other authority figures as well as the media (Woods & Scharmann, 2001). In addition, the

results of the narratives indicate a possible relationship between understanding of science

and acceptance. If schools taught biological evolution ineffectively or incorrectly (or

even correctly), students may hold a misunderstanding about what they are accepting or

rejecting (Miller et al., 2006; Nadelson & Southerland, 2012).

Significance and Future Study

The results of this study show students in this population have a perception of

conflict between faith and evolution and high rates of incorrect science or no science to

base acceptance. For science educators, student perception about personal faith and

biological evolution is important to effective science teaching. Knowing and effectively

teaching correct science is important for authority figures, such as science teachers.

There are common misconceptions based on this topic that could be target

objectives for lesson plans (Rosengren et al., 2012). According to Perry (1968), for those

with strong conflicting religious beliefs, a period of resistance may occur that instructors

prepare for. By keeping communication open and positive and by being aware that it may

take these students a year or more to accept a conflicting schema can combat resistance (Perry, 1968). When teaching about evolution, it is fundamental to create a strong foundation with a category that is easier to accept, such as microevolution. Difficult categories to accept, such as macro and human evolution, need a solid foundation (Rosengren et al., 2012; Nadelson & Southerland, 2012). More importantly, instructors hold an incredible amount of power and authority in student's eyes and carefully choose the language and attitude appropriate to the profession and the topic is paramount (Bloom & Weisberg, 2007). What high school biology teachers present of evolution has a long-lasting impact of student acceptance (Moore & Cootner, 2009). If the study is a snapshot of the population of students in Midwestern secondary classrooms, the results are call to action to address the effectiveness of correct science teaching. If students leave high school having learned incorrect science, the chances of accepting evolution may decrease. The narrative in questionnaire targeted student understanding while the I-SEA instrument targeted student acceptance. The thick descriptions of the narratives and scores of the I-SEA may hold a clue to the role of understanding in acceptance. If religious factors are the number one reason for evolution rejection, is it possible that understanding could be second (Woods & Scharmann, 2001)? The relationship between understanding and acceptance has mixed conclusions and be studied further.

This study explored student perspectives about religious beliefs and acceptance of evolution. Because this population is just beginning higher education, it may be worth doing a longitudinal study on how their acceptance has changed over time and based on

what factors. This would be especially useful as these majors complete their science courses that directly teach biological evolution.

Note that this study is not about religion versus science because religion and science have different roles to play. Rather, many reasons require religion and science remain separated. One reason is that people have a habit of picking and choosing what doctrine works for them. For example, each denomination of Christianity has chosen parts of the Bible they choose to accept while rejecting other parts. In science, you cannot accept parts of a theory and reject others; the theory as a whole is invalid without all of its parts. Many participants applied this picking and choosing from their religion to the theory of evolution. For those who have a Biblical literalist perspective, it is not possible to accept the correct scientific definition of biological evolution without rejecting literalist beliefs. It is imperative that science educators be credible sources that teach correct science while being sensitive to the learning process of students who hold fundamentalist beliefs.

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APPENDIX A

IMMANUEL KANT ON WORLDVIEW

There is a well-established connection between student belief in religious texts and acceptance of evolution. Although, there is a gap in literature regarding student "worldview," as defined by Immanuel Kant, on acceptance of biological evolution. The term *worldview* stems from Immanuel Kant's *weltanschauung*, which means a perception of the world gained empirically (Kant, 1987). Kant was a philosopher who lived near the end of the Enlightenment period and was best known for his thoughts on epistemology, ethics, and aesthetics. He made an important contribution to modern science by liberating it from theology through giving lectures and writing books. His writing masterpiece, from 1781, is entitled *Critique of Pure Reason* (Philosophers.co.uk, 2012).

APPENDIX B

DEMOGRAPHIC QUESTIONS

Questions 1-7 were part of a larger study and was not used for this project.

8. What is your present religion, if any? Are you: (Please check)

	Protestant (e.g. Lutheran, Presbyterian, Methodist, etc.)
	Roman Catholic
	Mormon
	Greek Orthodox
	Russian Orthodox
	Jewish
	Muslim
	Buddhist
	Hindu
	Unitarian Universalist
	Atheist
	Agnostic
	Nothing in particular
	Something else – please write in

8-11.

Yes	No		Question
			If atheist, agnostic, nothing in particular: would you consider yourself a Christian?

12. As far as your present religion, what denomination or church, if any, do you most identify with? Please check.

	Baptist
	Methodist
	Lutheran
	Presbyterian
	Pentecostal

	Episcopalian
	Church of Christ
	Disciples of Christ
	Congregational or United Church of Christ
	Holiness
	Reformed
	Church of God
	Nondenominational
	Independent Church
	Something else – please write in
	None in particular

13. What comes closest to your view?

    a.   Religious texts (e.g. The Bible, Qur'an, Torah) are the word of God

    b.   Religious texts are written by humans and is not the word of God

    c.   Religious texts are word of God interpreted by humans

14. If you believe religious texts are the word of God, would you say that say religious texts:

    a.   Is to be taken literally word for word

    b.   Not everything in religious texts should be taken literally, word for word

15. Based on your religious worldview, is it possible to accept biological evolution? Please explain.

16. Does your religion accept the theory of biological evolution?

    a.   Yes

    b.   No

    c.   I don't know

17. Do you agree with your religion's stance on evolution?

    a.   Yes

    b.   No

    c.   I don't know

APPENDIX C

I-SEA QUESTIONNAIRE (NADELSON & SOUTHERLAND, 2012)

For the following items, please indicate your agreement/disagreement with the given statements using the following scale:	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
1. I think that new species *evolved* from ancestral species.					
2. I think that the fossil evidence that scientists use to support evolutionary theory is weak and inconclusive.					
3. There are a large number of fossils found all around the world that support the idea that organisms *evolve into new species* *over time.*					
4. I think all complex organisms evolved from single celled organisms.					
5. I think that new species evolve from a lot of small changes occurring over relatively long periods of time.					
6. There is little or no observable evidence to support the theory that describes how one species of organism evolves from *a different*					

ancestral form.					
7. The forms and diversity of organisms have changed dramatically over time.					
8. I think that all organisms are related (or share a common ancestor).					
9. I think that organisms, as they exist now, are perfectly adapted to their natural environments and so will not continue to change.					
10. All groups of organisms will continue to change.					
11. There are a large number of examples of organisms that have undergone evolutionary *changes within the species* (i.e., antibiotic resistance in bacteria, production of new strains of the flu virus).					

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
12. Species were created to be perfectly suited to their environment, so they do not change.					
13. I don't accept the idea that a species of organism will evolve new traits over time.					
14. I think there is an abundance of observable evidence to support the theory describing how *variations within* a species can *happen.*					
15. *Species* exist today in exactly the same *shape and* form in which they always have.					
16. There is overwhelming evidence supporting the theory of evolution to explain how *variations in* a species *develop* over time.					
17. There is reliable evidence to support the theory that describes how humans were derived from ancestral primates.					
18. Although humans may adapt, humans have not/do not evolve.					
19. I think that the physical structures of humans are too complex to have evolved.					
20. I think that humans and apes share an ancient ancestor.					
21. I think that humans evolve.					

22. Humans do not evolve; they can only change their behavior.					
23. The many characteristics that humans share with other primates (i.e., chimpanzees, gorillas) can best be explained by our sharing a common ancestor.					
24. Physical variations in humans (i.e., eye color, skin color) were derived from the same processes that produce variation in other groups of organisms.					

APPENDIX D

IRB LETTER OF APPROVAL

Office of Research and Sponsored Programs

University of Northern Iowa

Human Participants Review Committee
UNI Institutional Review Board (IRB)
213 East Bartlett

Lauren Scherff
207 Brentwood Drive, #1
Cedar Falls, IA 50613

Re: IRB 15-0003

Dear Ms. Scherff:

Your study, **Exploring How First-year Experiences in Higher Education Influence Student Acceptance of Biological Evolutionary Theory** has been approved by the UNI IRB effective **7/23/14**, following an Expedited review of your application performed by **IRB member, Helen Harton Ph.D.** You may begin enrolling participants in your study.

Modifications: If you need to make changes to your study procedures, samples, or sites, you must request approval of the change before continuing with the research. Changes requiring approval are those that may increase the social, emotional, physical, legal, or privacy risks to participants. Your request may be sent to me by mail or email.

Problems and Adverse Events: If during the study you observe any problems or events pertaining to participation in your study that are *serious* and *unexpected* (e.g., you did not include them in your IRB materials as a potential risk), you must report this to the IRB within 10 days. Examples include unexpected injury or emotional stress, missteps in the consent documentation, or breaches of confidentiality. You may send this information to me by mail or email.

Expiration Date: Your study **approval will expire on 7/23/15** Beyond that, you may not recruit participants or collect data without continuing approval. We will email you an Annual Renewal/Update form about 4-6 weeks before your expiration date, or you can download it from our website. You are responsible for seeking continuing approval before your expiration date *whether you receive a reminder or not.* If your approval lapses, you will need to submit a new application for review.

Closure: If you complete your project before the expiration date, or it ends for other reasons, please download and submit the IRB Project Renewal/Closure form and submit in order to close our your protocol file. It is especially important to do this if you are a student and planning to leave campus at the end of the academic year. Advisors are encouraged to monitor that this occurs.

Forms: Information and all IRB forms are available online at http://www.uni.edu/rsp/protection-human-research-participants

If you have any questions about Human Participants Review policies or procedures, please contact me at 319.273.6148 or anita.gordon@uni.edu Best wishes for your project success.

Sincerely,

Anita M. Gordon, Ph.D.
IRB Administrator

cc: John Ophus, Faculty Advisor

APPENDIX E

IRB AMENDMENT

Amendment to HP#15-0003

In response to my email discussion with Dr. Harton, we would like to add Heather Chamberlain on as a PI to HP #15-0003. She will be doing a project also using the same instrument as the one named in the proposal (I-SEA) but will be comparing to a series of short questions on biblical literalism. The survey will be given to the exact same population (will be administered for first time in both studies this fall), with the same risks and benefits as listed in the IRB document. The lone exception will be that Ms. Chamberlain will not be interviewing and providing interviewees with gift cards.

Amended documents, including the instrument, letter of consent and script are written below. Additions are highlighted.

APPENDIX F

IRB AMENDMENT APPROVAL

Anita,

Per our discussion, here's the amendment to Lauren's IRB proposal adding Heather as a PI and her questions to the instrument.

Thank you for your time,

John

Anita Gordon <anita.gordon@uni.edu>   Aug
                                                                                              6

to John, me, Lauren

Dear John, Heather, and Lauren:

This modification is approved. Please feel free to proceed.

Thanks!

Anita Gordon

Anita M. Gordon, Ph.D.
Director of Research Ethics
213 East Bartlett Hall
University of Northern Iowa
Cedar Falls, IA   50614-0394
(319) 273-6148 phone
(319) 273-2634 fax

APPENDIX G

QUESTIONNAIRE ADMINISTRATION SCRIPT

Myself or Faculty Advisor to research participants:

A) Purpose of the research: The purpose of this research is to study the correlation

between a literal interpretation of religious text and acceptance of evolution in

undergraduates.

B) General description of what the research will entail: To participate in this research,

you will be asked to complete a brief demographic questionairre as well as a 24-question

survey that asks basic questions regarding evolution at the beginning of the semester.

C) Contact information: If you have any questions during or after participation, please get

in touch with me.

Heather Chamberlain, hcransto@uni.edu or (319)610-9050. You may also contact my

faculty advisor: John Ophus, John.Ophus@uni.edu or (319) 273-3960.

APPENDIX H

INFORMED CONSENT FORM

Project Title: Biblical Literalism and the Acceptance of Biological Evolution in Christian

University Students

Name of Investigator(s): Heather Chamberlain

Invitation to Participate: You are invited to participate in a research project conducted through the University of Northern Iowa. The University requires that you give your signed agreement to participate in this project. The following information is provided to help you made an informed decision about whether or not to participate.

Nature and Purpose: This study is designed to evaluate the correlation between student belief in scripture on the acceptance of biological evolution.

Explanation of Procedures: If consent is given to participate, participants will be asked to complete a brief religious demographic questionnaire as well as a 24-item questionnaire that includes different statements regarding evolutionary theory at the beginning of the Fall 2014 semester during regularly scheduled class time.

Participants will not miss any regularly scheduled class and participation will not affect the participant's final grade in the course. If you choose not to participate, you will be given an alternative activity to complete while participants complete the questionnaires.

The purpose of the questionnaire is to determine the participant's religious affiliation and view of sacred scripture in relationship to acceptance of evolution.

All data collection will take place on the campus of the University of Northern Iowa. All data and accompanying information will be destroyed at the end of the study.

Discomfort and Risks: Risks to participation are similar to those experienced in day-to-day life. Participants may feel slight discomfort when reflecting on evolutionary theory.

Benefits and Compensation. There is no direct benefit for participant participation. Results from the research may benefit the field of study and ensure best practices for teaching students about evolutionary theory in a way that will further benefit students.

Confidentiality: Information obtained during this study, which could identify you, will be kept confidential. The summarized findings with no identifying information may be published in an academic journal or presented at a scholarly conference.

Right to Refuse or Withdraw: Your participation is completely voluntary. You are free to withdraw from participation at any time or to choose not to participate at all, and by doing so you will not be penalized.

Questions: If you have questions about the study or desire information in the future regarding your participation or the study generally, you can contact Heather Chamberlain at (319)-610-9050 or the project investigator's faculty advisor John Ophus at the Department of Biology, University of Northern Iowa 319-273-3960. You can also contact the office of the IRB Administrator, University of Northern Iowa, at 319-273-6148, for answers to questions about rights of research participants and the participant review process.

Agreement:

I am fully aware of the nature and extent of my participation in this project as stated above and the possible risks arising from it. I hereby agree to participate in this project. I acknowledge that I have received a copy of this consent statement. I am 18 years of age or older.

_____   _____
(Signature of participant)   (Date)

_____
(Printed name of participant)
_____   _____
(Signature of investigator)   (Date)

_____   _____
(Signature of instructor/advisor)   (Date)

APPENDIX I

I-SEA QUESTIONS FOR REVERSE CODING

(NADELSON & SOUTHERLAND, 2012)

Macroevolution	
Question	*Construct*
20	I think that the fossil evidence that scientists use to support evolutionary theory is weak and inconclusive.
24	There is little or no observable evidence to support the theory that describes how one species of organism evolves from a different ancestral form.
Microevolution	
27	I think that organisms, as they exist now, are perfectly adapted to their natural environments and so will not continue to change.
31	Species were created to be perfectly suited to their environment, so they do not change.
32	I don't accept the idea that species of organism will evolve new traits over time.
34	Species exist today in exactly the same shape and form in which they always have.
Human Evolution	
37	Although humans may adapt, humans have not/do not evolve.
38	I think that physical structures of humans are too complex to have evolved.
41	Humans do not evolve; they can only change their behavior.

Question 37 should be reverse coded. This was a clerical error on the part of the I-SEA's

authors