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ACCEPTANCE

This dissertation, HOW DO SCIENTISTS CROSS CULTURAL BORDERS BETWEEN RELIGION AND SCIENCE: A CASE STUDY, by CHESTER A. BARNER III, was prepared under the direction of the candidate's dissertation committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the College of Education, Georgia State University.

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ABSTRACT

HOW DO SCIENTISTS CROSS CULTURAL BORDERS BETWEEN RELIGION AND SCIENCE: A CASE STUDY

By

Chester Albert Barner III

The cultures of science and religion have had different levels of conflict throughout the past several hundred years due in part to the development of the theory of evolution. Although many ideas abound in science education as to the alleviation of this struggle, few studies have examined how scientists who profess religious beliefs deal with this conflict. In general, the study sought to understand the cognitive dynamic of the cultural interaction between the scientific and religious culture within a few individuals. Specifically, the study allowed scientists to explain how they found a measure of compatibility between their faith and their scientific endeavors. Within the boundaries of both the general and specific purposes for the study, the following research question was used:

> How do college science professors describe the interaction between their faith and their scientific knowledge in reference to their transitioning between a naturalistic or scientific understanding and a super-naturalistic or religious understanding?

Three theoretical lenses were used as backdrop to view the cultural interaction. World View (Kearney, 1984), Collateral Learning Theory (Jegede, 1995), and Faith Perspective in relation to the Stages of Faith Theory (Fowler, 1981) constituted the theoretical framework. Because of the qualitative nature of the research, the author used a modified naturalistic paradigm that stressed an emergent quality, grounded categorical design, and a modified case study written format that aided in the understanding of data generated

through multiple qualitative methods. Three overlapping themes emerged within the data that offer new insights not only into the complex nature of the conflict but also into the ways scientists themselves find a reason to have faith as well as scientific knowledge. Boundaries based upon a philosophical and world view difference, conflict due to culturally integrative ideas, and cultural bridges without distortion made up the overlapping thematic ideas that were consistently demonstrated by each participant. The insights demonstrated by this study may also enlighten the science education community to the importance of both culture and belief in reference to a meaningful learning experience in science.

HOW DO SCIENTISTS CROSS CULTURAL BORDERS BETWEEN RELIGION AND SCIENCE: A CASE STUDY

by
Chester A. Barner III

A Dissertation

Presented in Partial Fulfillment of Requirements for the
Degree of
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in
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Atlanta, Georgia
2011

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ABBREVIATIONS

MATE	Measure of Acceptance of Theory of Evolution
NOS	Nature of Science
PCA	Presbyterian Church in America
TOPE	Test of Preferred Explanations

CHAPTER 1

STATEMENT OF THE PROBLEM

Several years ago, a young student was having difficulty in my science class with resolving her knowledge of science with personal religious knowledge. She came to me one day after class with several questions regarding her conflict. I never gave her the right or one-size-fits-all answer that would alleviate all the difficulty that she was obviously having. I more or less allowed her time to discuss her issues with me and in that time establish a personal form of reconciliation. Similarly, in this study, ideas related to science and religion were also discussed by individuals who, like that student, have established personal reconciliation mechanisms to deal with cultural conflicts. Throughout history, science and religion has had a measure of conflict, in some cases because of the Theory of Evolution. This conflict is caused in part by the overlapping of ideas related to both science and society (Cobern, 1994), especially in relation to the origin of humanity. The science education community has sought solutions to the conflict in regards to making scientific knowledge more multicultural to students from varying backgrounds, including different religious backgrounds. This multicultural idea carries with it a connection to the idea of meaningful learning.

According to Cobern (1994), “learning takes place within socially held views of what is meaningful and significant” (p. 584). The idea of meaningful learning carries with it the connotation of a cultural connection. When there is no cultural connection or “when the culture of science is at odds with a student’s life world, science instruction will tend to disrupt the student’s worldview by trying to force that student to abandon or marginalize his or her life-world concepts . . .” (Aikenhead & Jegede, 1999, p. 274). This

disruption could then lead to learning that would be nonmeaningful for the student (Aikenhead & Jegede). Some students have a religious culture or community that they are involved in regularly. It is possible then for some of these students to have religious beliefs that are at odds with scientific instruction; thus, meaningful learning for those students would be difficult at best. The science education community looks for ways to provide meaningful instruction for all students. One possible way is in helping students transition across the cultural boundaries of science and religion.

Science education literature points to the idea that science instruction can transcend cultural borders of difference (Aikenhead, 1996, 1997, 2001; Aikenhead & Jegede, 1999; Jegede 1995, 1997a; Jegede & Aikenhead, 1999). Thus, science education can be better understood as the exchange of cultural ideas and does not necessarily have to be about the marginalization or abandonment of one culture in light of another. Studying professors of science themselves who have transitioned between religious faith and scientific knowledge can provide a greater understanding of this exchange of cultural information.

According to Geertz (1973), culture may be defined as a "historically transmitted pattern of meanings embodied in symbols, a system of inherited conceptions expressed in symbolic forms by means of which men communicate, perpetuate, and develop their knowledge about and attitudes toward life" (p. 89). Even though Geertz primarily deals with the culture of religion from an anthropological point of view, his definition also fits within the parameters of a scientific community or culture. Both scientific and religious cultures have transmitted meanings to their adherents over time. These meanings have been and are currently expressed symbolically in order to perpetuate knowledge that

affects the way people live. The religious culture espouses a super-natural understanding of reality while the scientific culture espouses a naturalistic understanding of that same reality. In other words, a religious culture that espouses faith in a god who really exists as the answer to many questions that concern humans is different from a culture that espouses naturalistic answers to many of the same questions.

The general purpose of this study was to understand better the interaction between these two cultures. Specifically, the purpose of the study was to understand how individual scientists who profess a religious background or connection reconcile their religious faith with their scientific knowledge. The following question guided this study:

> How do college science professors describe the interaction between their faith and their scientific knowledge in reference to their transitioning between a naturalistic or scientific understanding and a super-naturalistic or religious understanding?

This study offers the science education community a detailed interpretation of the manner in which a few scientists deal with many of the same issues that the general public deal with concerning the topic of science and religion.

In relation to the differences between the scientific and the religious cultures, science education has made great strides over the last few decades in espousing a culturally sensitive agenda. Cobern and Loving (2001) postulate the idea of "epistemological pluralism" (p. 63) or an equal and respected voice among competing forms of knowledge. Epistemological pluralism does not mean that other forms of knowledge, such as religion, have an equal voice alongside science within the school science curriculum. Epistemological pluralism instead relates to the idea of the valuing of "knowledge in its many forms and from its many sources" (p. 63).

The culture of science is distinct from the culture of religion in that science offers explanations that are naturalistic instead of super-natural. Cobern and Loving (2001) explain that "science seeks to parsimoniously explain how things work, invoking only natural causes, and these explanations are woven into a system of *theoretical* thought" (2001, p. 59). This offers a distinct border between science and religion.

In light of this distinct border, the conflict between science and religion can be viewed as the noncomprehension of the different forms of knowledge. This cultural clash between science and religion in many cases centers on the topic of evolutionary theory. For example, in studies dealing with the topic of the teaching of evolution in the field of science education, some studies have suggested using the nature of science (NOS) in order to create a limit, boundary, or demarcation within and without the theory of evolution so it will likely be more accepted among students who have religious beliefs (Dagher & BouJaoude, 1997; Sinatra, Southerland, McConaughy, & Demastes, 2003). In regards to this boundary, Sinatra et al. wrote,

> In this line of reasoning, as students develop a more sophisticated understanding of the nature of science (NOS)—understanding the fundamental assumptions of science and its methodologies, limitations, and boundaries—they are also more prone to accept evolutionary theory. It has been argued that a firm grasp of NOS concepts allows students to compare knowledge frameworks, to understand how and why knowledge produced through science is different from their religious beliefs… (p. 513).

Thus, an understanding of NOS could be one avenue that allows students to transition between their religious faith and scientific knowledge.

According to Lawson and Worsnop (1992), the "strength of religious commitment contributes negatively toward an initial belief in evolution and to a shift toward evolution during instruction" (p. 165). One example of the idea of religious commitment creating a buffer against the full acceptance of evolution after instruction would be that students in

the Lawson and Worsnop study who seemingly took a more literal view of scripture would have difficulty leaving their religious beliefs after instruction concerning evolution. In other words, if a person truly believes in a literal creation story in which God made everything, including humankind last as His crowning achievement, in six 24-hour days, then the realization that evolution espouses humankind as a direct descendent of other animals over millions of years will conflict with that belief. The conflict then comes about when the culture of science espouses something that is quite different from what certain religious cultures agree upon and accept as knowledge to be passed down to succeeding generations. The culture of science in general puts forth the idea that humans came about through natural means while many religious cultures put forth the idea that humans came about through a special supernatural creative process. Thus, in the area of human origins, there appears to be a major difference in the understanding brought forth in both cultures and a clear conflict of cultural ideas can be seen.

This apparent conflict relates to the metaphysical alliances of each culture and the inability of accepting other cultural knowledge. In relation to the acceptance of evolution, Sinatra et al. (2003) speculated that "perhaps knowledge is linked to acceptance when the topic is perceived to be less controversial or less ambiguous" (p. 521). They also add that "it might be that knowledge is linked to acceptance when it is not linked to firmly entrenched beliefs" (p. 521). Entrenched beliefs correspond to an individual's world view and the metaphysical alliances that are incorporated in that view. The acceptance of an idea is related to meaningful learning. In order to understand the process of accepting certain forms of knowledge more clearly, this study explored the degree of cultural or

metaphysical differences with individuals who have a tremendous amount of scientific knowledge.

The Problem with Conflicting World Views

An impingement, meaning two areas in conflict, can be seen more clearly in the realm of science in regards to evolutionary theory and the culture of religion in regards to super-natural involvement in creation because of the world views that underpin each form of knowledge. According to Dagher and Boujaoude (1997), "Darwin's *Origin of Species* and the assumptions it endorsed for explaining the diversity of life forms did not just present a new explanatory framework" (1997, p. 430). It created the context of changing the basic idea of how humans thought about themselves and their environment (Mayr, 1982, as cited in Dagher & Boujaoude). It also did not just bring about the knowledge of a differing world view but a powerful alternative explanation for reality. According to Rudolph and Stewart (1998), the power of Darwin's theory

> lay in its ability to make sense of the disparate facts of the natural world, to unify phenomena across a wide variety of disciplines, and to provide naturalistic answers to questions previously thought unanswerable. The empirical evidence supporting Darwin's theory was overwhelming. . . . (p. 1074)

Why does this overwhelming scientific evidence create a conflict with certain religious ideas today? How does the interaction between the differing world views of science and religion modify each world view? The first step to answering these questions is identifying the differences between the scientific and religious world views.

The underpinning world views or philosophies of people not only help create a clear distinction between the culture of science and the culture of religion but may also give rise to the conflict itself. For instance, Mahner and Bunge (1996a)explain that

religion and science are incompatible in part because of certain assumptions that underlie both systems of thought. According to Mahner and Bunge,

> If there were no conflicts in the factual account of reality, there would still be incompatibilities at a deeper level: the set of metaphysical or ontological presuppositions of science and religion. As previously claimed, the ontology of science is a naturalist one, i.e., neither supernatural entities nor miraculous or lawless events are featured in a scientific metaphysics. (p. 110)

In another article published as a defense of their first article, Mahner and Bunge (1996b) explain the necessity of a naturalistic metaphysic for science:

> When we say that science *presupposes* materialism we mean something far stronger than just 'science entails materialism'. That is, we mean that science would be rendered *impossible* if scientists were to take any ontological assumption above and beyond naturalism seriously. . . . In other words, there is no point in doing empirical studies unless we presuppose the truth of naturalism. (p. 190)

The term "naturalism" (as defined at the end of this chapter) does carry the connotation of a world view that does not espouse supernatural involvement but naturalistic explanations for reality.

One scientific philosopher who operates within a naturalistic world view system and demands the hearers of science to modify existing religious ideas in light of Darwin's revolutionary idea is Daniel Dennett. According to Dennett (1995), "Darwin's idea [Theory of Evolution] is a dangerous solvent, capable of cutting right to the heart of everything in sight" (p. 521). For Dennett, this solvent will dissolve away many beliefs, including a traditional belief in God. The traditional Christian God or Jewish God, according to Dennett, "is, like Santa Claus, a myth of childhood, not anything a sane, undeluded adult could literally believe in. *That* God must be turned into a symbol for something less concrete or abandoned altogether" (p. 18). Dennett goes on to say that

> In due course, the Darwinian Revolution will come to occupy a similarly secure and untroubled place in the minds—and hearts—of every educated person on the globe, but today, more than a century after Darwin's death we still have not come to terms with its mind-boggling implications (p. 19).

Thus, Dennett feels that Darwinism or a world view based upon the evolution of life will one day purge preexisting notions of certain religious traditions. He also believes that refuting Darwinism would be the same as trying to refute the heliocentric solar system model. The implications for the theory are tremendous from his viewpoint and major modifications should be made to existing religious thought and culture today.

Why then would Daniel Dennett take more of a negative stance for faith in a personal creator or God in relationship to evolution by means of natural selection? He does so because evolution by natural selection shows that the mechanisms dealing with the speciation of all life, including humankind, are the result of natural processes. As far as Dennett is concerned, these natural processes explain the origin of humanity and the natural world. The previous above-mentioned statements by no means suggest a negative implication to science and evolution. However, they do suggest that those religious cultures that espouse a supernatural world view and seek for ultimate purpose and meaning in existence apart from the natural processes themselves will have to deal with the evolutionary theory. This lack of ultimate purpose in the evolutionary process itself also does not suggest that a person cannot construct ways to operate within both a religious and scientific culture. Several scientists do just that.

Keeping the idea of impingement in mind, some scientists have adopted more of a super-naturalistic world view while operating within the scientific and naturalistic culture. Francis Collins, a geneticist and "leader of the international Human Genome Project" (Collins, 2006, p. 2), is a proponent of theistic evolution, and he has found a

synthesis between his faith and scientific knowledge. (Theism and its relationship to evolution are defined at the end of this chapter.) Collins sees evolution and religion as compatible and views theistic evolution as a way to bring about the integration of "scientific and spiritual worldviews" (p. 201). In a similar view, Kenneth Miller (1999), a biologist from Brown University, proposes a synthesis between evolutionary theory and his theistic beliefs. Miller offers a balance between evolution and personal faith that at times borders on the philosophical. According to Miller,

> It is often said that a Darwinian universe is one in which the random collision of particles govern all events and therefore the world is without meaning. I disagree. A world without meaning would be one in which a Deity pulled the string of every human puppet, and every material particle as well. In such a world, physical and biological events would be carefully controlled, evil and suffering could be minimized, and the outcome of historical processes strictly regulated. . . . By being always in control, the Creator would deny His creatures any real opportunity to know and worship Him. Authentic love requires freedom, not manipulation. Such freedom is best supplied by the open contingency of evolution, and not by strings of divine direction attached to every living creature. (p. 289)

Both Collins and Miller have reconciled their scientific knowledge and religious faith, and both individuals have developed a singular world view framework that allows for both a naturalistic and super-naturalistic understanding of reality without apparent conflict or the complete marginalization of one cultural system in light of the other.

Conflict between science and religion has occurred in the past, and in some cases this conflict continues today. This conflict has taken place in part over the different scientific and religious world views. These two ways of viewing reality help demarcate science from religion. What is not true or apparent is the idea that individuals must choose one or the other world view to operate within. Both views of reality were studied using collateral learning, world view, and faith perspective as lenses to view the data that emerged from the qualitative design. All three ideas offered insight into the

understanding of the ways individuals learn to function in both cultures. However, collateral learning became the dominant means in which to view and interpret the data. The theoretical nature behind this framework to view the data will be summarized in the next section and explained as far as the relationship to science education in Chapter 2.

Theoretical Framework

Three lenses were used to interpret the findings for this study: collateral learning, world view, and faith perspective. All three aided in better understanding the resolution mechanisms for the individuals because they related somewhat to the ideas put forth by Jean Piaget. According to Snowman and Biehler (2003),

> Piaget believed that people are driven to organize their schemes in order to achieve the best possible adaptation to their environment. He called this process *equilibration*. But what motivates people's drive toward equilibration? It is a state of *disequilibrium*, or a perceived discrepancy between an existing scheme and something new. In other words, when people encounter something that is inconsistent with or contradicts what they already know or believe, this experience produces a disequilibrium that they are driven to eliminate. (p. 37)

Learning for the individual takes place then as a result of this ongoing process (Snowman & Biehler). It is in this striving for equilibrium that a resolution between the cultures of science and religion takes place.

The term "border crossing" has been used in several published articles in science education (Aikenhead, 1996, 1997, 2001; Aikenhead & Jegede, 1999; Brand & Glasson, 2004; Jegede & Aikenhead, 1999). Border crossing is a concept synonymous with the movement between a student's normal cultural world and the cultural experience of science (Aikenhead, 1996; Aikenhead & Jegede). The term "collateral learning" was first introduced by Olugbemiro Jegede (1995). According to Aikenhead and Jegede, they researchers sought to combine the idea of border crossings with the idea of collateral

learning, thereby offering a cognitive rationale of the way people can mentally transition themselves in the school science cultural experience and other lived experiences without doing harm to those daily cultures. According to Jegede (1995), collateral learning is "an accommodative mechanism for the conceptual resolution of potentially conflicting tenets within a person's cognitive structure" (p. 117). For Jegede, humans function in parallel domains or spheres brought about by competing explanations for reality. These explanations are also cultural and fit into a single world view for each individual (Jegede). If this is the general case, then humans learn to adapt and link differing spheres of knowledge together depending upon the community that the individual finds himself or herself operating in at the time.

Collateral learning is divided into four types that "are not necessarily distinct from each other. They are not to be viewed as compartmentalized but rather as a continuum within the learning of science concepts in a socio-cultural framework" (Jegede, 1995, p. 121). Jegede asserted that a student could have movement from least interaction to more interaction of schemata via the proper education (See Figure 1.). According to Aikenhead and Jegede (1999), the "Parallel" type of collateral learning fosters the idea of "compartmentalization" (p. 278), when a student will contextualize the use of differing cognitive frameworks. According to Jegede, because there is no contextual contact of schemata, then there would be no conflict between differing views. The "Simultaneous" type of collateral learning takes place "…when ideas from two world views about a particular concept are to be learned at the same time" (Jegede, p. 120). The "Dependent" type of collateral learning "occurs when a schema from one world view is presented to challenge another from a different world view to an extent that the declarative and

Parallel	Simultaneous	Dependent	Secured
No Interaction	Concurrent Interaction	More Interaction	Most Interaction
No Incompatibility	Schemata from two world views are learned at the same time.	Schema from a new world view modifies existing schemata.	One schema from one world view will reinforce another schema from a different world view.
Compartmentalization	Schemata are simultaneously assessed.	The new schemata do not destroy the existing world view or radically alter it.	Convergence of world views or explanatory frameworks
		Not usually conscious of conflict	Evaluation has occurred thus conscious of conflict.

Figure 1. Collateral Learning Chart. The information and much terminology on this chart comes from the research of Aikenhead and Jegede, (1999, p. 278) and Jegede, (1997b, pp. 69-71).

strategic knowledge permits a learner to modify existing schemata" (Jegede, p. 120). Finally, the "Secured" type of collateral learning takes place when the student "evaluates seemingly conflicting world views or explanatory frameworks and draws from them a convergence towards commonality" (Jegede, pp. 120-121). This type of collateral learning lies basically at the other end of the continuum opposite of parallel collateral learning with some form of resolution taking place between the conflicting schemata (Aikenhead & Jegede, 1999).

Three of the types of collateral learning can also be illustrated in light of a hypothetical example of a religious student who has more of a fundamentalist background confronting the idea of deep time in a science classroom. The student at first might keep the two different forms of knowledge completely separate using his or her learned ideas regarding science within the context of the science class and his or her ideas regarding religion as it relates to the age of the earth within the context of his or her

family and church. This would be similar to “Parallel” collateral learning. The student might also modify his or her religious beliefs in time without destroying them by simply looking at the days in regard to creation as nonliteral or not 24-hour days. This would be similar to “Dependent” collateral learning. The same student might in time become more aware of the conflict between religion and science in this realm and create more intricate forms of resolution, like looking at parts of his or her religious beliefs and finding a commonality with science. For example, the student might decide that the progression of life forms in the Biblical narrative is similar to the progression of life forms in the fossil record. This is similar to the idea of “Secured” collateral learning.

In reference to this study, collateral learning was viewed primarily in regard to two different ways. First of all, individuals compartmentalized different cultural ideas thereby alleviating possible conflict. Individuals also created zones of convergence by reinterpreting different cultural ideas in light of the opposing culture, thereby eliminating the appearance of conflict. Therefore, in my opinion, similar forms of “Parallel” and “Secured” collateral learning were viewed throughout the study.

World view offered insight in this study because it helped offer an understanding of the way individuals view reality. In other words, a scientist who has the ability to view reality both naturalistically or empirical evidence-based and super-naturalistically or faith-based has a world view that offers a basic understanding of the way the scientist resolves certain discrepant cultural ideas. According to anthropologist Michael Kearney (1984), “world view is the collection of basic assumptions that an individual or a society has about reality” (p. 42). Kearney thus creates a model of generalizations that a

researcher may use to analyze the assumptions that a culture or individual creates to design and maintain meaning.

Perhaps the best advantage for Kearney's (1984) theory of world view is in his theoretical model or in the way he builds a utilitarian construct that allows for the variety of world view systems that are present within and without human cultures and societies. Kearney builds what he calls a "*logico-structural integration*" (p. 52), which allows for assumptions to be made about reality and shows the interrelation of those assumptions and the outcome that takes place within the culture itself in the form of action and behavior. Kearney believes that the world view assumptions are in a relationship with the external environmental conditions in that the "human social behavior, social structure, institutions, and customs are consistent with the assumptions about the nature of the world" (p. 52). Likewise the world view assumptions are also mutually effected, organized, and shaped by an internal striving for equilibrium within a cultural system. According to Kearney, this striving means ". . . that some assumptions and resultant ideas, beliefs, and actions predicated on them are *logically* and *structurally* more compatible than others, and that the entire world view will 'strive' toward maximum logical and structural consistency" (p. 52). In other words, this means that, according to the group, culture, and society, their rules and beliefs that affect behaviors and attitudes make sense and are consistent with the reality that the group has constructed. For example, science has through the empirical processes confirmed repeatedly naturalism as a cultural belief system that is internally consistent within the culture. Likewise, a religious culture confirms its outlook or world view through the faith of the participants in certain consistent aspects of the supernatural.

Even though Kearney's (1984) seven universal assumptions of Self, Other, Classification, Relationship, Causality, Time, and Space are interrelated, the concept of *Classification* did emerge within this study and offered insights into the world view ideas of the participants. According to Kearney, "the way in which a people categorize the major areas [classify] of their conceptual world constitutes an important part of the framework of their world view" (p. 78). This universal assumption offered insights for each participant in dealing with the way the person categorized ideas that belong to the different domains of knowledge within the realms of science and religion.

The understanding brought about through the lens of faith perspective offered insights into the creation of cognitive mechanisms that would allow a personalized form of resolution to take place between scientific knowledge and religious faith. Faith perspective has both on outward expressive quality and an inward subjective quality. Faith can have an expressive nature derived in part and acting in some cases through religious doctrine and tradition. Faith also contains a subjective, more experiential nature derived from many sources, including but not limited to the psychological, emotional and historical background of the individual.

Faith perspective for this study dealt with the parameters of both the expressive and religious elements coupled with a better understanding of the subjective nature of religious faith in relation to scientific knowledge. The use of faith perspective also allowed a better understanding of the world view of each individual and how that world view strives for equilibrium.

In light of the subjective nature of faith, James Fowler (1981) has created a stage theory of faith development in which faith is seen as progressing from the more concrete

to the more complex and abstract somewhat mirroring the psychological theories of Piaget, Kohlberg, Selman, and Erickson (Fowler; Muuss, 1996). The progression in faith is caused by a movement from disequilibrium to equilibrium within the individual's cognitive faith-work system (Fowler; Muss). For example, a latter stage of faith development for Fowler is called "Conjunctive Faith" (p. 184), and it is the stage in which paradoxical beliefs in truth are atypical because of the complexity of life. This stage is typified by the individual's being "alive to paradox and the truth in apparent contradictions . . . [The individual] strives to unify opposites in mind and experience" (p. 198). In other words, people in this stage tend to not only reclaim their faith but live with the multiple contradictions that life has generated. This latter stage is somewhat similar to a cognitive mechanism by which individuals in the study resolved issues related to science and religion.

Definitions of Key Terms

Belief

Belief has to do with the mental acceptance of an object or idea as being true to reality.

Border Crossing

"Border Crossing" (Aikenhead, 1996) denotes the transitioning between differing cultures. The cultures primarily discussed in this study are science and religion.

Collateral Learning

"Collateral Learning" is a theory proposed first by Jegede (1995) as a mental resolution mechanism that an individual uses because of a possible cognitive conflict with science.

Culture

Geertz (1973) defined culture as a "historically transmitted pattern of meanings embodied in symbols, a system of inherited conceptions expressed in symbolic forms by means of which men communicate, perpetuate, and develop their knowledge about and attitudes toward life" (p. 89). This definition carries with it the connotation of culture's being a universal aspect of humanity.

Faith

According to Tillich (1957), "faith is a total and centered act of the personal self, the act of unconditional, infinite and ultimate concern" (p. 8). Faith carries with it the idea of commitment (Smith, 1977) and is the way of understanding the supernatural.

Faith Perspective

"Faith Perspective" primarily describes the faith process for the individual in relation to their issues with scientific knowledge.

Naturalism

"Naturalism" is defined by Paul Kurtz (1990) as a philosophy that

> wishes to use the methods of science, evidence, and reason to understand nature and the place of the human species within it. . . . The naturalistic outlook is skeptical of the postulation of a transcendental realm beyond nature, or of the claim that nature can be understood without using the methods of reason and evidence. (p. 7)

The above-mentioned definition of the term carries with it a world view connotation.

Super-naturalism

"Super-naturalism" carries with it the connotation of explanations for reality that go beyond the natural. In other words, a person who espouses a supernatural world view believes that reality in part or in the whole can be explained or attributed to a supernatural presence like a God or gods.

Theism

According to Dawkins (2006), "theism" denotes a belief "in a supernatural intelligence who, in addition to his main work of creating the universe in the first place, is still around to oversee and influence the subsequent fate of his initial creation" (p. 18). Theism is a world view belief that espouses a faith in God as a creator.

Theistic Evolution

Eugenie Scott (1997) believes theistic evolution to be "a theological view in which God created but relied more upon the laws of nature to bring about His purpose" (p. 271). In other words, God used evolution to bring about the progression of life.

World View

"World View" refers to the basic beliefs that an individual or group have about a given reality.

Summary

In this study, individuals with a higher knowledge of science were studied to understand the cognitive mechanisms that the participants employ to cross cultural borders. The culture of science characterized by a naturalistic understanding of reality by its participants and the culture of religion characterized by a super-naturalistic understanding of reality by its participants were explored more closely to comprehend better the personal interaction between somewhat highly dissonant cultural domains. To examine the interaction more closely, I used the lenses of collateral learning, world view, and faith perspective as backdrops to investigate the underpinning processes of individuals who have dealt or currently deal with the differences between science and religion. The understanding of how these individuals resolve differences between science

and religion will help inform the general populace of specific techniques or mechanisms that could be employed by individuals who also have a desire to find compatibility between their religious faith and scientific knowledge.

CHAPTER 2

REVIEW OF THE LITERATURE

The purpose of this study was to try to understand how three individuals in the scientific community constructed meaning and purpose for themselves that encompass both the cultures of religion and science, thus crossing cultural borders. This understanding could also offer insight for the science education community in general for the ways in which students might also cross cultural borders by allowing for the proper understanding and acceptance of science while not marginalizing religious ideas. Througout history, people have sought a reconciliatory posture when it comes to science and religion. According to Arieti and Wilson (2003),

> Religious philosophers and scientists alike have sought compatibility between their scientific conclusions and their religious beliefs ever since the beginning of science in ancient Miletus in the sixth century B.C.E. The search for reconciliation between these apparently disparate views of the world continues in the academic world today. Despite the profound differences between ancient and modern science, despite the diversity of religious belief in the West, despite even the move from paganism to religions affirming the Bible and the variations of belief within religions affirming the Bible, there has been throughout Western history a remarkable continuous effort to reconcile science with the divine (pp. xiii-xiv).

A reconciliation process for science and religion can also be seen in reference to the science education literature.

To understand the three areas that make up the theoretical framework for the study more fully, I discuss in this chapter the literature in relation to science education. My goal is to gain a measure of what Strauss and Corbin (1990) call “theoretical sensitivity” (p. 41) to the data being gathered via qualitative means. Although three areas were initially used as a lens, parallel collateral learning became more dominant than the

other two areas in interpreting the data. Therefore, I present more information regarding the relationship to parallel collateral learning and science education in this chapter.

Theory of Collateral Learning in Relation to Science Education

Researchers have used the theory of collateral learning as a lens to interpret cultural studies and their relation to science education. For instance, Herbert (2004) investigated students from two secondary schools in Trinidad and Tobago and their responses to an evaluation after a series of units that were designed to teach accepted scientific ideas and health issues by building cultural bridges. Qualitative evidence supported the idea that certain individual students experienced parallel collateral learning. For example, one student used both her own traditional knowledge about the cause of the common cold and also a scientific approach to the same idea when the context demanded it. Also, evidence of both dependent and secured collateral learning became apparent after a preintervention and postintervention analysis (Herbert). Herbert discovered that "secured collateral learning led to the construction of more developed conventional science concepts" (p. 153). Thus, the lens of collateral learning was used to interpret and enlighten the data from her study.

Haidar (1999) links his study of nature of science views among both preservice and in-service teachers in United Arab Emirates with the idea of teaching science from a constructivist viewpoint instead of a traditionalist viewpoint. The theory of collateral learning was discussed as one way of teaching science from a constructivist format. According to Haidar,

> collateral learning helps students to understand that there is more than one way of understanding nature, and consequently they can use a suitable way without having to abandon their original beliefs. Therefore, if science is introduced from the constructivist perspective, students will have the

> opportunity to realize that science is only one way of knowing, that has proved to be helpful, and will not feel a sense of violence. (pp. 818-819)

Haidar recommended in one instance that preservice science teachers be allowed the opportunity to construct their viewpoints about science from a constructivist format using a discussion framework. He even fostered the opinion that preservice science teachers be given "ample experiences to compare their views and the constructivist views about the nature of science, and relate them to the nature of teaching and learning" (p. 819). Thus, collateral learning in this case was recommended to help facilitate a constructivist approach to science.

Sutherland (2005) conducted a qualitative study with students who had Cree ancestry. The study included two interview sessions with a total of 20 students. The first interview session relied on questions that discussed the student's normal world culture outside of class and personal information related to science and information related to their science teacher. The next interview session "used critical incidents to elicit students' negotiated boundaries with science and their personal experiences" (p. 601). Sutherland used collateral learning to interpret the data that emerged from the interview sessions. Sutherland discovered that 7 out of 20 students probably used collateral learning and of those both parallel and secure types were employed with some difficulty as to distinguishing what student belongs to which category. One final conclusion put forth was that because secured collateral learning carries with it the idea of a combination between "Western science and indigenous knowledge" (p. 610), that form of knowledge would not be as accepted in science class. Thus, Sutherland was able not only to use collateral learning as a lens for the data but also to interpret the theory's usefulness by the data themselves.

The theory of collateral learning relates specifically as well to the topic of religion and science and the interaction between the cultures or world views related to both systems of knowledge. Aikenhead and Jegede (1999) use collateral learning as a lens to analyze other research within the literature dealing with this subject. Aikenhead and Jegede use a 1997 study by Roth and Alexander to employ collateral learning as a lens for understanding the study's findings. According to Aikenhead and Jegede, collateral learning can be used as a lens to look at three students who dealt with the conflict between science and religion in the original study and scientists who also deal with similar issues. One student out of the three did not take part in collateral learning because the difference between his own faith and the science physics class was so great that any type of meaningful learning could not take place (Aikenhead & Jegede). Another student developed what Aikenhead and Jegede called "a form of secured collateral learning" (p. 281). According to Aikenhead and Jegede, Todd experienced the integration between science and religion because "his science schemata . . . reinforced his religion schemata" (p. 281) through the use of language and his idea of God. A third student was viewed by Aikenhead and Jegede as having a form of parallel collateral learning because he used a method for coping that employed one form of knowledge over the other depending upon the context and kept the two forms of knowledge separate (Roth & Alexander as cited in Aikenhead & Jegede).

Aikenhead and Jegede (1999) also discussed the science and religion issue among scientists themselves. They described the resolution mechanism the scientists employed in the original Roth and Alexander study as one of secured collateral learning relating to the science and religion issue. The scientists reached this form of collateral learning

through a specific process which allowed “an individual to look at the object of inquiry . . . from two mutually exclusive viewpoints and integrate these through a dialectical and hermeneutic process”’ (Roth & Alexander as cited in Aikenhead & Jegede, p. 282). An example of this would be in using the idea of abortion or euthanasia and being able to integrate two different viewpoints about the idea in a higher way (Roth & Alexander as cited in Aikenhead & Jegede). Thus, the study originally done by Roth and Alexander was used by Aikenhead and Jegede as a backdrop for the theoretical ideas of border crossing and collateral learning, and the theories demonstrated their useful nature.

Other studies within science education also relate tangentially to the ideas of collateral learning, border crossing, and the religion/science issue. A study that illustrates border crossings within the realm of science and religion is the Brickhouse, Dagher, Letts, and Shipman (2000) study and the reanalysis of the original study in the Shipman, Brickhouse, Dagher, and Letts (2002). The researchers in the Brickhouse et al. study used an astronomy course as a backdrop to study the nature of science conceptions of a group of nonscience majors who make up the students in the course. The three topics relating to the nature of science that were studied were “the nature of evidence in astronomy, relationship between science and religion, and nature of astronomical theories” (Brickhouse et al., p. 343). Two sources of information were used by the researchers to study class trends in regard to the three topics and the developmental aspects of certain student views and perceptions regarding the nature of science. Work that came from the entire class of 340 was analyzed along with specific interviews of 20 students. The science and religion topic in relation to the nature of science was not dealt with in class for an extended period of time. Some time was given in class to discuss an article written

by the astronomy instructor on the topic. Students also completed two assignments in which they considered "the possible role of a supreme being in scientific discourse" (p. 349) and they were asked "to choose and argue a position on whether public funds should be spent on either origin of life research or on research such as Stephen Hawking's on the moment of creation itself" (p. 349).

The actual data on the science and religion issue from a select number of individuals from the class was discussed by Shipman et al. in greater detail in a paper published in 2002. According to Shipman et al., they sought to assemble the data produced from the smaller group of participants interviewed several times and classify the participants into specific categories. The "Distinct" category was composed of those students who had limited involvement in the topic. The students in this category seem to keep the two topics separate and "believe that the natural sciences have no bearing on religious affairs" (p. 531). The "Transitional" category was composed of those "students who allow for the possibility that science and religion can address the same questions but whose thinking does not include any detailed arguments on how those questions are addressed" (p. 532). For example, the authors classified one individual as transitional based upon the idea that the participant thought both "science and religion are different but closely related" (p. 536). The "Convergent" category was composed of students who showed an interface between science and religion and each interface or even integration at times was somewhat individualized and particularly specific to the individual's views on the topic. The authors concluded that the four Convergent students discussed in the paper had begun the process of border crossing. The authors used certain categories that are somewhat similar to certain concepts of Jegede (1995) in dealing with collateral

learning (See Figure 2). The concepts of religion and science were kept in categories of compartmentalization or parallel collateral learning (Distinct) and integration or secured collateral learning (Convergent).

The study by Colburn and Henriques (2006) helps explain these mechanisms that allow for integration or compartmentalization of differing concepts. The study dealt primarily with clergy members' views about religion, science, creationism, and evolution. In the first part of the study, eight clergy members and one professor of religion were interviewed. According to Colburn and Henriques, the individuals "included three women and six men; two Presbyterians, five Methodists, one Roman Catholic, and one Episcopalian" (p. 422). The interviewees completed a survey and answered three basic questions:

Distinct Category	Parallel Collateral Learning
Science and religion offers different views of the world.	Opposing schema show no influence on each other.
Domain specific	Compartmentalized schemata
Conflict is negated.	Schema is approached on a context specific basis.

Convergent Category	Secured Collateral Learning
Integration of science and religion	Schemata focalize toward a collective meaning or
Scientific view of the world with respect to the religious view	Both conflicting schemata are held onto for personal reasons

Figure 2. Similarities between Categories from Shipman et al. (2002) and Collateral Learning. *Note.* The information comes from Shipman, Brickhouse, Dagher, and Letts (2002); Aikenhead and Jegede (1999); Jegede (1995); Hewitt, Suchocki, and Hewitt (1994) as cited in Shipman et al. (2002).

1. What do you believe are the major ideas in the theory of evolution?
2. How would you counsel a parishioner who felt that accepting the tenets of the scientific theory of evolution meant giving up their belief in God or Christianity?
3. How do you respond when people say the Bible has been proven false by science (p. 422)?

The second part of the study used a 36-item survey of a large number of clergy representing a grouping of more mainstream Christian denominations similar to the interviewees. The survey was created in part by the initial interviews with the above-mentioned study participants. The survey dealt with the ideas of evolution, religion, science, compatibility between topics, and the educational setting for the above-mentioned issues including creationism (Colburn & Henriques).

The information gathered from the interviews and survey showed that clergy believe religion and evolution to be basically agreeable and not incompatible, that creationism should not be taught within a science classroom, that the Bible should not be understood as a scientific book and a literal document, and that most of the clergy believe that God does have a part in the evolution and creation of life (Colburn & Henriques, 2006). The researchers go on to look at the information and data discovered in the interviews and survey in light of Nord's (1999) categories dealing with the religion and science issue. The researchers discovered that all clergy interviewed and surveyed held to an independent or compartmentalized view of science and religion or a convergent or integrated view of science and religion. The researchers also discovered that no participants during the study held to a more conflicting aspect of the issue where one topic is held to be correct over another topic by virtue of one topic being elevated over the other. For example, no individual held to the idea that religious knowledge is more correct than scientific knowledge when a conflict occurs, which would demonstrate more

of a literalist or fundamentalist view of scripture (Colburn & Henreques; Nord). Conversely, no individual viewed scientific knowledge as more correct over religious knowledge, which would include the philosophical naturalists (Colburn & Henreques; Nord). This aspect of the study falls also in line somewhat with collateral learning in that the clergy themselves kept the topics separate as in parallel collateral learning or found integration points as in secured collateral learning. Finally, Colburn and Henreques said that the religious leaders or clergy "may be among those best suited for speaking critically about issues that come from seeing religious traditions through a scientific world view" (p. 439). It is in this view that the other side or theological side of knowledge is looked at in order to shed light on the scientific aspect of knowledge and this lends itself also to viewing a person's subjective faith perspective as possibly one way of differentiating both science and religion for that person. For example, several of the above-mentioned religious leaders did not view the Bible as literal or without error (Colburn & Henriques). This makes a statement about the faith of several of the clergy not being tied to a literal understanding of scripture. Colburn and Henreques even discussed their study in light of crossing cultural borders in which "religious beliefs are respected while developing a deeper understanding the place of both science and religion in human understanding" (p. 439). It is in this frame of thought that cultural border crossing should be viewed as a way that people can mutually respect all areas of life and create contexts in which differing cultures are mutually respected even within the context of science and religion.

Thus, the research by Colburn and Henreques (2006), Shipman et al. (2002), and Aikenhead and Jegede (1999) all use the idea that individuals create mechanisms to

accommodate conflicting knowledge. These mechanisms, while somewhat different in all three research articles, still build upon the premise that, within the parameters of the science and religion conflict, certain individuals are using mechanisms to transition cognitively across cultural borders. It was not the main purpose for my study to designate individuals into differing categories of collateral learning but to understand more completely how and possibly why certain individuals tend to compartmentalize or integrate differing aspects of cultural knowledge. It is within this framework that I used world view theory and faith perspective as lenses to understand better why individuals possibly create these subjective mechanisms.

Use of World View in Relation to Science Education

The use of world view theory in science education has been both sporadic and in some ways limited in view of other theories that seemingly dominate the research field. Of the researchers in science education publishing articles addressing world view and world view theory, William Cobern (1991) published the first detailed monograph on world view as it relates directly to the world view theory written about by Michael Kearney. Cobern's research in general provides a different bridge or link between the science curriculum and the basic thinking processes by going beyond conceptual change ideas and calling for the inquiry into the world views of the students. Clearly then, the process of learning through conceptual change is concerned with a student's understanding of the scientific concept (Driver, 1983) while learning through the process of world view ideas are also concerned with a student's acceptance of the same concept. Several studies within science education have sought to use world view as a lens.

As evidence for the use of Kearney's theory, Cobern (1989) cites a former study involving the Test of Preferred Explanations (TOPE), which was designed to analyze the variations within the universal causal category in dealing with scientific explanations versus nonscientific explanations. The former study using TOPE was later published in 1997 by Cobern. The design of the TOPE was completed in order to differentiate among college students according to world view difference in the causal category (Cobern, 1989, 1997). According to Cobern (1997), 120 first-year college students and 88 professional scientists completed the paper and pencil questionnaire that asked students to choose the more scientific or less scientific explanation for a specific phenomenon that in actuality was a complete fabrication. Seventeen different phenomena were used to elicit a response. The college students were grouped according to science interest into three divisions on a continuum of no interest in science to having an interest in science. The study clearly showed a difference in higher TOPE scores along the continuum according to scientific interest and culminating with the research scientists themselves having the highest scores. This result was not surprising but interestingly the professional scientists had a lower average score than what was expected. Cobern (1997) admitted that "even scientists are likely to have more than one notion of causality" (p. 10). In the study, the questionnaire with unfamiliar phenomenon seemed to elicit responses that show world view variations within the causal universal category and scientists varied according to their own world views in causality in regards to scientific phenomenon. The dissertation study also created a research context that demonstrated variations in how scientists found compatibility between differing world view systems.

There are other studies within the research field of science education that have used world view and particularly Kearney's (1984) world view theory as a backdrop for an investigation into world view variations among students of different ages and educational levels. One such study was conducted by Cobern (1993) in that he used qualitative means to conduct research on a select number of female students preparing for a career in nursing at a community college located within an urban setting. He researched the beliefs of the participants regarding nature and described them using six distinct contrasting pairs of terms: "naturalism/religion, chaos/order, mystery/knowledge, function/purpose, mundane/special, and science/no science" (p. 947). The results suggested that the science courses had little or no influence on the student's individual views of nature and thus their world views in general, even among nursing majors who had taken several science content courses (Cobern). However, a nursing major is not the same type of major as a biology major; therefore, the results of this study might not be as transferable to other cases. According to Sinatra et al. (2003), "knowledge must reach a critical level to influence students' acceptance of ideas" (p. 521). In other words, the nursing majors may not have had enough science content to influence their views about nature. However, for Cobern (1993), this research was a clear step to show the relationship to world view, science education, and a topic such as nature. This particular study also showed that the cognition of the students was rationally developed, but very little explanatory power was given by the students to the topic of science as it relates to nature given the scientific world view as a backdrop (Cobern).

The use of the contrasting categories of naturalism and religion by Cobern (1993) parallel nicely the world view impingement idea in this dissertation study. Cobern defines

naturalism for research purposes as "the belief that material or physical causation provides a sufficient basis for understanding the natural world. It rules out theistic and pantheistic supernatural involvement in nature" (p. 939). He goes on to define the religious person as one who "clearly believes there to be supernatural involvement in nature" (pp. 939-940). Although Cobern also believes that a religious person could "accept naturalistic explanations in nature" (p. 939), he or she would believe in some form of intersection between the natural and the supernatural. For Mahner & Bunge (1996a), this intersection between the natural and the supernatural will come into conflict. According to Mahner & Bunge (1996a),

> if there is any point to a religious belief that goes beyond just assuming a transcendental world that makes no contact with the natural world, and that goes beyond mere subjective feelings or a merely pragmatist view of religion, the religious realm must overlap with the scientific one. . . . We maintain that the main point of the religious belief of most religionists consists in assuming, exploring, finding or establishing *some relation* between the supernatural and themselves. Since the religionist is part of the natural world, any such assumption amounts to making a *cognitive* claim about the world. As soon as such cognitive claim is made, religion is bound to conflict with scientific competence (p. 108).

In other words, if any explanation is offered for any natural phenomenon other than a naturalistic one, a conflict will result between the explanation offered by science and the explanation offered by another source. How then can an individual maintain a super-naturalistic world view yet cross borders into a culture that seeks naturalistic answers? Even Cobern admits "Logically there can be little middle ground between religious views that allow for direct supernatural involvement in nature and naturalistic views that do not" (p. 941). In his study, the individuals involved in the study except for one "tended to clearly identify with one group or the other" (p. 941). If indeed "worldview is intimately related to religion and metaphysics" (Cobern, 1992, p. 5), then this dissertation study,

which was partially concerned with the demarcation between world view ideas, offers insight into the way religious science professors viewed their world.

In a qualitative study by Wesley McCoy (2002), the theory of evolution was addressed in light of student world views. The participants for the study were made up of six ninth grade students between the ages of 14-16 years who had not entered into an official high school biology course. According to McCoy, a questionnaire form was used to differentiate among students based upon the world view universals or assumptions of classification, relationship, and causality. The researcher held three interviews with each student and then all students were invited to a focus group interview. For McCoy, the major reason for the study was to describe the world views of each student in relationship to biological science before the participants attended a biology class. Kearney's model seemed to be chosen because of its analytical power within the scope of a qualitative study. The following two implications were made by McCoy after a thorough analysis was completed of the data and several assertions had been made:

> Implication One: World View causes students to hold implicit theories of the world that are based as much on personal feeling as on thinking.
>
> Implication Two: World View causes students to separate what we call "scientific thinking" from their "everyday thinking" about living things. (pp. 163, 165)

McCoy's study once again reinforces the idea of multiple variations within world views among students and the explanatory power that Kearney's (1984) model has for analysis and the implications for science education research.

In a recent study by Hokayem and BonJaoude (2008), worldview was used as a backdrop to understand how specific college students enrolled in an evolutionary course viewed evolution. In addition, the course professor's viewpoints were also taken into account and compared to the students. The researchers used individual interviews and

questionnaires to collect data. The two questionnaire forms were the Measure of Acceptance of Theory of Evolution (MATE) and the TOPE, which tested for "presuppositions about causality" (pp. 400-401). A total of five categories emerged during the study, in which religion and science represented one category. In reference to religion and science, a slight majority of students viewed religion and science as separate, while some students viewed them as conflicting. Only a small minority thought that science and religion complement one another. The study used two of Kearney's (1984) universal assumptions as a backdrop and asserted that the concept of "belief" has a place in evolutionary teaching along with the valuing of differing world views.

The idea of world view as interpreted by both Kearney (1984) and Cobern (1991) has been used repeatedly within science education. Similar ideas related to world view were used as a backdrop in this dissertation to understand better the beliefs of scientists who operate within varying degrees of super-naturalism and naturalism. Even though the purpose of this study was not meant to explain fully all of the universal assumptions as they related to each scientist, the idea of classification did emerge as a factor that demonstrated the scientists' ability to deal with the relationship between science and religion. Like many other theories, world view should be linked with other research within science education and beyond the boundaries of science education to grasp better and understand the holistic picture of the human understanding and acceptance of scientific cultural ideas.

Faith Perspective in Relation to Science Education

Because many students of science, science teachers, and scientists are involved within a religious context or have participated within a religious culture at one time,

conflicts between science and religion in general seem to take place. In particular, the Theory of Evolution is a lightning rod for those who wish to discuss the differences between science and religion and for those who want to debate the contextual issues. In the science education research field, several studies have taken place attempting to shed light on the practice of teaching the Theory of Evolution and of its acceptance among students in general. Brem, Ranney, and Schindel (2003); Dagher and BouJaoude (1997, 2005); Hokayem and BouJaoude (2008); Lawson and Worsnop (1992); Martin-Hansen (2008); and Sinatra et al. (2003) are some of the studies that have been conducted dealing with the above-mentioned issues centered upon the teaching of evolution. These studies have similar aspects in that they all develop ideas from their research on how best to teach the Theory of Evolution. Certain studies also postulate a demarcation, boundary, or limitation which would separate scientific knowledge in general from other forms of knowledge like religious knowledge (Martin-Hansen, 2008; Sinatra et al., 2003).

Brem et al. (2003); Dagher and BouJaoude (1997, 2005); Lawson and Worsnop (1992); Hokayem and BouJaoude (2008); and Sinatra et al. (2003) also examined the issues (including religion) surrounding the teaching of evolution from a science or science education perspective, as is expected within the science education literature. What is missing is a prolonged discussion of an individual's personal faith perspective in light of a higher amount of scientific knowledge.

Another example of religious faith being used as a backdrop for other research in science education was the study by Cobern and Loving (2005). The researchers used a quantitative "survey method to gain a general impression of support of science and support for orthodox Christian belief" (p. 4) among 545 preservice elementary teachers.

Results of the study demonstrated that there was no evidence for the idea that a lack of support for science increased as Christian faith became more orthodox (Cobern & Loving). However, this study was quantitative, and it lacked a prolonged discussion element in dealing with certain specific issues that surround this topic.

In a qualitative study in dealing with religious faith and science, Jackson, Doster, Meadow and Wood (1995) demonstrated the difficulty certain people involved in the scientific culture have with reconciling their Christian faith with evolutionary science. Jackson et al. used scientists, science educators, and others involved in science teaching and prospective science teaching to understand more about the interaction between certain aspects of science and religion. Two criteria were used o gather participants for the study. The individuals "must have [a] identified themselves as orthodox Christians and [b] demonstrated, by virtue of their current occupation, a strong interest in science and science teaching" (p.590). In some cases, the study was similar to my in that the researchers allowed individuals with a higher amount of scientific knowledge (two science professors and one professor of science education) to discuss their religious beliefs in reference to scientific knowledge. While the study demonstrated certain areas of conflict that people have in regards to this topic, the researchers made clear the positive outcomes generated by their research:

> An expanded personal dialogue between people from two such largely separate worlds can lead to greater mutual respect and understanding in both the personal and intellectual realms. Nobody was converted to a radically different set of beliefs or values. . . . What did occur in the case of several of the participants was a real change of attitude (p. 607).

It was in this positive context that a multicultural understanding of the issues came about for several people. This study in certain ways mirrored my desire for certain religious scientists to be given a voice regarding this issue, but it never went into much detail as to

the individual's personal faith perspective in reference to their religious background. More detail with regard to faith perspective might have better explained the personal connection that the participants had with both conflict and reconciliation.

Another example of religious faith and scientific knowledge was the study by Colburn and Henriques (2006). This study demonstrated that clerical views about the science and religion issue, especially surrounding evolution and creation, did not conflict. Instead, participants sought reconciliation either by compartmentalization or some form of integration. This study also demonstrated that the clergy interviewed may not have been as knowledgeable regarding science as the people of faith who also had scientific knowledge within the Jackson et al. (1995) study.

The biggest reason for using the faith perspective was to understand how the faith of a few scientists interacted with personal scientific knowledge. Did their faith result in conflict, as was demonstrated during the study by Jackson et al. (1995), or was it more reconciliatory, as was demonstrated in the Colburn and Henriques (2006) study?

Summary

In conclusion, all three areas (collateral learning, world view theory, and faith perspective) were used in this study as a lens to understand how a scientist deals with the interaction between his or her religious faith and scientific knowledge. Collateral learning became the dominant lens to view the emergent data primarily because of the similarities between the types of collateral learning and the reconciliation mechanisms of the participants. Faith perspective and world view did offer a backdrop for interpreting certain ideas related to different cultural contexts. The science education research also aided in bolstering the qualitative nature of this study by offering examples of methods that sought to

understand more clearly the human interaction between religion and science. All in all, these three areas helped guide this study primarily in relation to the boundaries, conflicts, and resolutions for each participant.

CHAPTER 3

METHODOLOGICAL DESIGN

In this research, I investigated how college science professors mentally transitioned between their scientific and religious cultures. I chose a qualitative methodology to gain an understanding and appreciation of this phenomenon. According to Denzin and Lincoln (2000), qualitative by definition implies an attention to the qualities of substances and on meanings and processes that will not be measured in a quantitative fashion that leads to a more experimental design. In light of the qualitative design, both Denzin and Lincoln observe that "researchers stress the socially constructed nature of reality, the intimate relationship between the researcher and what is studied, and the situational constraints that shape inquiry" (p. 8). Understanding the meanings of differing subjective experiences was the primary focus of this study and was used to produce more emergent and grounded categories that grew out of the qualitative design (Lincoln & Guba, 1985; Strauss & Corbin, 1990).

Modified Naturalistic Design

In taking a qualitative approach, I adopted a modified naturalistic paradigm that used an emergent and grounded categorical design written in a case study format. This study was designed to research a cultural and mental phenomenon as it was taking place in its natural setting, allowing an understanding to be gained through the ideas that emerged. The use of the term "naturalistic" in this qualitative context in relation to a study setting should be differentiated from the use of the same term in relation to the scientific cultural belief system. According to Lincoln and Guba (1985), there are five axioms or beliefs within the naturalistic paradigm (pp. 37-38) and these beliefs were

adopted in light of the purpose for the study. The naturalistic paradigm is philosophically postpositivist as far as methodology and theoretical framework is concerned (Lincoln & Guba). All in all, the naturalistic purpose was not to construct a pure cause-and-effect rationale through the manipulation of variables but to understand the individual construction of meanings in light of the cultural and mental phenomena in question.

Lincoln and Guba (1985) have explained several characteristics and ideas that accompany the naturalistic approach to research. A naturalistic ideological position was adopted, but the characteristics and ideas that accompany this ideology were used in part, modified, or not used depending upon the specific circumstances of the study. The three characteristics of a grounded categorical design and an "emergent design" (Lincoln & Guba, p. 41), and a modified "case study reporting mode" (p. 41) were used to fit the specific context and content of this study.

The term "grounded categorical design" is somewhat similar to the term "grounded theory," used by Lincoln and Guba (1985). According to Strauss and Corbin, (1990),

> a grounded theory is one that is inductively derived from the study of the phenomenon it represents. That is, it is discovered, developed, and provisionally verified through systematic data collection and analysis of data pertaining to that phenomenon. Therefore, data collection, analysis, and theory stand in reciprocal relationship with each other. One does not begin with a theory, and then prove it. Rather, one begins with an area of study and what is relevant to that area is allowed to emerge. (p. 23)

A more naturalistic approach would then lend itself to producing an emerging theory or a theory that is directly tied to and comes out of the research data instead of simply substantiating already existing theoretical knowledge by making the data fit into preconceived theoretical constructs. For this study, a grounded categorical design was used instead of grounded theory to denote the limited nature of this particular study. It

was not the purpose of this study to generate one theory but to understand better the categories and overarching patterns that emerged from the data while using qualitative methods. Thus, the major categories and overarching patterns that emerged were grounded in the context of the data that was generated.

For this study, I adopted a modified case study written format to provide a description of the phenomenon in question and an interpretation of the categories and overarching patterns that emerged from the data. Thus, an interpretive and descriptive account (Laws & McLeod, 2004) was used to operate at diverse levels of analysis (Lincoln & Guba, 1985). The case study format was specifically modified to fit within the parameters of this study by offering a thorough written analysis (both descriptive and interpretive) of the phenomenon of cultural border crossing and the interaction of faith and scientific knowledge in relation to the main categories and overarching patterns that emerged for all of the scientists individually and collectively.

Keeping the above-mentioned naturalistic characteristics in mind, in my study I incorporated these ideas in order to formulate a qualitative approach to understanding the cognitive processes that were taking place when individual scientists crossed cultural and mental borders in dealing with both naturalistic and super-naturalistic ideas. A qualitative approach was preferred because of the nature of the subjective experiences of the participants. For example, Aikenhead and Jegede (1999) build upon the qualitative nature of past studies to integrate the concepts of border crossing and collateral learning in light of a cognitive context of reality. Lewis (1998) concludes that qualitative designs allow for an enriching process in reference to Kearney's (1984) world view theoretical model. Fowler (1981) uses a primarily qualitative approach to understanding the differences in

the faith perspectives of individual people while developing a theoretical base for a continuum of faith development. Likewise, I used a qualitative design, digging deeply into the experiences and understandings of a small number of participants.

Theoretical Sensitivity

With keeping the grounded and emergent design coupled with a case study written format, it also must be said that even when conceptual categories and overarching patterns developed out of contextual data, sensitivity to the already existing research base was maintained in order to link the prior research to the new findings produced by the emergent data. According to Strauss and Corbin (1990), the sensitivity that gives the researcher an already existing insight, understanding, and a talent at generating meaning is called “theoretical sensitivity” (p. 41). Theoretical sensitivity before the new data is analyzed comes from the literature base and both the professional and personal experiences of the researcher. As a qualitative researcher, I was aware and open to the research produced in reference to the theoretical framework and science education. I also wanted to offer experience from my own research into the ways in which humans integrate sometimes philosophically opposite concepts like super-natural and naturalistic understandings by virtue of certain types of knowledge exposure like evolutionary theory (Barner, 2005). With theoretical sensitivity in mind, I wanted to create a naturalistic design that allowed for the data produced to be enlightened by certain parameters of the previous research and theoretical developments of others. This enlightenment allowed for the deeper understanding of those grounded ideas.

Overview of the Methods

Because the methodology employed in this study was one that used a modified naturalistic design, I summarize the methods in this section and provide a more detailed discussion of them Appendix D. The methods were implemented because they allowed for triangulation of data. Using different methods is one way of achieving triangulation (Denzin as cited in Lincoln & Guba, 1985). According to Lincoln and Guba, "triangulation by different methods thus can imply either different data collection modes (interview, questionnaire, observation, testing) or different designs" (p. 306). Because the study involved a naturalistic or grounded design, "it would not be possible in advance to patch together multiple designs" (Lincoln & Guba, p. 306). The idea of different collection modes was adopted to ensure the process of triangulation.

Overall the study and data collection process took place from January 2009 through October 2009, and three differing types of data collection modes were employed for the study. These collection modes are generally outlined in Figure 3. A questionnaire (Appendix A) was used to gather the initial data in regards to each individual's scientific and religious background coupled with individual ideas about science and religion. The questionnaire was initially emailed out to 25 faculty members of a local university and 3 individuals were chosen who have both faith in a personal God and work within the scientific community. Three follow-up interview sessions were used with each individual participant to clarify the ideas expressed on the questionnaire form and to add depth to the emerging data in relation to the phenomenon of transitioning between a religious and scientific cultural understanding. Outside readings were also used periodically during some of the individual interview sessions to aid in the clarification and explanation

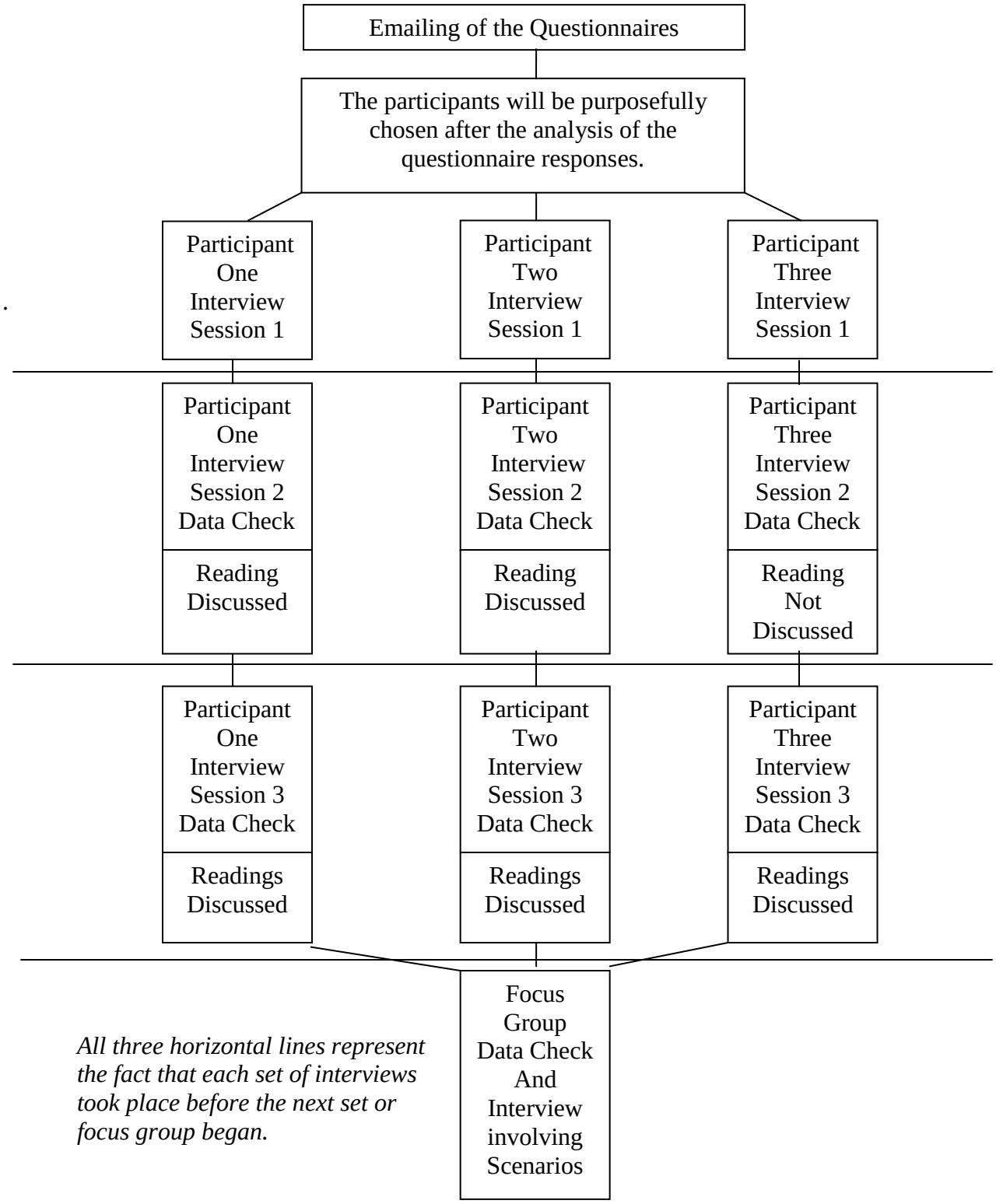

Figure 3. Flowchart for the Qualitative Interview Steps.

process. Finally, a focus group session was implemented with all of the participants taking part at a single time. The focus group session was designed primarily to clarify the overarching patterns that emerged during the individual interviews. The different modes of data collection in this study (questionnaire, individual interviews, focus group interview) helped create a qualitative and emergent design for the express purpose of understanding the ways in which scientists cross cultural borders between their scientific knowledge and super-natural faith.

Throughout much of the individual interview sessions and focus group session, certain major categorical ideas that emerged were continually discussed and refined, allowing for individual feedback to take place. This feedback became a form of "member checking" (Lincoln and Guba, 1985). According to Lincoln and Guba, "the member check, whereby data, analytic categories, interpretations, and conclusions are tested with members of those stakeholding groups from whom the data were originally collected, is the most crucial technique for establishing credibility" (p. 314). This ongoing feedback helped focus the interview sessions within the parameters of the emerging categories and gave impetus for exploring other ideas and questions that emerged during the coding.

This examination and exploration of the major categories and ideas from the beginning of the study relates somewhat to the concept of what Strauss and Corbin (1998) call "theoretical sampling." According to Strauss and Corbin,

> theoretical sampling is cumulative. Each event sampled builds from and adds to previous data collection and analysis. Moreover, sampling becomes more specific with time because the analyst is directed by the evolving theory. In the initial sampling, the researcher is interested in generating as many categories as possible; hence, he or she gathers data in a wide range of pertinent areas. Once the analyst has some categories, sampling is aimed at developing, densifying, and saturating those categories. (p. 203)

Theoretical sampling for this study focused on the development of the major categories and certain overarching patterns that started emerging from the beginning of the study and was not used to generate one particular overarching theory.

Setting and Participants

The study used three faculty members within one university to understand better the scientific and religious cultural border crossings of a few individuals. The medium-sized, public, four-year university chosen for this study is located in the southeastern United States. The focus of this study was among individuals from the Department of Biology from the College of Science and Math. The faculty in this department comprised a localized selection from the scientific community at one university in which the study took place.

Even though faculty members were chosen from the same university, they were all distinct with regard to several items. Bob was an African American man who operated in the scientific culture in relation to his research interests in embryology. He also operated in the religious culture partly because of his ties to a Baptist community of faith. Mary was an African American woman who operated in the scientific culture in relation to her research interests in pathogenesis. She also operated in the religious culture partly because of her ties to a Catholic community of faith. Susan was an Asian American woman who operated in the scientific culture within the area of human genetics. She operated in the religious culture partly because of her connection to the Presbyterian denomination. All three are deeply committed to both their scientific work and religious beliefs.

According to Lincoln and Guba (1985), a naturalistic approach to research will also have the characteristic of purposeful sampling because, among other ideas, purposeful sampling relates to an intentional and emergent purpose for gathering data. Accordingly, Lincoln and Guba claim that purposeful sampling leads to a process that takes into account local contexts and conditions that might lead to the likelihood of transferring the results (p. 40). Within the realm of purposeful sampling, Lincoln and Guba, while using research from Patton, discussed several reasons for purposive sampling. The one type of sampling that was adopted for this study was "extreme or deviant cases" (p. 102). This type of sampling was used "to obtain information about unusual cases that may be particularly troublesome or enlightening" (p. 102). This type of sampling was used to enlighten the science education research community about reasons that certain individuals maintain both naturalistic and super-naturalistic ties to the two different cultural perspectives of science and religion.

Data Analysis

All nine individual interview sessions and one focus group session were recorded with audio tape, transcribed and coded for all of the participant responses. Open coding was the general type of coding procedure used in the analysis of data. Several steps were used for the open coding related somewhat to what Strauss and Corbin (1990, 1998) recommended, especially in reference to the overall ideas of questioning, comparing, and grouping the data into patterns. Audio transcriptions were first read through to capture an overall perspective of the entire interview session. Line-by-line coding followed to help break down the document and form a rudimentary ideated basis. The process of color coding followed in order to organize the emerging ideas into broader categories. The

categories were then summarized and/or outlined and written down in a memo book. Categorical ideas were often compared to one another and questions were continuously asked to identify meanings within the data. Each major category was also summarized in the final two individual interview session transcripts in order to focus as much data as possible into a succinct pattern. Hundreds of hours were spent in the analysis and organization of the qualitative data. An example of this coding scheme can be viewed in Figure 4 in relation to Bob's category of cultural relevance. It should also be noted that the ideas stated in Figure 4 were not all of the ideas generated from this one single excerpt. The ideas listed were originally written above, below, and beside the actual excerpt in the transcription document, so they do not necessarily correspond to the actual transcript line to the immediate right on the table. Overall this process of coding created a thick description of the data that emerged from the study.

Trustworthiness

Trustworthiness in the accepted or conventional context deals with the concepts of "internal validity, external validity, reliability, and objectivity" (Lincoln & Guba, 1985, p. 218). According to Lincoln and Guba, a naturalistic study would look primarily at the characteristics of the data and not the investigator's preconceived ideas. The data would then come from the research and would be grounded in the particular study and the particular categories that emerge. This naturalistic qualitative study allowed for a new parameter to be created that used different terms other than the conventional terminology used within a more quantitative methodological study. According to Lincoln and Guba, credibility, transferability, dependability, and confirmability (pp. 301-327) will take the place of the above-mentioned conventional terms in order to align with a more

Line by Line Coded Ideas	Actual Transcript	Memo Summary
Affirms the boundary Religious people Personal Causality Boundary Negative response My belief based upon culture His own story in that culture Have to believe faith or hell exists Don't question this stuff You have to believe in God or else It is how you produce meaning From a cultural perspective Personally responsibility Religious cultural expression > backsliding What about the way you produce meaning in the scientific culture? Religious ideas are immutable.	Yeah that . . . would help to some degree but I think that it would cause some . . . less than joyous feelings my notion with the religious group is that there's almost an obligation to believe. It's not just cause oh . . . you believe too. No . . . you're supposed to believe in God. That's what you're supposed to do. God has done a number of great things for you and you should be . . . joyous. You should honor Him. And if you don't go there then you know you're decline.	- To some degree but I think, it would cause some less than joyous feelings because with • There's almost an obligation to believe. You're supposed to believe in God. • If you don't go there then you know you're in decline.

Figure 4. Partial Coding Scheme for Bob during the Third Interview.

naturalistic design. The ideas that encompass these terms and bring about a trustworthy nature to this research specified by Lincoln and Guba were also adapted to reflect the limited nature of this study.

Credibility is linked to internal validity in the conventional framework or paradigm (Lincoln & Guba, 1985). The findings of the study were deemed more credible because of the use of member checking, triangulation, and peer debriefing. A measure of member checking was the predominant basis for much of the second and third individual interviews and used at the beginning of the collective interview session. Major categories, ideas, and understandings were discussed and explored with the feedback of the

participants. The emergent ideas were also clarified and questioned throughout the study. Triangulation occurred by the use of the multiple methods of the questionnaire, individual interviews, and a collective interview or focus group session. Peer debriefing was also used in this study to establish a measure of credibility. After the first individual interview session for all of the participants, a discussion took place between Wes McCoy and me. Dr. McCoy obtained his Ph.D. in science education with similar research interests, and he acted as a peer debriefer for my study. The beginning discussion allowed me to gather ideas that affected the "next steps in the emerging methodological design" (Lincoln & Guba, p. 308) and to discuss the overall first impressions from the beginning interviews. The second session took place after all of the individual interview sessions had taken place. This discussion allowed me to ask questions of the peer in regards to the major categories and understandings that developed in the study and to explain the reason those ideas seemed to be developing. I read excerpts from some of the color coded transcripts that allowed Dr. McCoy to interact with the data directly. The peer helped to clarify the meanings of my interpretations, as described Lincoln and Guba. He also aided in a question that was used during the final focus group session. All in all, all three strategies of member checking, triangulation, and peer debriefing aided in the overall credibility of this research.

Transferability is linked to external validity in the conventional framework or paradigm (Lincoln & Guba, 1985). Using the questionnaires, three individual interview transcriptions, the collective interview transcriptions, and memo books, a rich and focused description was generated in Chapter 4. The transferability of the findings will be limited to the context which occurred naturally within this particular qualitative study.

Dependability is linked to reliability in the conventional framework of research (Lincoln & Guba, 1985). In this study, an audit trail was kept with the questionnaires, transcriptions, memo books, and any other material which would allow other researchers to examine the process of research if they so choose. Member checking, triangulation and peer debriefing will also aid in establishing the dependability of this study.

Confirmability in a naturalistic design replaces objectivity in a more conventional paradigm (Lincoln & Guba, 1985). Although a professional audit is recommended for both dependability and confirmability by Lincoln and Guba, during this limited study, the triangulation of different qualitative methods, member checking by the scientists, peer debriefing, and an audit trail aided in the confirming of the research.

Human as Instrument

According to Lincoln and Guba (1985), the human inquirer is the preferred tool in a naturalistic study. Keeping this in mind, it is important that I explain in this section a little about the reasons I was interested in the type of research and the limitation and strength that was inherent throughout the study. First of all, I believe my background made me a suitable instrument in the questioning and analysis of research dealing with collateral learning, world view, and faith perspective. I graduated from a Baptist university in 1988 with a major in “Pastoral Studies.” The Baptist university at that time was philosophically more in line with a Christian fundamentalist perspective upon not only religion but also upon reality in general. At the time, I was going to college and upon graduation, I did ministerial work within an evangelical philosophy. I then attended seminary for a short time to continue the furtherance of my knowledge within the dynamic sphere of theological and ministerial work. Shortly thereafter and as life would

have it, I made a vocational change into science education and that change not only had a profound impact upon my career choices but also eventually helped to create in me a desire to understand more about the interaction between science and religion. I eventually earned a Master's degree in education with a concentration in middle grades science and social science from Georgia State University. By having a dualistic educational and vocational background which encompasses both certain elements of religion and science education, I believe I was well suited to investigate the interaction between science and religion within a framework of qualitative research.

This research was limited because of the number of participants (3) used in this qualitative study. I partially based the amount of participants on the idea that the depth of the interview sessions would indeed affect the amount of data produced in dealing with this type of subject more than a large amount of participants. For example, in the pilot exercise conducted in June 2007, the length of the interview process aided in the understanding of the interaction between the professor's ability to cross cultural borders between science and religion. Although the individual professor in this exercise was known beforehand, a similar relationship between the science professors in the dissertation study and myself was attempted in order to deal with the personal issues surrounding this topic. The limitation of the number of participants was therefore compensated by the depth of interaction with each participant. A small participant base also helped in that the professors knew one another in the same university department and seemingly felt more comfortable discussing these issues within the focus group session. Thus, the grounded categories and overarching patterns developed from the study were

limited to the contexts and interpretations of both the participants and me. It is my hope that this study will be used by others to further additional research in this area.

A positive strength for this study had to do with the very nature of a naturalistic study. According to Lincoln and Guba (1985), “the inquirer and the ‘object’ of inquiry interact to influence one another; knower and known are inseparable” (p. 37). Thus a reflexive relationship occurs between the researcher and the object of research. According to Pollner and Emerson (2001), “social actors have a sense of the field of action, explicitly reason about the field of action, and act in the light of such understandings and reasonings in ways that variously (reproduce or change) the field of action” (p. 121). It is within the parameters of this social change that a reciprocal relationship was intended to exist between myself and the participants. This relationship hopefully allowed for a deepening of the personal understandings of the cultural interaction between science and religion for the subjects as well as the researcher. The striving for personal understandings helped produce this social change that was a natural outcome of both a limited naturalistic and reflexive study.

Finally, my own cultural border crossing into the scientific culture through vocation and education has changed not only the way I view my own religion and faith but also the way I view the tentative nature of human knowledge in general. After examining how scientists themselves deal with some of the questions and answers that I have also dealt with on this journey between the cultures of science and religion, I feel that a personal faith growth has taken place. The belief in God has become more real and an acceptance of scientific ideas has been made more legitimate. Finally on a personal

note, I would like to thank Lassiter (1993), McCoy (2002), and Roberts (2004) for having suitable qualitative research models for me to follow in writing this dissertation.

Summary

This qualitative study was designed to create a microscopic look more deeply into the areas of scientists' border crossings between their scientific and religious cultural viewpoints. This was done partially by allowing each scientist time to explain how they have found a measure of compatibility between their super-naturalistic culture in which they have faith and their naturalistic culture in which they work. The impact of the study was limited to the contexts of the individual participants. The benefit of the study was in the area of deepening the understanding of the issues of how scientists themselves deal with the multiple worlds in which they are asked to take part. Each human is a holistic mass of integrated thoughts, cultures, and perspectives upon reality. It is in this reality that a study that looked at cultural border crossings among scientists is invaluable in that it not only showed the processes involved in the cultural border crossings but also could tentatively aid in the better understanding of the deeply held beliefs that appear in many people.

CHAPTER 4

PARTICIPANT INTERVIEW DATA

This chapter focuses on the individual participant's major categorical data generated during the individual interview process and the major overlapping themes generated from the focus group session. While the participants' major categories will be different and similar in certain ways, three overarching and similar patterns did emerge for all three participants. These patterns will be discussed in relation to the literature and overall purpose for the study in Chapter 5. Because not all of the categorical data can be presented in this chapter, my purpose is to focus the information into highly descriptive cases, thereby creating a contextual relationship with the overlying patterns. An introduction is given in the beginning of many categorical sections that offers more of an overview and interpretation of the data that will be elaborated upon more fully within each section. The following focus question was used during the study and acted as a basic guideline for this dissertation:

> How do college science professors describe the interaction between their faith and their scientific knowledge in reference to their transitioning between a naturalistic or scientific understanding and a super-naturalistic or religious understanding?

Bob

Table 1 presents a concise representation of some of the patterns in the data. The table also demonstrates contextually by interview session when the patterns emerged. Four major categories were used to identify patterns over data generated from three individual interview sessions for Bob. "Cultural Relevance" demonstrated a subjective and limited nature for both science and religion. A less than positivistic stance for

Table 1

Emergent Patterns in the Data for Bob

Categorical Data	*Interview 1*	*Interview 2*	*Interview 3*
Cultural Relevance	1. Science is subjective. 2. Cultural dependence based upon personal experience	1. Science and religion are opposites regarding process	1. Clear Distinction between science and religion
Cultural Boundaries	1. Boundary due to philosophical differences (Science – systematic, Religion – faith)	1. Supernatural not considered in science 2. Science cannot answer questions dealing with religion (no tools).	1. Science ignores the boundary and religion creates a boundary. 2. Science does not except the miraculous.
Cultural Conflicts	1. Tension comes from not understanding both cultures. 2. Denies personal tension	1. The cultures of science and religion create a separation at present – no conflict 2. The merging of cultural ideas brings conflict.	1. Scientifically explaining God is counter to having faith.
Cultural Bridges	1. Human development is a cultural bridge. 2. Formation of life and order of creation is a cultural bridge.	1. Order of creation is a cultural bridge 2. A day in the life of a human versus God is a cultural bridge. 3. Morality carries with it a cultural bridge.	1. Theistic evolution is a cultural bridge. 2. Faith is the driving force behind bridge building.

science stayed consistent throughout much of the individual interviews. “Cultural Boundaries” were represented by philosophical differences. Science was clearly not

viewed as needing to be involved in the understanding of the supernatural. “Cultural Conflicts” demonstrated that personal tension involving either science or religion was denied at the beginning of the interview sessions but demonstrated repeatedly in relation to the integration of cultural ideas throughout the study. Finally several “Cultural Bridges” were demonstrated throughout the interview sessions displaying a possible higher level reconciliation mechanism. Many of the following patterns will be described and expanded upon in the next section in relation to their individual categories.

Categorical Data for Bob

Four major categories emerged during the interview process with Bob: conflict/-tension, boundaries, cultural relevance, and cultural bridges. Because no category emerged that related to his personal background (unlike the other two participants), this information will be briefly described in this beginning section. Bob has worked in the same university for over two decades. The area of concentration for his Ph.D. work centered upon experimental embryology. Like most scientists, his knowledge is highly developed within his specialty. One notices that he also used that knowledge to a certain degree when he discussed his religious views and beliefs. That interaction will be discussed in a later category. In the context of being raised in a religious environment, he briefly discussed his religious background but seemed to need more prodding in order to give a more detailed description.

> I grew up in a household where my parents were Methodist and Baptist. We went to church every Sunday and we did Sunday school and church summer camps and all kinds of different things like so. The church in terms of the community was a very big part of who we were. So it was an opportunity to socialize, an opportunity to be entertained, an opportunity to learn and it was an opportunity to do the right thing. . . . That right thing was . . . pushed in a notion that if you do the right thing, good things would happen to you.

His moral compass was thus formed at an early age, when he learned that positive things will take place as a result of correct and moral behavior. He later explained that he joined the Baptist church because of the influence of his father, and he still belongs to a Baptist church today. In this interview, he also demonstrated a sense of stability with the descriptions of the loyalty that he placed on his current connection to a community of faith that lasted throughout youth and into adulthood while not placing too much emphasis on denominational differences. Overall, it seems that Bob viewed religious ideas to be believed and accepted. For example he stated, "so we went to that church and the overall preachings were that . . . there's a God and you worship this God and that's it." He demonstrated a strong faith in God because of his family background. Throughout the study, he did not appear to question personal beliefs in his religious ideas. That non-questioning attitude could very easily have come from his strong family tie to a religious cultural community.

Cultural relevance. Bob viewed both religion and science as different cultures. He discussed the limitations and biases of each culture as well as the specific ways that each culture views reality. Viewing both science and religion as both imperfect cultural pursuits is the primary meaning in relation to this category. He had no problem in placing both science and religion within the framework of a cultural context. In the interview sessions, he did not appear to elevate the cultural ideas of one above the other, thus allowing a measure of equality within a framework of compartmentalization. His cultural views about science and religion maintained a form of relevance for each culture within its own sphere of influence. The following excerpt is in relation to a question asked about

the possibility of different interpretations that scientists might have concerning a single set of data:

> Oh without a doubt! Yes. Science is to some degree a subjective area. We think that it is a hard core, right-or-wrong sort of a concept. That's not necessarily true. Science attempts to communicate with nature and nature in most cases won't have the capacity to speak. So we are left to our interpretation to what nature is saying. Two people could come to very different conclusions as to what nature is trying to tell us even though they are looking at the same sort of info or data that is being presented.

He believed science to be a human endeavor with cultural limitations placed upon the interpretation of nature. For Bob, in a way, science seemed to be culturally dependent for the individual scientist. For example, in reference to interpreting data, he discussed a possible rationale for different interpretations.

> A lot of that has to do with personal experiences. If we've been in an environment where these things mean one thing then we interpret them that way. . . . So there is a great degree of how you have grown up or what culture you have been exposed to that would dictate the way you interpret certain aspects of data.

His views here showed that he believes science to be partly a subjective, human interpretive system, alluding to a less than positivistic and universal endeavor.

This category also demonstrated that Bob believes that God created reality and both religion and science are human creations that try to interpret that reality:

> What we call science here in the U.S. might be very different than what somebody else calls science in a sort of distant jungle or something of that nature. . . . So what I'm saying is that there are different ways in which we as people look at God, . . . different ways in which we look at science.

He believed people have multiple ways of interpreting their reality based upon a cultural identity, and he appeared to foster an equality of cultural importance for both science and religion based upon a pluralistic approach to both cultural ideas. In other words, Bob did not appear to foster only one way of conducting either science or religion.

Bob also went into a discussion about the overlapping nature and investigation of the scientific culture into the religious culture. In reference to a question about science creating a tension for him by investigating why humans have a need for religion, he explained,

> No, absolutely not. Because what we're what they're doing at that point they're not investigating science and religion. They are investigating these cultures that have sprung out from around these. . . . And if you go farther back enough and you use a psychological aspect you can even talk about why there's a need to be there. So you're . . . in that sort of zone.

There was not conflict when science investigates religion for him because of, in part, his differentiation between God and the human created cultures of science and religion. In other words, science did not investigate God in this context but the actual religious culture. This demonstrated a potential demarcation for him between physical interpretations based upon science and spiritual interpretations based upon faith.

He went on to create a distinction between science and religion in regards to the process of developing cultural ideas in relation to the final big picture:

> So how do you evidence the fact that the universe is created from a single particle? When how do you tell me the exactness that there is a single particle that created the universe but you have no way of telling me how to get there? Well, on the other hand religion would say what you are supposed to do is feed the hungry. You're to clothe the naked. It's very specific. Now what is that going to give you? It's going to give you peace with God. But what is that? Peace of God. . . . Yeah it's fuzzy you know. Does that mean I get to wear shoes? I don't know. Yeah, you know who cares about this? But that is the exactness of what you are supposed to do.

He differentiated science from religion by using an analogy to process and ending point ideas. He basically asserted that science would have a specific ending point (law and theory) with a vague process or methodology to achieve that ending point idea versus religion that uses a specific process (moral attributes) to achieve a vague ending point "peace with God." Within his distinction for both science and religion, he created a

limitation for both cultures and a far less positivistic stance for science by even using terminology like “hocus pocus” in reference to the scientific process. He even affirmed the idea that a person cannot be sure of anything within the scientific culture. This idea clearly placed science within a realm that is the antithetical to the idea of science equating to truth or a complete factual account of reality.

He also differentiated the cultures of science and religion within the context of a system of belief. With this idea in mind, both systems of cultural knowledge maintained a very human and subjective element. In reference to a question concerning the lens of science or religion being a true picture of reality, he responded,

> We don’t. They both have a belief system embedded in them. The religion belief system isn’t about them uh you know uh here it is it is written. The Bible said it, I believe and that ends it. I’m just saying. Science says show me the empirical evidence, show me the significant difference and I believe it. . . . But both are based on a lot of faith in the systems.

Bob clearly asserted that faith played a part in the acceptance of ideas within both systems of thought and that possibly neither cultural system holds the complete, true picture of reality. Within this idea of equality of subjective belief, he went on to further differentiate the faith of religion from the faith of science by demonstrating the dogmatic nature of religion as opposed to the faith in the process for science. Obviously, the process of science for him does not necessarily equate to ultimate truth or fact.

The above-mentioned emergent ideas demonstrated that Bob understood both science and religion to be imperfect, culturally human pursuits. While they were imperfect, a clear distinction existed for him between the cultural ideas and methods of both science and religion.

Cultural boundaries. Cultural boundaries signify not only philosophical differences between the two cultures but also a sense of individual separation between the

two cultures. This separation is based in part on the different philosophical ideas inherent in each system of thought.

First of all, even though Bob wanted to integrate both science and religion in his own mind, he saw the practices and procedures of both as separate or compartmentalized cultural practices at that time. The separation for Bob was more of an external form of cultural separation instead of an internal form:

> And I have this belief in science and if I am to be at peace internally, they have to coexist at the same time. Now where I separate these two in terms of my behaviors and my practices is more from the standpoint of the world that I live in, the culture I live in. Because the culture won't integrate them.

He demonstrated a desire to integrate his religious faith and scientific knowledge but realized that culturally the practices at present did not allow for this kind of integration. For example, he stated, "from that stand point, yes, there is integration and for me I would like to blend them. But the inability to blend comes from the cultural practices that we hold for the two." His desire for personal integration was tempered by the cultural view that he believed to be currently held within both religion and science. Personal integration for him will be discussed more in the next two categorical descriptions.

Keeping the idea of cultural separation in mind, Bob seemed to understand that one boundary for science and religion was separation due to philosophical differences:

> See one of the problems that happens when you get knowledge of both of these areas. Science is a very systematic organized . . . set of activities that say there is a cause effect relationship between all things there's a logic to things that can be understood. Well when you get to a God that you can't see, you can't touch, you can't . . . deal with an intangible sort of a way. How do you get that sense of logic? Well the whole concept of religion says that you aren't suppose to even go there. You just suppose to believe it and deal with it and that's just it.

A clear distinction between science and religion existed for him because of the dogmatic nature of religious faith versus a logical process of cause and effect. He did maintain a rigid, dogmatic stance for certain religious ideas throughout the entire interview process. For him, a clear barrier existed in wanting to use the scientific process to interpret dogmatic religious ideas accepted by personal faith. Science was also viewed philosophically, and he asserted that a super-natural cause was not considered in science. The idea of philosophical differences as a boundary was further explained within the context of the limitations for science. For Bob, "science wants to explain everything," but it is clear that the explanation would be a naturalistic one versus a super-natural one. For example, Bob asserted that science cannot explain "spirituality" and "religion." He said in regards to religion, "science can't deal with that because it has no tools to deal with it." As was implied by him earlier, science can interpret the physical aspects of the culture of religion but offers no help in relating to the super-natural. This philosophical boundary or separation can be viewed further within the context of an overlapping scientific or naturalistic rationale for religion. In reference to a question concerning a hypothetical scientific explanation discounting religion, he explained,

> Actually, no, it actually wouldn't because the way I would end up looking at it. See. religion I think is much greater than the science piece from the standpoint of is its own existence. Science can't come over here in religion based on where we are in our culture and dominate religion and make religion do like it want to do. . . . But one of the tenets of religion is that it's just so. This is just the way it is kind of concept.

Once again Bob demonstrated the clear idea that religious faith is very rigid and dogmatic while science offers no dominance or trumping over religious ideas. He later affirmed the idea that the "scientific culture is biased and it has a boundary from the religious culture due to its naturalistic outlook versus its supernatural outlook." For Bob, a clear boundary

existed because of differing cultural interpretive outlooks upon reality. For him, science simply ignores the super-natural. For example, in reference to the idea of a super-natural boundary, he discussed the following idea:

> Like, builds up a boundary. Not like what I think religion does that creates a big boundary with science and says that almost that you can't go there. I think religion has a little more . . . of a tendency to create this boundary than science. I think science ignores it. So from the scientific point of view, we aren't even talking about that. That's not even an issue.

Overall, he affirmed the idea of naturalism versus a super-natural cultural outlook as a boundary between the two cultures with science ignoring the boundary and religion wanting to outwardly express the boundary. Bob further provided an example of a naturalistic interpretation for a super-natural event and clearly demonstrated the extent of the scientific philosophy:

> Yeah, unless . . . something . . . major happened. Uh we wouldn't believe. I mean, uh if the sky opens up, people are raised from the dead, he walks on water. Ah man, those are just gimmicks let me show you I can do this myself. And now what happened is there was a mad rush of science to explain this scientific point of view still.

For Bob, even during a hypothetical divine or super-natural intervention, the scientific culture would stay true to their interpretation of reality based in part on naturalism. For him, a distinction was made from two different interpretive outlooks that do not necessarily conflict if kept apart.

The category of cultural boundaries demonstrated that for Bob a distinction existed between the scientific and religious cultures based in part on beliefs in naturalism and super-naturalism. While this is a clear demarcation between the two cultures, it also served as a zone of tension for Bob as well. That tensional zone or conflict will be discussed within the next major categorical description.

Cultural conflicts. For Bob, a separation between the cultural practices of both religion and science allowed a negligible amount of conflict to exist within each cultural idea or practice. In other words, his main conflicts did not come from specific cultural ideas or practices. His main conflicts were generated in regards to a blending or integration of cultural ideas or practices.

In regards to the topic of conflict, he affirmed on the Scientific and Religious Background and Opinion Questionnaire that a tension does exist between science and religion but denied having experienced any tension himself. He initially viewed the conflict between science and religion as something that is happening with other people and not himself:

> In the general public one of the tensions exist along this whole concept of creationism. So there are those people who would say . . . God created man in His own image and that was it. There are people who say evolution exist and evolution may have been a vehicle by which humans were created . . . and that tension is born out I think more so by a general population who lacks understanding in the two.

He believed in both God and evolution and seemed to have found a measure of compatibility. In reference to a question concerning personal tension, he asserted "No. And . . . in one sense you may have chosen the wrong person because one of the concepts that I presented . . . is the thesis on evolution creation . . . both. God as a scientist." His measure of compatibility seemed to be a form of theistic evolution viewing God as the originator of the evolutionary process, and this outward cultural conflict did not foster a major internal problem for him. He was even adamant about never doubting his faith in God in relation to science. Throughout the study, Bob never questioned important cultural ideas and practices for both cultures but did seem to want to integrate or blend

cultural ideas. This blending did allow for a measure of tension with regards to certain specific topics.

He dealt with the integration of cultural ideas as one who became conflicted when integrating cultural ideas. In the excerpt below, he discussed the idea of God in light of the scientific culture:

> I immersed myself in that environment to . . . be successful as a profession. It spills over and now you want to do that for everything. Well now it's over here in this religious area and its saying OK I like this God . . . OK how does God work? Where'd he come from? How long has He been there? . . . So that science forces you to ask these kind of questions and it feels to be honest . . . a little nasty to even go there. . . . My science background won't let me not.

Bob demonstrated personal conflict when interpreting a specific super-natural cultural idea like God through a scientific lens. Personal tension was apparent when the idea of God was questioned in a scientific manner. He went on to add, "the moment that I pose these questions . . . it makes me feel less than OK." For Bob, the tension was easily seen during the cultural integration of ideas in which the super-natural was interpreted naturalistically. Bob also discussed this idea of integration in reference to the reading of the article by Mahner and Bunge (1996a):

> What I'm saying really is that I have made a deliberate choice to believe in religion. I have made a deliberate choice to practice science. Inside of me, these are two separate events that can set side by side on the table and have no problems whatsoever.

For Bob, the compartmentalization of the practice of both science and religion allowed for little tension to exist between cultural views. Within the same interview context, he went on to demonstrate a possible tension by the following statement:

> Now what I was saying about, OK, well, where you see some conflicts, well, let's . . . take those and blend them as one. . . . Now that's hard. How do you make science the same as religion and how do you make religion the same as science?

For Bob, it seemed that when the cultural practices were separated, there was no conflict. When the cultural practices were integrated, conflict for him seemed to be apparent. He went on to assert that "when we start to blend these and make these one, we now start to get into some conflict because the practice of one is completely the opposite of the practice of the other." The article by Mahner and Bunge (1996a) also seemed to create a measure of tension in dealing with the integration issue as well. Bob went on to say in reference to the article that "you've got to keep that level separate right now. . . . That's why I took my chair and I threw it over and I said okay let me answer this from only a religious point of view." All in all, the ideas and practices of each culture needed to remain separate for him in order to avoid tension "right now."

Bob did describe a specific tensional idea for him in light of science taking the place of God. He went on to describe the idea of humans becoming intelligent enough to seed another planet and produce life thus trumping the need for a divine creator.

> God came to Earth and created the Heavens and the Earth. . . . And He put human life on Earth and all of this was good. And this was the center of I guess His existence or His being by putting life on Earth. . . . Let's assume that man will go and put life on another Earth. . . . We go in the soil of the new planet and we get the ingredients to build basically a living entity. . . . And we put within that living entity the capacity to change, and evolve, develop. . . . What have we done?

For him, the idea of humans taking the place of God through scientific knowledge caused a degree of personal conflict because science was viewed as moving into an area that for him could be associated with the supernatural creative act of God. He went on to describe his conflict in reference to the above-mentioned idea.

> You know and . . . that's the conflict that I have. Because the moment that I go there and it causes me to say, "Wait a minute, well, then, what is this notion of God?" . . . And now have we become God is my question. You know that keeps bothering me. And if we are then what does that mean about the God that created this Earth?

For Bob, this specific idea of humans replacing God through science appeared to be one specific form of conflict through integration. Integration can be further demonstrated in the following statement:

> Well see, I think that the problem comes from the cultures that we're creating. This religious community says that the Bible says, I believe it, and that's it. . . . No debating science says I want to see evidence and proof of it. But wait a minute, how are you going to tell me that I've got to prove to you what God said or what God did? And show you that I can do the same things so I am now just as great as God. No, don't even go there. The moment that you go there, you've violated me.

The specific idea of proving God through science which would be an integration of cultural ideas clearly distorted his religious cultural view of the supremacy of God. This same idea was expanded on further in light of the empirical nature of religious beliefs. For Bob, trying to prove a specific religious idea like the resurrection of Christ scientifically should not be attempted. Bob explained that integration should not take place "because the moment you start to blend them you're now asking can I be God." This distorted his religious beliefs in that God is seen as supreme. Although Bob would like to integrate certain cultural ideas, he realized that to do so would allow a distortion of cultural ideas and practices that are diametrically opposite. In regards to the basic premise for his cultural conflicts being one of integration, the following excerpt encompasses much of the basic ideas involving this issue:

> Remember from earlier I said that is . . . private side that I don't do that publicly. Now even though I want to express some of that my notion is that maybe I'd like to get some of this out because maybe they'd fit together better than they are apart. But the moment that you put them together you have to ask some very, very, very nasty questions. Such as can I be God? Which is you know the bottom line kind of the deal. And now the moment that you ask that, you have to ask can I be better than God?

Even though Bob personally desired a certain measure of integration, he clearly showed that his conflict or tension with science and religion took place because of this attempt to integrate or blend the two cultures together. For him, this was clearly seen in light of the religious cultural idea of God. He was thus forced to "keep these things separate."

In conclusion, Bob when discussing each cultural viewpoint or practice, showed and offered no sense of conflict or tension. Although demonstrating a personal desire for more of a blending between cultures, when he did integrate the two cultures, he demonstrated a certain amount of tension and personal conflict. If the boundaries for both cultures were respected, then a possible series of cultural bridges or reconciliation points could be made. These cultural bridges or reconciliation points will be discussed in the next section.

Cultural bridges. Bob personally desired for a certain amount of integration between science and religion. As explained earlier, he believed that blending would bring about a distortion effect within certain integrated ideas. However, he did have a desire for cultural reconciliation and within the parameters of that reconciliation created cultural bridges between distinct interpretive viewpoints. These bridges also did not distort his scientific or religious ideas and practices.

Bob created several types of cultural bridges that can be differentiated from an integration of concepts by the initial separation of cultural interpretations. In the following excerpt, Bob demonstrated the idea of the compartmentalization to reconciliation effect:

> OK, the moment that we are okay with religion as it is and science as it is then we can ask the fundamental question: are there areas of overlap? Are there areas where science and religion overlap and basically say the same

> thing? If they say the same thing, we can then ask the question "I wonder why?"

Initially, Bob wanted to separate the cultural practices of both science and religion within the interview process but then through time shared his personal desire for integration:

> And . . . I was a peace at that point. That was one of those peaceful; we keep everybody calm and peaceful. If you ask me today, I . . . don't feel so much like that. I want to merge them. Let's make them get together and tear down these walls and get into it. And . . . come to one . . . accord.

His personal desire in this context may have led not necessarily to conflict through integration but a deeper understanding of what constitutes as a higher form of reconciliation. He alluded to the idea that the understanding of both cultures would be a process that might lead to a measure of reconciliation:

> Well, I'm saying that between the two cultures. To bring these two cultures together it takes people to be ready to open themselves up and say . . . to the alternate culture okay come in and I will deal with you whole heartedly 100%.

For Bob, the idea of opening up to another culture carried with it the idea of gaining that cultural knowledge. Thus, he basically asserted that the understanding of different types of cultural knowledge could be the catalyst for more of a deeper reconciliatory approach for understanding reality, and this approach seemed to mainly be associated with cultural bridges that he created between cultural ideas and practices.

A cultural bridge can be defined as a concept or idea that allows a person to navigate between two distinct cultural viewpoints (like naturalism and super-naturalism) without distorting the idea within the context of either viewpoint. The boundaries or limitations have to be fixed for a cultural bridge to be created. Bob created many different bridges based on many different ideas. In the following paragraphs, several of these will be discussed:

In the following excerpt and during the first interview, Bob created a cultural bridge based upon the idea of human development:

> Understanding what each is saying is a critical piece to put a place for them. For example, here's an example. If you take the development of a human, a human starts out as gametes. Gametes fuse and form a zygote. A zygote is transformed to a fish-like organism with gills and tails and all these kinds of things. Well, for a religious person there is no doubt . . . that God created humans. But at the same time there is no doubt that God created gametes to fuse to create the zygote . . . that ultimately transforms into a human.

Bob observed human development at first from two distinct cultural viewpoints. He then navigated between cultural ideas without distortion by viewing God as the overseer of the process of human development. The concept of human development linked his scientific research in embryology with his faith in a creator.

In another example of a cultural bridge, Bob explained how he viewed and interpreted the biblical record in light of his scientific knowledge. This interpretation did not conflict with his cultural views of science or religion.

> Well, the whole notion for me is that when you think about the Bible describes . . . how God created humans, it's almost identical to what an evolutionist say is that happened in a formation of a life. . . . …the Bible talks about God reaching down to the earth and taking up the earth and building man, Adam, or something. Well, that is basically the same thing that an evolution will say that led to the formation of the first living organism. …the chemicals out of this massive organic soup ultimately acquired the characteristics of life and were transformed into life.

Bob created a cultural bridge between evolution and the Bible by discussing the formation of life from two different cultural perspectives without integration. Bob basically believes that both cultural viewpoints tell the same story from different perspectives. Neither cultural idea was distorted for him because both ideas retained their cultural meanings. In fact, his scientific ideas may have helped inform his religious beliefs because of a possible allusion to the idea that God created life through the process of

evolution. In the same interview section, he went on to create a similar bridge around the concept of the progression of life:

> And the Bible talks about you know creating all of the organisms. Now wait a minute, maybe that doesn't contradict either because and I'm guessing to some degree the Bible speaks of the creation of these organisms first before man. I may be wrong. But if that's the case then that's directly in line with what evolution says.

He looked at the progression and order of life as being similar for the scientific and religious culture and created a bridge that did not distort either cultural viewpoint. In a later interview, he discussed a similar idea in relation to a reading from Genesis, Chapter 1:

> If you go back and look and see what you just said there, God created the earth, the rain, separation of day and night, the plants, the animals, the humans. You know what was just defined? . . . That's exactly what evolution says. Yeah, when you read . . . that in absolute literal sense, well what about bacteria? . . . It's not talking about that level.

Bob interpreted a biblical passage in light of scientific knowledge without distorting his biblical beliefs. He simply saw the process of evolution within the biblical narrative and limited the narrative. In another biblical idea, Bob discussed the biblical use of the concept of day in light of scientific cultural knowledge. He simply used the idea of God as having a different viewpoint about time in relation to His creation:

> Then the whole concept says that time is very different . . . something that small . . . The day in the life of an amoeba is very different than a day in the life of a mouse. . . . The day in the life of a mouse is only four hours. A day in the life of a dog is only nine. A day in the life of a human is a twenty four hours. But wait a minute, you mean if we look at these different organisms that exist well what we might consider is that a day is very different.

For many religious people, the concept of a literal 24 hour day creative cycle is very important to their religious cultural viewpoint and can be very dissimilar to a scientific approach to an old earth idea. Bob took the concept of time for humans and animals and

created a bridge for his cultural view of religion that would allow for an interpretation of Genesis to be broader with respect to the length of a day. God's concept of time is simply different than a human's concept. This basic idea did not distort his scientific viewpoint with the need for deep time to allow for the progression of life. All in all, in the context of the discussion of the biblical text, Bob never seemed to have conflict over the text in light of scientific knowledge. He created cultural bridges out of key biblical concepts.

Bob also created cultural bridges within the area of morality. In the following excerpt, Bob discussed an overlapping area for both science and religion:

> One of the areas that comes to mind instantly is the whole notion of moral values . . . that whether you're dealing with religion or whether you're dealing with science, there is the built-in mechanism that basically says that it has to be moral. It has to be of truth. . . . The way you . . . achieve this truth is different and all.

The above excerpt became a cultural bridge in the area of morality because Bob viewed the moral idea of truth through two different cultural lenses. In reference to idea of morality, he went on to create a cultural bridge around the moral idea of homosexuality that did not distort either cultural view or interpretation for him.

> So in terms of homosexuality in terms of being wrong or being right, while I speak from a personal point of view, I look at the science point of it. I try to ask myself is there a functional purpose for it? And in science there are all kinds of studies that show that . . . homosexuality can exist in other species other than humans. . . . Well, from the standpoint of creating life, that is contradictory to what religion says we are supposed to do which one of our charges is to be fruitful and multiple and all of this. . . . From the religious standpoint I don't even question as to why it exist. But rather my focus is on the fact that it does. What does it mean? Well it . . . means that there is a violation in the terms of God you've got to deal with that.

For Bob, the scientific interpretation of homosexuality was limited in that "there are some factors that cause this to happen" while the religious interpretation was one of the moral mandate to create life. Homosexuality was viewed as immoral only within the religious

cultural viewpoint and not within the scientific viewpoint. Both viewpoints were clearly separate and limited as to their scope and created no distortion for him in regards to the alternate cultural viewpoint. Thus, he was able to maintain both distinct cultural viewpoints without conflict in dealing with one concept creating a cultural bridge of multiple interpretations.

The final cultural bridge that will be discussed for Bob was a bridge centered upon the idea of theistic evolution. He created a clear cultural distinction:

> Well, one of the things that science will do for this conflict that I talk about sometimes is alright we are going to go with a blend of the two . . . God created everything. We use science as a vehicle to create all of this . . . Okay, go back to the day that God started the creation. . . . Okay explain exactly what happened. Okay alright I got that. Now go back before that. . . . so you get at a point now where it's getting real fuzzy. So at this point of Him starting it, it's already fuzzy. . . . But you can sort of conceptualize the fact that okay what if He had been there to start it? . . . And this is the mechanism that He used to do this.

This final bridge demonstrates the idea that both viewpoints were upheld and neither science nor religion for Bob was distorted. Even the term "blending" for him here took upon the connotation of separation. Bob asserted that God simply existed before the world began and used the natural processes like evolution to create the world. Within the study, Bob seemingly viewed God as separate from the creation and beyond the natural processes that explain the formation of everything. Bob has created a bridge of theistic evolution that allowed for both the religious idea of God and natural processes to coexist within their respected spheres of influence.

The idea of cultural bridges carries with it the premise that for the individual the prerequisite for a bridge was the demarcation of cultural viewpoints. When cultural views were limited within their framework, then bridges could be created from concepts that contain multiple interpretations. The interpretations would also be correct within the

framework of the cultural ideas for the individual. This was clearly demonstrated by Bob on a continuous basis during the interview process using concepts like human development, formation of life, order and progression of creation, morality and truth, homosexuality, and theistic evolution.

Although the above-mentioned phenomenon clearly took place, the reason or cause for the individual's creation of these bridges was more elusive. One possible reason dealt with the concept of faith. Bob discussed a reason for this phenomenon:

> I don't know a lot about religion. . . . So it's not because I know a lot about religion. Uh, I have a strong faith in religion but I don't know a lot about it. You know, not from the standpoint that I can quote you scriptures out the Bible and so forth. . . . So my notion of it is driven out of my faith.

He admitted that his knowledge of religion was limited. Therefore, he probably knew more scientific knowledge than theological knowledge. It could thus be deduced that his faith propelled him to create reconciliation points and not his religious knowledge. He clearly discussed the role of faith in his life:

> When I think about my childhood, I have a strong belief in God. And that's because my parents provided the environment for that. . . . But as I've grown, I haven't changed that. It's still there. Uh, it's something that . . . was natural for me to hold on and keep going. It didn't take practice . . . it didn't take you know a lot of effort you know. It was a natural kind of thing.

Both excerpts alluded to the idea that Bob had a great cultural allegiance for his own religious practice and belief. His personal faith may have been the catalyst that helped him create the cultural bridges. For Bob, one way of building these bridges would have been to have built up a faith in the cultural systems and that would seem to have taken time.

All in all, Bob seemed to create these cultural bridges because of an intense desire to view reality from cultural viewpoints that he had in the past and is currently aligning

himself with today. His faith in the ideas perpetuated by his religious culture created the "natural tendency" to create a form of reconciliation with his scientific culture.

Conclusion

Bob has existed through work or family in both the religious and scientific culture for several years, and he has created different cultural bridges between science and religion. These bridges allowed him to have a measure of reconciliation between cultural ideas. Keeping these bridges in mind, Bob asserted that both science and religion are limited cultural ways of understanding reality with a definite philosophical boundary. He displayed conflict only when he tried to integrate distinct cultural viewpoints like science and the super-natural. Bob's desire was for more cultural reconciliation. This personal desire may also lead him to construct more cultural bridges in the future.

Mary

Table 2 presents a concise representation of some patterns in the data. The table also demonstrates contextually by interview session when the patterns emerged. Six major categories were used to identify patterns over data generated from three individual interview sessions for Mary. Her "Background in Relation to a Void" demonstrated that, for her, a spiritual void developed in childhood and was later filled by her connection to her Catholic community of faith. Her "Religious Beliefs" consisted of believing in the deeper and moral lessons of her religious traditions without necessarily taking the traditional stories as fact. Her belief in a noninterfering God stayed consistent throughout the study, demonstrating a belief in the super-natural aspects of her faith. Her "Scientific Cultural Beliefs" consisted mainly of her ideas that science is both a positivistic culture and a universal process for establishing facts that have been scientifically proven. For her

Table 2

Emergent Patterns in the Data for Mary

Categorical Data	*Interview 1*	*Interview 2*	*Interview 3*
Background In Relation to a Void	1. No organized religion for most of her developmental years (A void developed)	1. Experience with mom maybe the reason she keeps religion and science separate 2. As she grew older, she needed to have some questions answered or the spiritual void filled.	1. Affirms that her spiritual void is now complete. 2. Affirms that her church is more liberal than other Catholic churches.
Religious Cultural Beliefs	1. Believes in baptism into one faith, sanctity of marriage and God (Bible not taken literally). 2. Don't need proof in Jesus – moral example is important 3. Believes in a higher being (God) that does not interfere with humanity	1. The Bible has lessons but is not necessarily true (myth) 2. Baptism is symbolic (morality).	1. Believes in guardian angels 2. Believe God aids and supports
Scientific Cultural Beliefs	1. Scientific faith is proven. 2. Initial scientific interpretations can vary (faith) and then becomes a fact (truth). 3. Science is universal.	1. Scientific culture cannot accept it if it cannot be proven (God). 2. Scientists look at reality naturalistically.	1. Both cultural realities are equally important. 2. Affirms belief system is naturalism (processes).

(Table continues)

Categorical Data	*Interview 1*	*Interview 2*	*Interview 3*
Cultural Boundaries	1. Cannot prove heaven 2. Do not need proof in the cross or the resurrection of Christ 3. Faith is something that is not proven.	1. Cannot prove the existence of an angel 2. Evolution does not disprove a God who played a role. 3. Science cannot explain things that are taken on faith. 4. Maybe science should not get to the point of accepting the supernatural (Distortion).	1. Affirms that science cannot and should not explain supernatural or higher order matters that require faith to believe 2. Affirms that religion cannot and should not explain natural matters that require empirical evidence to prove
Cultural Tension	1. Tension existed from peers who challenged her faith. 2. Her peers displayed hypocritical tendencies.	1. Negative attitude about religion in graduate school and her post doc training 2. Displays tension when integrating religious ideas and scientific ideas.	1. The idea that everything can be explained by natural selection causes tension. 2. Does not agree with extremist positions (Creationism vs. Scientific Atheism)
Reconciliation Mechanisms	1. She displays a middle of the road approach. 2. She enjoys being active in both cultures which remain separate in relation to her life. 3. Creates a cultural bridge with the human body (energy) and the human spirit.	1. Her idea of separation is related to a personal experience. 2. Creates a cultural bridge with the idea of theistic evolution.	1. God started the natural process and let it go without interfering. 2. The religious idea of God as the "Alpha and Omega" illustrates theistic evolution. 3. Science can be viewed as a way of understanding God's design.

the "Cultural Boundaries" of science and religion consisted of the idea of religious faith versus the idea of scientific proof. This related tangentially to the idea that science should probably not seek to understand the supernatural although the scientist in her did not necessarily want to limit the scientific endeavor. "Cultural Tension" emerged for her

mainly at first in light of a conflict that she had over the religious judgment afforded her by her peers. The interpretation of religious ideas (Bible) in light of science or the interpretation of scientific ideas (Neurobiology) by her religious faith clearly demonstrated conflicting elements. This interpretive tensional idea later emerged and was consistent with the other two participants. Her "Reconciliation Mechanisms" mainly consisted of her ability to keep the cultures compartmentalized in her life without integration. Cultural bridges emerged throughout the individual interview sessions but she displayed fewer when compared to the other participants. Many of the following patterns will be described and expanded upon in the next section in relation to their individual categories.

Categorical Data for Mary

Mary had several categories that emerged during the study that are described within each of the following sections. Excerpts and ideas are presented to illustrate each category and the relationship of that category to the overall thematic patterns that emerged.

Personal background in relation to a void. Her background was interesting because of the disconnect that she did have in the past with the religious culture and how that disconnect was alleviated. Mary described her religious faith:

> . . . my earliest memories, I would say, my parents were Jehovah's Witness. We would go to that it's called a Kingdom Hall. …then they . . . disassociated themselves for you know whatever reason. One reason or the other and then it was really no religion in the house . . . . We believed in Jesus Christ. We believed in God, things like that, but we didn't have an organized religion. Nor did we adopt any specific . . . religion. . . . So I would say we had a spiritual house but not necessarily any kind of affiliation from that point on. . . . A majority of my developmental years there was no organized religion in the house.

There was no organized religious connection for Mary for most of her developmental years. She would later describe a void that developed as a result "of not having that kind of real religious affiliation." She tried to remedy the emptiness she felt concerning organized religion during her "early adult years" by attending different religious functions but "it just never really felt right." She demonstrated a personal desire for a religious cultural connection, and the spiritual void was later filled with an affiliation with a religious cultural community.

> I didn't make a connection in that particular faith or that particular environment until much later when I . . . visited the Catholic Church and the Catholic faith. And it just felt very comfortable filled that void that I felt was needed . . .

She also would later add that she became baptized into that particular faith as an adult. She may have felt connected to that Catholic faith due in part because of underpinning lessons of the Bible were more important to her than the factual truth of the biblical stories. In other words, "you try to learn from . . . lessons but you don't have to take the Bible literally . . ." In a later interview, she would allude to the doctrines of her particular Catholic church being "just a little bit more liberal." This liberal nature of her church had a direct connection with her religious beliefs, which will be discussed in the next categorical description.

Perhaps the most interesting item in dealing with her background came from the description that she gave of a conversation that took place between herself and her mother when she was young. This conversation would have an impact on her life as to the issue of science and religion:

> I know that's one of the reasons why I was in search of filling my spiritual void because I couldn't really talk about religion at home for whatever reason. . . . I remember trying to about evolution with my mom. The reason I was trying to talk about evolution but it was in high school . . . the

> process of evolution was discussed. I came and asked my mom about something about the fossil collection and . . . before I even finished a discussion she was like we don't descend from apes and monkeys and things like that. And it was like the conversation was halted because she thought I was going that way, which was going against creationism I guess.

Her mother never discussed the issue surrounding this topic with her, and this event had an impact upon her in dealing with science and religion. She went on to describe that the event may have been the reason she kept science and religion "separate, completely separate." The next excerpt demonstrates the impact of this event upon her life:

> So I went on about my life. But I think you know as you picked up on as I matured and grew older, I did start to feel the void . . . and needed to have some of those questions answered or the spiritual portion filled for me.

That void was later filled somewhat by connecting to a community of faith that she agreed with in doctrine and in practice.

Mary is both a working scientist in the field of microbiology and is involved in her religious cultural community of faith. That cultural community of faith has helped fill a void in her life due to the disconnect that she felt with organized religion as she was being raised. She demonstrated balancing her professional career in science with her own personal faith practice.

Religious cultural beliefs. The next dominant category that emerged was her religious cultural beliefs. Mary can be viewed as a person who had liberal tendencies as far as religious ideas were concerned. She demonstrated belief in God or a higher being but did not necessarily believe in certain specific religious traditions that have been passed down within Christianity as a whole. Keeping her doctrinal views in mind, she did limit her ideas in her religious cultural community to faith beliefs that were partially based upon mythical accounts of religious tradition.

In the area of religious doctrine, Mary did not take the biblical stories literally but did believe in the moral principles that underpinned those traditional stories. In the following excerpt, she described her religious beliefs:

> Some of the things I do . . . believe in baptism into a faith and one baptism and not just hopping around from place to place kind of thing. …I do believe in marriage you know the sanctity of marriage and . . . belief in a God . . . a belief in the general . . . lessons of a Bible though not a complete taking the Bible . . . and saying it's in the Bible you have to live this way.

She connected her community of faith with her likeminded attitude regarding the Bible. This excerpt demonstrated certain specific religious ideas that she believed in and were important to her like a sense of permanence within a religious community of faith, the importance of marriage, and a theistic belief. These ideas alluded to the importance of family for her. She did not take the Bible as literal and believed that "human error goes into play there as well." She stated that the Christian scriptures "may have been loosely . . . based on truth but what you are actually getting from them now has lost the actual factual content." Within this context, she also asserted that "we don't have a lot of physical . . . proof really of our religious beliefs or our faith you know." She definitely demonstrated the nonliteral nature of her biblical hermeneutic. She basically believed that the Christian scripture is myth. Her faith seemed to be placed within the realm of the lessons that underpin the stories instead of the stories themselves. In the next excerpt, Mary discussed a doctrine that is central to the Christian faith:

> Well, I . . . don't know if I need proof in . . . the existence of Jesus Christ and or His resurrection. I believe I guess strongly in the ideals and the morals of the whole of Jesus Christ you know. Not only His life but . . . indicating that He was someone that was . . . God like or . . . living in the manner in which the best the highest moral manner in which hopefully we would . . . live or morals that could be passed down to help us guidelines that were passed down for us to live.

Her views about Jesus Christ demonstrated the importance of the underpinning lessons that scripture has for her. She believed that the important idea about the traditional stories are the morals that are taught and not if the stories themselves are true.

For the most part, her religious beliefs stayed consistent throughout the interview session and in relation to her acceptance of Catholicism:

> That was it was more symbolic as in . . . accepting Catholicism and being accepted by that community and now recognized as a Catholic. There are some spiritual references to the baptism, like washing away all of your previous sins. I don't necessarily agree with that kind of thing you know I don't take it to that extreme I just . . . look at it kind of starting over a new spiritual life going down this faith and this pathway and dedicating myself to this . . . faith community and . . . moral direction and things like that and gaining a foundation for my children.

For her, certain religious ideas and events recorded in scripture are symbolic and mythical. This did not detract from a personal importance that she placed on certain ideas like baptism. It simply means that she was nonliteral in her overall approach to religious stories from the Bible. She would be considered somewhat more liberal about her religious views when compared to the other participants. However, her liberality did not seemingly nullify her faith in a divine being during the study.

Even though Mary did not believe in the actual stories from her religious tradition actually having to take place, she demonstrated faith or belief in the spiritual world or certain supernatural phenomenon. For example, Mary asserted belief in a higher being or God, and she placed an emphasis on her faith. This faith seemed to only limit her religious ideas, and she differentiated it from an idea that needs proof. She stated, "That's not what . . . most religious people need. They don't need or want to see proof or disproof . . ." She further gave a rationale for the idea of faith and explained why it is important:

> There's no real proof you know but . . . the reason why it's so strong is the belief in the faith . . . or have a religious faith . . . is because it helps us

> reconcile some of the things those questions. . . . You know it's . . . hard for many of us to believe that if I die . . . you know my parents my love ones are crying and miserable that I just evaporated into nothing and disappeared. You know it gives them comfort to know that perhaps my spirit lives on now in a better place that better place you know maybe heaven or you know with the higher being…

Her faith here can be interpreted as a faith that helps answer difficult questions of life. She still used language such as "perhaps" and "maybe" which could have signified the nondogmatic or less extreme stance that she takes in regard to religious ideas. Her faith can be further demonstrated in regards to her answer on the last question on the Scientific and Religious Background and Opinion Questionnaire involving faith in a personal God. On that particular question, she marked "I do not know" in regards to faith in a personal God. In the first interview session, she stated that she believed in a "higher being" and that that "spiritual being . . . has played a role and plays a role in shaping our lives but I don't believe that this is a God that . . . interferes with human life." In a way, she appeared deistic regarding divine interference and in relation to faith in a real God that does not interfere within the natural world. Even though she did not believe that God interferes with humans, Mary believed that God does help, and she believed in prayer:

> But there are times when I feel like by leaning on Him . . . or having faith and just kind of stepping back from . . . day to day that it does kind of help . . . get me through. And I don't think that He's interfering . . .

She even went on to state that "I pray . . . quite often" and prayer "gives me some peace sometimes . . ." These ideas may have signified a faith in the super-natural aspects of her religious beliefs "peace" and not necessarily in the natural aspects of an interfering God. So her faith in her religious beliefs seemed to be quite active and consistent but not necessarily based upon the complete truth in the physical or natural reality. She also believed in other spiritual beings like guarding angels:

> I just feel like there have been times in my life that there was something that definitely interceded. . . . Driving off the road and looking up at the right moment or something seemed to get my attention. . . . There is absolutely no explanation and it just felt like something actually brought me around just in time.

These ideated emergent patterns continually demonstrated that Mary has an active faith in the spiritual side of life even if she does not believe in the reality of traditional beliefs based on biblical stories.

One subtle idea that was consistent throughout this category was that Mary separated her faith in the spiritual and physical realms. In other words, physical proof or a physical reality did not play a part in her faith. She did not necessarily believe in the physical facts of religious stories. Spiritual ideas and spiritual entities did play a part in her faith. Ideas like prayer, God, and angels seemed to make spiritual sense to her. Keeping this in mind, she compartmentalized her religious cultural ideas from her scientific cultural ideas. A discussion of this compartmentalization mechanism will be mentioned later in this chapter.

Scientific cultural beliefs. Mary demonstrated an extremely high regard for scientific cultural knowledge. She used terms like “facts” and “proven” to describe scientific knowledge. Therefore, her descriptions of science had a positivistic or truth-based allusion to them. Although she demonstrated a limitation as to her knowledge about different areas of science like physics, she maintained a resolute faith in science as a universal process and as a factual basis for reality. In the next excerpt, Mary discussed faith in regards to scientific knowledge and practice:

> I don’t have to have that kind of faith in the tools and practices that we put forth and the theories that we put forth and the data that we seek to support . . . because that’s going to be our foundation for therapies and you know the applications that help to better human life you know. . . . I would say . . . a non-believer would say that well I’m really . . . proving . . . my

> scientific faith. I'm proving it with data that comes out or the application I'm showing. I have an end product in my hand that was a result of whatever I was believing in that . . . I actually proved.

It appeared that Mary viewed faith in science as something that would be verified in time whereas faith in the supernatural could not be actually proven. Mary used the term "proving" to differentiate scientific faith from religious faith, and her positivistic tone was further demonstrated in the next excerpt in relation to a discussion concerning science and facts:

> Science . . . yes, I believe in the end product it's putting forth theories and . . . backing those up with some kinds of facts. You know even with everything we know pretty much about almost everything and that the reason why evolution has been . . . it has been proven. You know maybe . . . we haven't filled in every single gap of evolution you know . . . still got missing links here and there but there is genetic records there's actual physical records of the process of evolution and those types of things. So I do believe there is factual information to back up science.

Mary had a strong view of science as a completely factual and reliable source of knowledge. She also believed religious knowledge to be almost opposite in regards to the idea of factuality and proof. This demonstrated a major difference in her viewpoint for each culture. The cultural differentiation can be demonstrated further in relation to a discussion dealing with human interpretation being involved in science:

> We have known facts we have some kind of . . . proof or data. You know just like in the Bible as well as I was saying earlier, it is human error that goes into play. And that's why there is a faith that's part of science. That mixing those invisibles . . . is going to give you what you think it is. I mean you know I've always think like physics. . . . I have to have faith in his knowledge and his ability I suppose to interpret the data. And a body of his peers . . . will . . . agree on those decisions. And so . . . yes that theory stands and this is now a fact kind of thing. And so yes the interpretations . . . can vary but it . . . becomes . . . established or accepted . . . knowledge.

This excerpt shows a discrepancy between her viewpoints about cultural knowledge. The Bible was equated to "human error" and the term "fact" for her equated to "something

that's true." This was different from Bob's personal take upon the human interpretation of science being very subjective and not necessarily fact. Mary basically asserted that human interpretation happened at the outset for science, but if the knowledge was accepted by the scientific community, it would become known as fact and the fact would be true. Her viewpoint about science was very much positivistic with scientific knowledge establishing factual information. In the next excerpt, Mary discussed part of a reading out of Mahner and Bunge (1996a) dealing with the philosophy of science. Mary had a problem with her initial interpretation of a section of the article that discussed the idea that scientific truth was partial or approximate while religious truth was absolute or ultimate. She initially disagreed with this idea about science but later changed her mind and continued to reflect her positivistic ideas:

> Understanding of things is always evolving as we get better tools and things like that. Better methods to investigate. . . . facts can be partial. I understand that it can be partial. Just because you don't understand the complete picture doesn't mean that . . . part of it isn't a true fact. You just don't have the complete picture. You know only a small let's see let me go back to that. I think truth is partial and approximate. I guess I just don't like the way it's written. It's not fully in context.

She eventually changed her mind and agreed with the authors about scientific truth. Overall, the article by Mahner and Bunge displays a measure of positivism in relation to the dependability of science over religion. She did not like the overall tone of the article. Mary did cling to the idea that science was about facts even if they were only partial facts. Her positivistic tone stayed consistent throughout the interview process.

Her scientific cultural beliefs also related to her ideas about science itself being a culture and that culture for her displayed naturalistic tendencies. Within the cultural context, she also believed science had a universal nature as compared to religion:

> Yes, I … do. Science is yeah I can see that you know being universal regardless of . . . where you've grown up where you've lived. . . . What you learn about microbiology here should be the same across the world if you're studying microbiology.

She affirmed that this viewpoint was the difference between science and religion. At the beginning of the research study, Mary did not view science as being affected by the values of a culture. Later, a definition of culture was stated as being "an established set of rules, doctrines, knowledge that is passed down from one generation to the next." She then affirmed the link between science and religion:

> That we all have a scientific . . . process the hypothesis theory . . . the scientific method is done in the same manner and it's always. And I teach my student's and my . . . future research students to do the same practice the same scientific method you know. The original theory still stands that was put forth by Darwin. . . . So science . . . people always say that . . . they do say the culture of science and like it's . . . own culture in itself. So yeah if you look at it that way it is a culture.

For Mary, her cultural views reflected her positivistic leanings. She even viewed the scientific method as static and universal. The subjectivity of science was almost non-existent in this excerpt. She viewed science as a culture that fosters traditions that do not change much with time. In a later interview section, Mary alluded to the nonsuper-natural tendencies of the scientific culture in reference to God:

> Lots of things could exist but we just don't have any way of proving or the method or anything like that so again we have to although the way the culture of science is . . . you can't accept it if you can't prove it or have evidence . . . you have to at least know it's there.

Mary affirmed that science could be flawed because it refuses to go outside a naturalistic explanation and she stated that "Just because we can't prove it doesn't mean it doesn't exist." In a later section of the same interview, Mary described certain naturalistic ideas in reference to her connection with the article by Mahner and Bunge (1996a) and in light of her ideas about paranormal research being scientific. She did not discount the idea of

paranormal research evolving into science one day but the research would have to establish “some facts” that can be scientifically validated. In reference to the paper, she also admitted that scientists including herself “look at it totally naturalistically.” For her, science is about understanding the natural processes. Because she was neither an atheist nor agnostic, her form of naturalism would be considered more functional or process oriented. This form of naturalism did not negate her personal religious or super-natural beliefs. She simply seemed to compartmentalize both systems of thought.

As this category demonstrated, Mary continued to use positivistic terminology when discussing her scientific cultural beliefs. She held scientific knowledge in very high regard throughout the entire interview process. She also affirmed science to be a naturalistic culture that has universal qualities. In the next category, a boundary between both cultural views will demonstrate her underpinning faith in science as not only a process but also a belief system.

Cultural boundaries. This category demonstrated the limits of both cultures in relation to one another. In other words, this category was differentiated from the categories of Religious Cultural Beliefs and Scientific Cultural Beliefs by the idea that she discussed the cultural limitations of each one in reference to the other. For Mary, the scientific or naturalistic interpretation of reality puts forth a measure of proof using natural causal agents through the use of empirical evidence. For her, the religious or supernatural interpretation of reality puts forth a measure of acceptance of supernatural ideas based upon faith. Mary demonstrated a clear boundary between the scientific and religious culture.

Mary looked at religious ideas and clearly demarcated those ideas from scientific ideas. She discussed the idea of heaven and created a boundary for that idea within the realm of religion. She stated, "if you do xyz, you'll go to heaven. How do you know? We can never prove if you did this you're going to go to heaven." For her, the terminology used to describe science "prove" does not fit in reference to this supernatural idea. A clear boundary in regard to positivistic terminology was demonstrated in this case. One foundational idea for Christianity is the resurrection of Jesus Christ. This idea also did not seem to connect with the positivistic idea of proof for her. For example, she stated "I don't need . . . the proof that He actually was on the cross, the proof that he did come back." Throughout the study, empirical evidence did not go with religious ideas. She asserted that both cultural ideas are distinct and separate from one another. She also discussed angels in reference to her personal constructed boundaries. She stated that "many people have felt somebody intervene and help them that day. And we often say angels did it and that kind of thing. But can you prove the existence of an angel? No." Within this boundary related to angels, she affirmed a clear demarcation for science based upon naturalism. In the next excerpt, Mary discussed the concept of faith in relation to needing proof:

> So you know it's the same thing it's just that faith . . . something you don't prove. And it goes back to my earlier comment. I just think people that have that faith don't need that proof you know. Because it's a kind of in their reconciliation and peace that is each person takes from what he gets.

For Mary, her religious ideas carried with them a boundary that separated them from needing any type of scientific evidence and proof. Even her faith while being personal seemed to go beyond the need for proof. While being a different form of cultural knowledge, religious faith was not looked down upon or to a lesser degree by her when

compared to scientific knowledge. She even stated that both science and religion "are equally as important" in her life.

Mary also limited her scientific ideas from the need to intrude into the religious realm. In the following excerpt, Mary discussed evolution in light of religion:

> How could you dispute there is a dinosaur bone? We have the fossil. . . . You can't say that . . . they didn't once exist or that they didn't play a role. There's different stages where you can see evolution in the process, the evolutionary process. So you can't discount that but for me I still don't feel that . . . brings into religion.

For her, the idea of evolution was clearly demarcated from the idea of religion. She even believed that faith in evolution does not negate either faith in God or some form of divine intervention within the evolutionary process. She stated that belief in evolution "doesn't . . . disprove that there was a God that played a role in it . . ." Some ideas were not as clear as to the limitation or boundary of science. In the next series of excerpts, the concept of the paranormal was discussed as to whether or not an investigation of that phenomenon is scientific or not. She started by acknowledging that topic as nonscience in reference to a question concerning things that science cannot explain:

> The only thing that I can I am sure there are lots of things that science can't . . . explain. But most of it comes back to the things you take on faith I guess. Or has a more spiritual because we don't . . . necessarily acknowledge for instance metaphysical stuff. Things ghost hunters and things like that. . . . Is a good example of it would never be looked at as a real science because you can't prove those types of things and if you are investigating or have paranormal stories that's just entertainment. That's not real science.

Science was once again viewed by her in a positivistic format and as different from a form of knowledge that is taken on faith. She completely separated the two cultural systems in this context. In a later section of the interview, she went back to this topic and expanded upon her earlier viewpoint:

> What if somebody could tap into the supernatural? What if somebody could devise a machine that would sense supernatural events? . . . So do you discredit them and say that you can't ask that question, you can't attempt to? . . . but you know I don't think I would be quick to judge but you know what if they do it for forever and they can never get anywhere. Then they know that you can't prove it. . . . Then it doesn't develop into a science.

Mary had a somewhat easier time demarcating religion from scientific ideas but for her it seemed that limiting science was more difficult. She still fell back upon the idea of proof for the existence of super-natural entities. Her positivistic ideas became for her the boundary line that separated the religious culture from the scientific. In the final discussion about this topic in the same interview, Mary discussed the paranormal in light of a possible naturalistic explanation versus super-natural explanation. She stated, "I don't know . . . if science would ever get that sophisticated to be able to accept the supernatural . . . I don't know if science will get to that point. And again maybe we shouldn't." All in all, Mary discussed the supernatural as being a boundary for science not because it is necessarily super-natural but because the super-natural cannot be empirically tested and validated. Her view of the boundary line for science and religion was more or less static and unchanging.

During the last individual interview, Mary affirmed that the boundary line between science and religion is a natural interpretation (naturalism) as opposed to a super-natural interpretation (super-naturalism) of reality. During the study, she also described atheistic or theistic ideas that try and use science to bolster their positions as both going beyond the boundary of science. Throughout the interview sessions, she held a positivistic viewpoint that pervaded the idea of a limitation for science being one of proof. Thus, a big part of her religious and scientific cultural views existed as the boundaries or separation points for both cultures.

Cultural tension. Mary did not like tension to be a part of her life, and she believed that this aspect is tied to her personality. She asserted that the tensional idea is one reason she keeps the scientific and religious cultures separate. However, her personal predilections did not equate to being perfectly free of conflict or tension. She demonstrated a tensional aspect when interpreting one cultural view in light of the other culture. She also maintained that certain members of the scientific community display a particular amount of bias for the religious culture or community. Overall, she demonstrated the she does not appreciate that bias.

First of all, Mary stated on the Scientific and Religious Background and Opinion Questionnaire that she is becoming aware of a tension that exists between the scientific and religious cultures. She also asserted that there is no tensional aspect for her personally. During a discussion of the questionnaire, she talked about the tension between science and religion:

> Well, I have to only really speak from my point of view and not that I really feel I've never been exposed in the . . . environment where a religious person came at me saying being a scientist is wrong because it's anti-God or whatever anything like that. But what I have been exposed to is scientists on the other hand who believe that it is ridiculous to believe in God. . . . And so . . . the tension that I felt have been from some of my own peers . . . not here . . . that you know would challenge the fact that I have a religious faith and a religious belief because they think it's pretty ridiculous.

She has been exposed to a certain amount of bias against religious perspectives within the scientific community, and this bias has left a lasting impression on her mind. She believed that for some of her peers, science basically equates to an atheistic world view and this world view looks at religion as lunacy. Mary later discussed the hypocrisy of certain scientists' beliefs in regards to this bias and described in more detail this tension from the scientific community:

> There are different periods of my education where it was more prevalent. . . . Graduate school was I saw the beginnings of that but it was more so at . . . my post doc at a heavy research institution and I don't know if that had an impact because these were a higher level university doing higher level research. . . . You know my advisors all the way down to the graduate students. I don't know if that is why I came across more of that negative attitude there. . . . most of the negative views unless it pertained to things that were very personal I did see them turn to a religion. Getting married, oh I have to take sacraments, I have to take vows. Or in terms of poor health, leaning on or going returning to their spiritual foundations. I did see that.

She thus pinpointed a specific time and place in which the tension happened. As she advanced within the scientific culture as far as training was concerned, the culture displayed more of a bias against religion. It was interesting that she asserted that the biased scientists turned to a form of religion thereby demonstrating the possibility of having a relationship to both cultures. Within this context, the idea of hypocrisy created a measure of conflict for her in that peers would display religious traits and yet would "knock" her "for going to church regardless." She not only displayed a negative attitude toward that bias observed in an earlier time in her life but also displayed negativity toward scientists in general who show a bias toward the religious culture. In a later interview and after reading excerpts from two books that demonstrated a clear bias toward either theism or atheism, she described her thoughts on the books:

> I think "Finding Darwin's God" was easy of course for me to read. His tone probably matched more of my tone whereas Dawkins I found very difficult to read . . . because of his attitude, his immediate stance. …and you know . . . the title of it "The God Delusion." If we're delusional for believing there is a God and his belief that everything can be explained by natural selection was just very annoying.

She affirms the idea of conflict arising from two extremist perspectives: (a) a dismissal and disregard for religious perspectives by a scientist in reference to natural selection going beyond the boundary of science and (b) creationists who impinge upon scientific

ideas. She affirmed that both extremes go beyond the boundary of science. Overall, Mary displayed a negative attitude for anyone within the scientific culture who believes and asserts that science somehow trumps God's existence.

In general, Mary attempted to keep both cultural viewpoints separate. However, at times during the interview process, she tried to integrate opposing cultural ideas and this created a tensional aspect for her within the interview process. Mary thus created a certain amount of personal conflict when she viewed the religious culture through a scientific cultural lens. The following excerpt demonstrated a response by Mary to the partial reading of Genesis, Chapter 1:

> You know, the thing is this again, this is why Genesis is so hard because you know you can look at it as . . . thousands of years passing and all these events and this being the process of evolution of God or . . . the generation of His earth. . . . You know some people use the big bang as God sparking all these events to occur. . . . I have no reconciliation for Genesis whatsoever. . . . 'Cause science . . . how could you . . . prove this? This is one of those, Genesis to me is one of those most perplexing

She clearly displayed a degree of tension when trying to integrate certain scientific and religious cultural ideas. One interpretation is that she displayed this tension because during the process of integration she interpreted the religious reading through her scientific positivistic lens. She demonstrated that she believes the Bible cannot be empirically proven. With this idea in mind, it is interesting that she did not fall back here upon her nonliteralist beliefs about scripture and simply separate both systems of thought. In the following excerpt, Mary was asked to discuss any tension in regards to another reading from Genesis chapter one that describes the creation of humankind:

> I think does bring a little to me . . . so. That's when I believe the writers of this Bible interjected their own thoughts and beliefs or what . . . their hopes into this. . . . The Bible says that man is created in God's own image and things like that. . . . Do we not take what we look like today as what we looked like then? . . . But we know we have documentation of

> Neanderthals and different forms of man that has come. Where did they come from? . . . I don't . . . know. I can't . . . reconcile the . . . man fossil with the introduction of man at the time or shortly after the generation of earth.

In the both above instances, Mary was not asked to integrate science and religion but simply asked about any tension that the scripture might bring about. The attempt to interpret the religious ideas in light of her scientific knowledge demonstrated a clear tensional context. The two differing cultural ideas did not reconcile well for Mary.

At one point, she did attempt to link a form of reconciliation with a nonliteral viewpoint of scripture but could not elaborate upon this idea. If reconciliation equated to more of an integrative process for her, then it is understandable as to why she demonstrated conflict.

Mary also demonstrated a measure of conflict in dealing with the interpretation of scientific cultural knowledge in light of religious belief. Within the context of an outside reading of Mahner and Bunge (1996a), Mary discussed the possibility of conflict due to the hypothetical idea of working in another scientific field:

> I do feel the paper brought up kind of a good example as far as when they were talking about people that might study neurobiology and . . . when they think about the soul and the mind. . . . But people that are a part of neurobiology . . . considered that the mind is tied to the brain which is a part of a function and once the brain dies then there is not mind therefore . . . there is not mind or soul that lives on. . . . And so you know some people may think that you know that you can't really divorce that because the brain body is still alive . . . perhaps you know they still have their spirit. It is there still lingering and you know they may have a religious belief.

Mary clearly viewed the scientific interpretation of this issue as simply a physical process without a spirit or soul and the religious interpretation of this issue as needing a spirit. The problem for her arose when both interpretations were merged together. For Mary,

religion was seen here as possibly interfering with science. She went on to discuss religion's impact upon this area of science:

> I could see it coming into play more because you would have to constantly tell or explain to people defend that you know this person has passed on and . . . their body is you know there. You would have to say their soul is not here or something like that which ties into religion. ...I know it's not very clear.

The above excerpt demonstrated that Mary has difficulty when trying to view certain scientific ideas in light of her religious cultural beliefs. Mary asserted that she does not like any conflict and would not want to be in a field or even teaching a class in which conflict would take place in dealing with science and religion. In reference to this particular issue, she went on to state, "I would try to steer away from something like that, that would force me to integrate the two on a daily kind of basis." Mary believed herself to be a "middle of the road kind of person" who did not want to gravitate toward the extremes. She wanted to keep the two cultures separate as much as possible.

For Mary, the conflict over the issue of science and religion came about from an integrative approach to both cultures. She did not like conflict and asserted that she wants to keep the cultural ideas separate personally and in practice. However, at times as the excerpts demonstrated, when opposing cultural ideas are viewed simultaneously, a measure of tension or conflict became apparent when she tried to interpret one culture in light of the other. She was also aware of the tension caused by a measure of bias within the scientific community against religious ideas. Overall, she wanted to display a middle of the road approach and not offend others within her scientific cultural community with an overbearing approach to religion.

Reconciliation mechanisms. Mary did not spend very much time trying to reconcile her religious faith and scientific knowledge. She separated or

compartmentalized both cultural views. This compartmentalization of cultural views was the dominant means of reconciliation for her. However, she did create points of reconciliation by creating bridges between cultural ideas.

Reconciliation for Mary involved the idea of separating cultural ideas into different spheres of influence. In the following excerpt, she discussed reconciliation in the context of a discussion involving her answer to question 6 on the Scientific and Religious Background and Opinion Questionnaire (Appendix A) involving the idea of tension. In her answer on the questionnaire, she stated, "I have never really gave it much thought or felt it was necessary to reconcile one with the other. Thus, I may exist in a naïve bubble – works for me!" She went on to describe her approach to this issue:

> Right, well, yeah, that's . . . what I mean . . . my middle of the road approach is kind of . . . I just walk my path and . . . don't really concern myself with other people. Nor have I felt the need to even though when I think back to . . . when I was thinking about my mom and you know how I couldn't discuss evolution and things like that. And then getting in another environment where it was strictly evolution was the complete belief.

She did not gravitate to extremist perspectives in relation to both cultural viewpoints. This may have been due in part to her personality or "middle of the road approach." She went on to say in reference to her graduate work: "So everyone was evolution crazy and I wasn't so much one way or the other you know." This nonextremist perspective may have partially led to her reconciliation mechanism of compartmentalization.

> Still even . . . now it's just like, OK . . . I . . . don't have like I still don't have a . . . clear reconciliation I haven't read any . . . works that said oh yeah this is really . . . what I'm thinking of how I deal with it. I just kind of yeah I like science; I enjoy investigating the questions you know. Many of us that do micro pathogenesis hopefully can make some kind of contribution that will help eliminate that disease which you know I can do that . . . would be great. At the same time, I go to church and I enjoy that part of . . . my life and . . . the mental tools that are laid down I used as a foundation for my life and I continue on and I just exist in my little bubble

> and just hope to be a good person and raise my children in the same manner.

She obviously had not completely reconciled both cultural perspectives nor had a tremendous need to do so. Neither culture dominated the other one for her. She compartmentalized each cultural domain in a different sphere of life and obviously enjoyed both aspects of her life. Her religious faith was part of her "moral guide work" that "carries on into everyday life," but she did keep "separate" her faith in God from her scientific pursuits. Mary believed her faith was somewhat tied into her moral compass or direction. She even asserted that questions of her theistic faith do not have a part in her day to day work as a scientist. Similar personal reconciliation mechanisms could also be seen by the way she presented scientific ideas to her students. In reference to teaching evolution, she attempted to "negotiate it again down the middle" and not force the students "to believe in any of this." In a later interview she discussed a rationale as to why she keeps both cultural viewpoints separate in light of her childhood memory of the conflict with her mother:

> I think maybe that experience with her is why I never did . . . I continue to keep them separate, completely separate. . . . That's probably why I do back off when I'm talking to other communities when I don't know everyone's religious beliefs. . . . They will turn their ears off if I immediately offended them by saying you must believe in evolution or you must believe . . . that God designed this. And so you know you lose people. They stop learning if they feel like you are trying to bias them in one way or the other, or convert their religious viewpoints. Or even their non religion. Atheists get just as offended.

Mary simply presented the scientific material without trying to influence belief. She never crossed boundaries with science and religion, keeping them in separate spheres of influence when she teaches as well as in the majority of her life. She stated, "What if I found a cure for cancer? . . . And it comes out that she's Catholic. Oh, my gosh, she's a

Catholic . . . a Catholic found out . . . a cure . . . that would be ridiculous. It wouldn't matter." All in all, she tried to stay within her personally constructed cultural boundaries and this created a form of reconciliation which emerged as her dominant mechanism for maintaining an allegiance to each culture.

Even though she admitted to not working at a reconciliation process, Mary did create zones of reconciliation. These zones or cultural bridges allowed for her a measure of reconciliation. These bridges also came out of her ability to separate or create boundaries between the two cultures. One cultural bridge was created around the idea of a human spirit or soul:

> If you look into people's eyes . . . I don't want to say you can see a spirit but there's obviously something animated in each person . . . and that's gone when they die. And for me that's the spirit which is the same thing as their soul. And to get up every morning and you know see my spirit see my soul feel it interact with others and then say ok after I got hit by a bus now it meant nothing. That . . . light and energy that's there is gone and it meant nothing it had no effect no purpose on this life. . . . I feel the peace of knowing . . . my soul will go on in one form or the other and hopefully that's what other souls and that higher power that ignited that spirit.

She used the ideas of animation, light, and energy to interact with the idea of a human spirit. The concepts were never integrated but were compared and left within certain cultural boundaries. No distortion of naturalistic ideas or supernatural ideas took place. Mary used a theological concept of "spirit" or "soul" and created a bridge around that concept that could be viewed from two mutually exclusive cultural perspectives. For her, the idea of spirit could be separated or demarcated from the naturalistic viewpoint of energy or something animated thus allowing it to become a static concept within its own sphere of influence because it could not be scientifically proven. This idea of an energy source or spirit did not only fit into each separate cultural belief system but also connected viewpoints enabling Mary to create a cultural bridge.

Mary also created a cultural bridge using the idea of theistic evolution. The following excerpt is directly connected to the idea that Mary believes in a God that does not interfere with human choices:

> I think that is kind of the way I reconcile evolution. That you know this spiritual being probably started life, at one point. He started it and kind of let it go and watch and see, He saw what happened. But He is not necessarily interfering and dictating okay you need to go this way and you need to go that way and this way. You know and same thing with us you know. We're born . . . we make choices in life and things like that you know.

She created a space for both her scientific and religious ideas to coexist. According to Mary, God simply started the process off and evolution took over. She allowed for both evolution and a creator who does not interfere with human choices, which reflected her religious beliefs. This idea demonstrated a personal reconciliation with both cultural viewpoints without distortion or conflict. In the following excerpt, she discussed theistic evolution in light of a selected reading from Kenneth Miller (1999), who is also a theistic evolutionist. The reading alluded to possible bridges that the author has for himself in dealing with the ideas of predestination versus free will in reference to evolution. The idea of free will in the reading resembled Mary's own theological ideas about a non-interfering God. The following quotation was her response to the reading:

> I like that and it reminded me of a book. And it's totally a fiction book but by one of my favorite writers. She writes science fiction, Anne Wright. She wrote a book in which and this is going to sound silly. . . . This vampire basically gets to go and experience heaven and hell at the same time from God's point of view and talks to God. . . . And her point of view God was basically, kind of similar to what I think. That set things in motion and just set back and said wow look what's happening, look at this. And completely engrossed at how things were evolving and moving along and what humans were doing and coming up with. And it was all just kind of coincidence.

She asserted that God started evolution and basically stepped out of the way. She never clearly expounded upon how God actually started the natural process, but it was clear that the scientific and theological ideas were separate for her. In the next example of the use of theistic evolution, Mary used her religious knowledge to create a cultural bridge:

> That's one of those things from the Bible you know God is the Alpha and Omega, the beginning and the end and He was just that intelligent. He was just that clever, anything, whatever descriptor you wanted to use to be able to do that you know. It would be very boring if He . . . set this in motion knowing that it was going to lead to that. . . . But you know, how could we know . . . His purposes?

She connected her religious cultural viewpoint with her scientific cultural viewpoint without distorting either culture. She demonstrated a belief that God is the beginning and end and that alluded to the idea that evolution is a divinely inspired but not necessarily directed process. She used her biblical knowledge (Alpha and Omega) to create the bridge between cultural views. Her religious beliefs remained intact especially involving the idea that God does not interfere with humanity. Her scientific cultural views were also left intact without the interference of a creator throughout the process of evolution.

In the final example of a cultural bridge, Mary created a bridge out of the idea of science itself. The next excerpt was a response in reference to both science and religion conflicting:

> I don't see them as conflicting at all. I mean we think that for those of us who has faith, do we think that God is a jealous God that doesn't want us to figure out His plan so He figured out He set forth how flowers should bloom. . . . Because what do we do, generally the . . . greater good in society is taken into account. You know we invent new things to help mankind for the most part. And so I think all of that is pleasing and good and God looks upon that favorably. . . . And so I just don't understand the idea that you can't have two belief systems and that they . . . can't exist.

Mary demonstrated that she views science as a process for understanding God's design, thereby connecting that process with the theological idea of the favor of God. In other

words, the idea of science was linked to her theological ideas about God's wanting society to benefit. Science thus became a cultural bridge of reconciliation for her as she viewed it in light of not only her religious beliefs but also her beliefs about the human need for the process.

Mary believed both science and religion to be parallel spheres or cultures of influence that need to be respected in their own domain. She reconciled her faith and scientific knowledge by separating both cultural viewpoints. She also created cultural bridges based upon nonintegrative cultural interpretations that clearly correspond to her basic beliefs about both science and religion. For the most part, her reconciliation mechanisms allowed for very little conflict for her with this issue. The mechanisms also reflected her personality as a person who does not like conflict and has a middle of the road persona about this particular issue which causes extreme stances in others within her own scientific culture.

Conclusion

Six categories have emerged within the individual interview process that demonstrated that Mary believes that science and religion should be completely separate. Her cultural beliefs showed both science and religion to be distinct entities with separate ways of viewing reality. Her boundaries for both cultures appeared to be for the most part clear and limited. Her background demonstrated a person who is very conscientious about filling a spiritual void that developed early in life. What tension there is for her came in the form of either those within her own community who try to ridicule people of faith or an occasional integrative moment in which the scientific and religious culture were used to judge one another. Her reconciliation mechanisms showed primarily a

compartmentalization mechanism that allowed for cultural bridges to be created in part because of clear cultural limitations.

Susan

Table 3 presents a concise representation of some of the patterns in the interview data. The table also demonstrates contextually by interview session when the patterns emerged. Susan's "Dichotomous Background" category demonstrated an extreme dichotomy of cultural beliefs and involvements. The "Scientific Beliefs and Knowledge" category demonstrated both a high regard for evolutionary ideas and naturalistic processes for understanding the world. Her high regard for the cultural pursuit of science stayed consistent throughout the study. The "Religious Beliefs and Knowledge" demonstrated that morality and personal belief in God are more important in an active type of faith than the issues surrounding religion and science. The "Tension and Conflict" category demonstrated that certain cultural beliefs in religion conflict with her scientific understandings of evolution and cannot be reconciled. More of an integrative response to certain issues surrounding the conflict demonstrated the distortion of cultural ideas. She also seemed to have more personal conflict in regard to her own religious culture than the other two participants. The category "Cultural Boundaries" started to emerge during the second interview session and demonstrated a clear limitation for science in reference to the supernatural. "Reconciliation" demonstrated the need to separate cultural ideas for herself and in reference to dealing with other people in both cultures. Cultural bridges were used by her on a consistent basis throughout the study. Many of the emergent patterns will be elaborated upon during the next section.

Table 3

Emergent Patterns in the Data for Susan

Categorical Data	*Interview 1*	*Interview 2*	*Interview 3*
Dichotomous Background	1. Geneticist – inferring population history and molecular evolution 2. Attends conservative church (PCA) in which certain individuals cast a negative light on evolution	1. Co-founded the Graduate Christian Fellowship 2. Discovered that God has answers to certain questions 3. Tells students that she is both a molecular evolutionist and a conservative Christian	1. Goal is to intrigue students and co-workers with faith
Scientific Beliefs and Knowledge	1. Evolution is a mechanism for variation and an interpretive lens. 2. Science equates to knowledge (facts) in relation to the physical. 3. God is not a testable hypothesis. 4. Science has cultural values.	1. Naturalism provides a good explanation that works (genetic code). 2. Science can trump a faith based conclusion about the physical world.	1. Seems to affirm naturalism as the cultural belief for science
Religious Beliefs and Knowledge	1. Religious knowledge comes from various sources, requires faith, and is less open to criticism. 2. Believes in a physical basis for biblical stories 3. God has moral authority and that authority is expressed in the Bible.	1. Does not want to interpret figuratively behavior passages (slippery slope) 2. Her active faith is not just based upon the past but also the present and future.	1. She wants to believe in Adam and Eve and their conversation with God. 2. Makes a separation in her interpretation of Genesis (science and morality)

(Table continues)

Categorical Data	*Interview 1*	*Interview 2*	*Interview 3*
Tension and Conflict	1. Evolution requires death to take place and this does conflict with the theological ideas of the fall of humanity. 2. Her community of faith would feel uncomfortable if she took a figurative approach to Genesis. 3. In academics, religion is viewed as anti intellectual and uneducated.	1. Academic cultural advancement is tied to critical thinking (faith is difficult). 2. It is possible that Adam and Eve were not real people (disparity). 3. A reading from Genesis does not correlate with a scientific understanding (Integration)	1. God could have manipulated the environmental conditions (Distortion of evolution). 2. Religious cultural ideas seem to bring conflict (hell and suffering). 3. Chapter 8 in Dawkins' book tests faith.
Cultural Boundaries	1. Science does not prove or disprove God. 2. Science does not address teleology just physical causality.	1. Scientific explanations assume there is no supernatural being (physical reason). 2. Intelligent design equates to proof in God or supernatural explanations and science will not be open to either. 3. The supernatural cannot be quanti-tatively measured.	1. If you prove God with science, then you can manipulate Him.
Reconciliation	1. Comfortable with cultural separation partly because it does not impact her behavior. 2. She desires to reach out to both people of faith and science (no integration). 3. Creates a cultural bridge between genetics and a God shaped hole in the heart 4. Creates a cultural bridge in dealing with scientific explanations for moral behavior (Choice).	1. She agrees with Catholic Theologian friend that trying to prove the Gospel scientifically is wrong. 2. Creates a cultural bridge from the scientific idea of photosynthesis. 3. Creates a cultural bridge form the theological idea of an on-going creation.	1. Creates a cultural bridge out of cultural inconsistency. 2. Has idea that God's physical law maybe continuous with His moral law (Do humans have a choice?)

Categorical Data for Susan

Six major categories emerged during the interview process with Susan: Dichotomous Background, Scientific Beliefs and Knowledge, Religious Beliefs and Knowledge, Tension and Conflict, Cultural Boundaries and Reconciliation. The major ideas that encapsulate each category that relate well to the overall thematic patterns are discussed in this section.

Dichotomous background. Both Susan's scientific background and religious background were somewhat opposite in that she operates within two very different extremes of cultural belief. She was not only fully immersed in scientific knowledge regarding human evolution but also regularly attended a conservative evangelical church. Throughout the study, Susan demonstrated a thorough knowledge in relation to evolutionary ideas. She earned a Ph.D. in developmental genetics from Yale University and "did postdoctoral work in human genetics and human population DNA variation" at Emory University. She asserted that her postdoctoral and current scientific work looks at "human genetic variation, inferring population history and molecular evolution." She went on to describe some of her work in relation to "population genetics" in that a scientists "can look at the DNA variation and infer something about that population history." Susan's scientific research and background demonstrated one that is fully immersed into evolutionary thought, and she was comfortable discussing evolutionary ideas within the realm of the scientific culture that she operates. This scientific background and involvement was interesting when compared to her background and current involvement in her religious culture.

Her religious background demonstrated a willingness to be actively involved in the reconciliation between religious ideas and other apparent discrepant views produced in the academic culture. This willingness to be actively involved would not come about until adulthood. She grew up in primarily a non-religious home:

> I'm probably the most . . . faith-based person . . . so the rest of my family is not well I mean I think like my dad believes in God and he may think Christianity or Christ is like a great teacher. . . . I think my sister is like agnostic and then my mom is probably atheist or something. But . . . they're not adamantly opposed to the church. So . . . when I developed my own personal faith, I was more in college . . . more of an adult decision, but it wasn't like my family was anti religious when I was growing up. So I grew up with Christmas and going to church a little bit but not a lot.

Susan described her religious walk as a "personal faith" that grew in adulthood. She demonstrated that she probably had an early interest in the Bible and God as a child but her personal religious faith did not develop until her undergraduate college experience at Emory University. She stated that she "went to some of the Bible studies that was presented by this college group . . . and the strength of the college group was that they showed how rich scripture could be and how interesting." After discussing the development of her initial faith, she went on to assert that her faith really grew in graduate school because she "had to face evolution more" and was involved in a group of students who "were all challenged." Her group of Christians in graduate school "would try to work out the genuine valid challenges" that they would receive from their academic field of endeavor, which was "heavily anti religious." In a later interview, she explained how her group in graduate school took the Christian gospel and tried to make it applicable to all the academic areas. This idea would basically become "the mission of the Graduate Christian Fellowship" that she co-founded. Susan believed that the group in graduate school allowed her to grow in the viewpoint that her faith was a rational part of her life.

She asserted that the challenge given to the group in graduate school allowed her to see that not only does God "have an answer for these questions" but also allowed her personal faith to grow. All in all, the basic conflict during graduate school would lead her to create a measure of reconciliation between her culture of faith and her scientific cultural knowledge.

Her current involvement in her religious culture was seen in part as an outgrowth of her earlier days of being involved in the above-mentioned groups in college and graduate school. Susan asserted that she is an evangelical Christian who attends a Presbyterian (PCA) church and would be considered to some degree a conservative in many Christian religious settings in the United States. This conservative nature was demonstrated by her statement that "the churches I go to, . . . there are people who think evolution is wrong but I'm not going to go to hell for it." Her conservative church affiliation was also demonstrated in the context of a discussion in a later interview about teaching science to students who have a religious cultural barrier against learning science:

> I can tell my students that well I'm a Christian and . . . I just tell that I go to churches . . . that some people have a problem with evolution. . . . But I'm a conservative Christian and I'm a molecular biologist and I study evolution. I just tell them who I am, I don't necessarily talk about it. I just say, if you have any questions about it or would be interested to find out more . . . you are welcomed to do that outside my class.

She offered here to discuss religion and science outside of class, which demonstrated that she does take an active role in offering ideas for reconciliation. This active role in reconciliation was demonstrated within the context of a later interview:

> It is also to intrigue students who don't have a faith or who are more into the science that I hope to show that you can have a faith and that you can be a good scientist to. So I . . . suppose my main goal is to intrigue the students and to intrigue my co workers, my colleagues. I mean I don't talk about it as much with my colleagues. . . . You just live out your life.

The use of the term “intrigue” may have demonstrated an eagerness to share her faith with others, if not with words then with a lifestyle conducive for her personal faith walk. However, within all of the interviews, Susan demonstrated taking an active part in helping others with the issues surrounding religion and science.

In conclusion, Susan’s faith was demonstrated to be an active religious faith that has come about in adulthood and continues to be active with her involvement in her own community of faith and in the sphere of work. Her scientific background was very heavily immersed within human evolutionary knowledge. These dichotomous cultural involvements appeared to create in her a conundrum of beliefs (cultural allegiance) that will be explored in the next few sections.

Scientific beliefs and knowledge. Susan’s knowledge of science emerged as primarily knowledge that falls within the parameter of human evolution. Although we discussed several scientific topics, here I focus on evolutionary ideas because those ideas relate somewhat to her overall categorical ideas. Within this category, some of her evolutionary ideas also related to her views about the nature of science. Initially, she differentiated science from religion by explaining science as a process for understanding the physical world, and the process is what created the context for the demarcation for her within the individual interview sessions.

Evolution for her encapsulated what science is and should be about. She stated, “I . . . believe evolution . . . I think it’s the best . . . explanation for the variation that we see. So . . . I’m willing to mortgage my house on it, let’s say.” She went on to assert that biology would be very difficult to teach without evolution:

> Biology is a science . . . just trying to explain the physical world so evolution provides a mechanism for . . . the variation we see, so if you

> take it out then you know we lose the ability to . . . hypothesize the mechanism about how did the variant arise.

She also admitted that evolution carries with it a lens of interpretations inferring naturalism. She went on to explain this interpretive outlook upon reality:

> The . . . closest . . . challenging analogy—because I have tried to open my mind to … challenges to evolution— . . . might be like a . . . chair versus a stool. . . . …as a biologist you see this and you're looking through the lens of evolution and you assume that they are related. But you know the chair and the stool have no genetic relationship . . . So yeah I admit that there is a lens of interpretations.

Susan admitted to the need of an evolutionary lens for biology and alluded to the idea that biology would not make sense without evolution as it is a naturalistic mechanism through which change happens in nature. Thus, Susan asserted that biology is completely dependent upon the underpinning idea of evolution. She did seem to be honest and open about the interpretation of reality based upon a scientific or in this case an evolutionary lens. This verbal exchange seemed to offer a less positivistic (science equates to truth) viewpoint of science than the next excerpt. The following excerpt comes directly from an answer that she gave on the Scientific and Religious Background and Opinion Questionnaire. Overall, she wrote much more on the questionnaire than the other two participants. This excerpt dealt with question number 7 or the compatibility between scientific knowledge and her personal religious faith:

> Science is a gift from God. It is done imperfectly, but done well enough to let us learn about the world and do technological things with nature. A scientist comes up with a theory to explain the natural physical world. All or parts of the theory can be correct. Other scientists prove or disprove all or parts of his theory. Darwin contributed greatly with an all-encompassing theory that explains a lot of the diversity we see, plus a mechanism to account for it.

She asserted that science has its basis in God and is a way of understanding the world. The above quotation also dealt directly with her views about the nature of science. Even

though that excerpt was more positivistic, using terms like “prove” and “disprove,” she created more of a human and fallible context for viewing science. Overall, she viewed Darwinian evolution as a positive pragmatic idea that ties many other ideas together within the scientific cultural framework.

Her views on the differences between science and religion seemed to also illustrate her scientific beliefs. Science equated to “facts about the material world” whereas religion equated to “wisdom.” Within this context, she also viewed scientific knowledge as knowledge that is associated with learning about the physical world and separated that from learning about the super-natural. The following excerpt clearly demonstrated her views of what science constitutes as compared to religion:

> Real science is about you generate a hypothesis on a physical matter and . . . the hypothesis has to be testable meaning that you prove or disprove it. But if it’s not testable then well I mean maybe for future you can test it. But if you want to prove whether God exists or not, that’s not a testable hypothesis.

In this context, science is a physical process as opposed to a theological process of understanding God. She went on to assert that science itself is really agnostic toward the belief in God. In other words, the process can neither prove nor disprove the existence of God.

For Susan, science was also viewed as a culture that is a part of the academic culture that is made up of to some degree a diverse population. She believed that both science and religion are infused with cultural values. She used terms like “efficient” and “stronger” to describe positive scientific cultural values. In the following excerpt, she discussed changes within her scientific cultural knowledge over time:

> I think it was assumed that . . . only a few changes were made in evolution. . . . Those changes would be deleterious and then when molecular genetics and molecular techniques came along and they could look at proteins and DNA at the molecular level, they saw that there was a lot more variation in the healthy population than we expected. . . . So that

> kind of changed things. So to a non biologist that might seem small. But it didn't throw out evolution. . . . It kind of changed.

She described science at times as a changing culture within an academic attitude that is slanted toward political liberalism. Within the cultural context, she also believed that the cultural explanation is also a practical viewpoint that is culturally static in regards to a naturalistic interpretation. In other words, scientific ideas might shift at times, but the natural interpretation remains the same. The following excerpt which dealt with the interpretation of the genetic code demonstrated the static naturalistic nature of science:

> You can see the code as a pattern of design and I think that an atheist, geneticist or the official version is just that . . . are run by evolution. So if there is design in it, it's pattern that's accounted for. So there again we see . . . the genetic code. You know this set of genes, this family of genes. It's a family of genes and they're kept there because of their function.

Susan demonstrated here that evolution is the naturalistic idea that accounts for the data in regards to the genetic code, and the naturalistic idea is always adhered to within the scientific culture. She went on to assert that the cultural idea is "locked in" because of the idea that "it continues to . . . provide . . . a good explanation that . . . works." She even affirmed that science fell within the parameters of a culture as defined by Geertz (1973), and she was quick to assert that the term "culture" encompassed everything. All in all, Susan had no problem viewing science as a culture with certain beliefs and interpretations of reality.

In conclusion, her scientific cultural knowledge was demonstrated primarily in the area that she works within through research and teaching. Within this area, she demonstrated a strong viewpoint of the validity of evolution. She even asserted that evolution is a principle or a fundamental tenet of the biological sciences and not simply a theory. Science for her was about physical reality as opposed to a spiritual reality. In the

next excerpt, Susan discussed the purview of the scientific culture in relation to religious cultural understandings:

> You know, you could have a faith-based conclusion for physical creation. Oh, well, you think these are vital fossil records and God put them there and designed them to be such and such. And a scientist will say that no this is the reason that the fossil record is . . . and this is the reason that the faith-based conclusion is wrong. So that is an official endeavor in science.

Susan basically asserted that the scientific cultural purview exists within the area of offering a physical explanation of the world. The physical explanation that science offers was her basic overall viewpoint for scientific thought and practice.

Religion beliefs and knowledge. Susan's religious beliefs can be described as those beliefs that create in her an active and personal faith. Her religious knowledge was demonstrated as such that created for her a measure of spiritual growth within the context of what she believed to be a real and genuine relationship with God. Her religious beliefs and knowledge were intensely personal and spiritual. Her overall views about religion did not seem to change no matter what questions were asked. In other words, she maintained her same basic religious beliefs throughout the study which in some cases seemed to demonstrate either personal tension or reconciliation. The tensional and reconciliatory aspects will be discussed in other categories of this section.

Her answers to a question on the Scientific and Religious Background and Opinion Questionnaire demonstrated her basic religious beliefs and knowledge. The following excerpt contained part of her response to question number 8, which was concerned with the difference between scientific and religious knowledge.

> Religious knowledge goes beyond just understanding the physical world (although it can include the physical world). But religious knowledge is about teleology (the purpose or end of things) and origin (physical or spiritual). Religion is also about morals and correct behavior or correct relationships—between self and God, self and other human beings, and

> self and self. The morals given in religion guide the follower, and there is a concern in the follower (and in God) about the moral character of the person.

Morality, purpose, and origin seemed to encapsulate her initial viewpoint about the differences between religion and science. Later during the study, she alluded to the idea that the individual has free will according to choices of moral behavior. The next excerpt also came from a part of the same answer to question number 8 on the Scientific and Religious Background and Opinion Questionnaire:

> Religious knowledge seems to come from various sources—sacred texts, teachings of the church/institution/cultural tradition, prayer and reflection, life experiences. Because religious knowledge often requires leaps of faith, and holding true to a particular doctrine, it seems less open to criticism and modification (thus the rub with science).

This excerpt demonstrated not only her understanding of the origin of religious knowledge but also her willingness to be honest about the conflict between the two cultural viewpoints. She maintained this honesty throughout the interview process. All in all, the answers to the questionnaire allowed a personal glimpse into not only her theological ideas but also a possible basis for conflict (integration) and reconciliation (separation) with her scientific ideas.

Susan also demonstrated religious beliefs and knowledge about issues surrounding biblical views and interpretations. Her active faith also seemed to demand a certain allegiance to the truthfulness of the biblical text. She even asserted belief in the physical basis for biblical stories. The following excerpt demonstrated her allegiance to the truthfulness of the Bible:

> I think of Adam and Eve as real people. . . . So like in church when they are held up as models for marriage or something like that I think . . . that is valuable and I don’t think it’s just a hypothetical thing.

This excerpt did not necessarily mean that she takes a complete literalistic viewpoint about every story in biblical scripture, but overall she does hold them as having a truthful quality. For example, the next excerpt demonstrated what she is willing to adhere strictly to and what she is not within biblical interpretation:

> So as a check on my own behavior and my own choices, I make sure I don't get too figurative . . . about what the Bible says about our own personal behavior. So I will allow some blessing with my belief about what the Bible says about the creation of the physical world. . . . I don't think that necessarily impacts my behavior or how I treat my neighbor.

Susan demonstrated a willingness to take a softer and less literal approach to certain biblical ideas that do not directly impact moral behavior. During another section of the same interview, she affirmed the belief that Jesus was a historical figure who lived and died and also affirmed a certain measure of respect for biblical archeology. She did not take too much of an allegorical approach to biblical interpretation. She alluded to the idea that her morality might suffer from this approach. For example, she stated "I suppose I called it a slippery slope because . . . it's easy for Christians to make hard commandments to kind of reason them away." In reference to the other hermeneutical extreme, she did not take too literal of an approach to biblical interpretation either. She went on to state that "if I allow myself a figurative interpretation to Genesis, which I have to . . . if I want to also believe in evolution." This statement did not mean that she allegorizes the entire book of Genesis, but she does take somewhat of a figurative interpretation for the actual creation story. Susan did not want to go too far with an allegorical or figurative approach to her interpretation of biblical literature because of moral issues. The moral behavior affects her today and allows her to view her faith as an active faith. The next excerpt demonstrated this idea:

> So to me you know as a Christian what impact me . . . how I treat my neighbor and how I believe in God. …I mean so belief in God is not just about what God did in the past. It's about what God is doing for us or me today and what He will do for me in the future.

Susan viewed biblical literature not so much as something to be argued about and proven but to aid her in living out her faith today. In a later interview, Susan described a specific biblical interpretive idea in light of her active faith:

> And . . . trying to be open to what is God teaching us. So . . . that's why I want to keep Adam and Eve. What were they thinking when they were talking to God? And . . . I don't want to take a figurative interpretation on my actions because those are my identity elements as a Christian. . . . I am able to be soft with the physical elements with . . . what God says about the physical creation because that's not a part of my identity as a Christian.

Susan identified certain ideas as having a direct impact upon her Christian faith. Other ideas like evolution and the Genesis account of creation do not impact her moral identity elements directly. The next excerpt went into more detail as to a reason she is willing to take a softer approach to certain biblical stories:

> I make a separation for like my interpretation of Genesis. I'm willing to entertain a soft interpretation of Genesis so that I can continue as a biologist, as a molecular biologist. But because of evolution and creation do not affect how I treat my neighbor, I'm okay with that.

Susan seemed to want to interpret certain biblical ideas as having taken place because of the idea that they have a direct correlation to something relevant to her faith walk today. Certain beliefs would be consistent within her current identity as a Christian. For example, she stated that "God has a moral authority over you and that authority is expressed through the Bible, . . . that people have failed God's moral standards and . . . that Christ represents an atonement for that standard." Because of her belief regarding Christ's atonement, she asserted, "You aren't trying to earn your way into heaven: You're just trying to follow God's laws." All in all, Susan did hold an allegiance to the

biblical record as a whole as coming from God and literally accepts many ideas while holding a softer or less literal position on other ideas. She demonstrated that she believes and accepts many biblical ideas, such as God as the creator, Jesus as the Son of God, and the moral commandments as coming from God, because they directly affect her morality and walk of faith. With reference to religious knowledge, she demonstrated someone who believes and practices a personal and daily walk of faith based upon the moral principles of the Bible while simultaneously wanting to participate in the scientific community. The final excerpt in this category demonstrated this walk:

> A part of it is that you step out in faith and when God is faithful to that then that fills your belief or your faith that God will come to you and provide for you. So personally I am hoping that I will do that more so that I will grow more in my relationship with God.

This final statement summed up her religious beliefs and knowledge as grounded in what she already knows about God and her active faith in that God.

Tension and conflict. Although Susan discounted any personal tension between science and religion for her on the Scientific and Religious Background and Opinion Questionnaire and within the study, a measure of tension and or conflict was demonstrated during the interview process. She displayed a certain amount of conflict when dealing with the active involvement within the scientific and religious cultural communities, certain religious and scientific cultural ideas that seem to counter the opposing cultural ideas, and an integrative approach to both science and religion. Overall, she seemed at times more conflicted than the other two participants, especially in context with her own religious ideas and how they relate to one another and her own scientific knowledge.

Susan displayed a certain amount of tension when discussing involvement within her own religious culture. She demonstrated a personal knowledge for her in dealing with certain people in a religious cultural setting and an obvious affinity to their position. In reference to a reason certain religious people view evolution as wrong, she stated that "I think [they think] . . . it disproves God . . . and that it directly contradicts the Bible." She demonstrated an understanding of the position of many within her community of faith and also those who attend a more conservative church. The following excerpt showed a glimpse into the interaction between herself and her religious cultural community:

> So a good friend . . . he was a historian that just . . . how can you believe in evolution if it's a mechanism of . . . death. Right so natural selection shapes a population kills . . . the ones that have the unfavorable elements . . . but the Bible says there's this . . . pre-Fall state so in . . . Presbyterian church I think in general Christian church . . . before the Fall Adam and Eve and then after the Fall. So before the Fall . . . there was no death and then after the Fall humans experienced physical death. . . . There is . . . definitely a disconnect between how I function as a faith person versus as a scientist.

Susan described a conflicting area between her scientific cultural knowledge and her religious cultural belief or doctrine. Her conflict came from the disparity between the scientific process that uses death for speciation and the theological idea that asserts that at one time humans existed without death. This disconnect or conflicting element could not be reconciled for her. This excerpt not only demonstrated the disparity between her personal scientific cultural views and religious cultural views but also showed a glimpse into a possible disconnect for her as well between her religious culture and scientific culture. She stated, "People in my church would begin to feel uncomfortable if I took a figurative interpretation of Genesis." Because she did take a somewhat figurative approach to Genesis in regards to a literal 7-day creation period during the interview process, she probably could not be too vocal about these issues within her own

community of faith. Within a similar context of conflict with her own religious community, Susan also seemed to assert a measure of conflict over certain moral stances or inconsistencies that the church for her elicits. She stated, “Well, there’s all this attention on abortion or homosexuality and not as much attention on atheism. I mean if you really want to be logical about it, atheism would be the worse sin.” This same issue about the negativity of homosexuality was also mentioned on the Scientific and Religious Background and Opinion Questionnaire and obviously carried a concern that she had regarding the hypocrisy of ideas. Overall, Susan seemed not to agree fully with all ideas generated within her religious cultural community. In some cases and over certain ideas, Susan appeared to demonstrate a measure of conflict with her religious cultural community.

Susan also demonstrated tension regarding her involvement in the academic and scientific communities. In reference to the academic culture, she stated that “religion is seen as anti-intellectual and uneducated. But human nature is the same anywhere. Everybody loves to make fun of someone else.” She demonstrated a belief that if the academic culture was “completely fair about evolution versus some other theory that there could be . . . some alternative explanation.” She clearly viewed the academic and scientific cultures as biased against religion. The following excerpt demonstrates a possibility as to why for her the academic and scientific communities are antireligious:

> You might say academics are at risk for not believing because their ability our ability to think critically is a deep part of our identity and self worth. . . . So our ability to publish, our ability to be promoted completely depends on our ability to thinking critically and demonstrating to others that we can think critically. So . . . it makes it very hard for an academic to accept something on faith . . . and so it could just be part of their own personality to. . . . Young graduate students take a lot of their science culture and their academic culture from their academic superiors. So the

> attitudes of their advisors may have for their senior post docs or just senior scientists is passed on down to younger graduate students. So . . . like my first week at . . . I had like three different . . . conversations about Christianity. Like oh goodness, why are you a Christian?

She discussed this issue from two different perspectives aligned with both cultural viewpoints. She obviously understood what it means to compete mentally within the academic and scientific communities. She also understood what it means to feel a bias against her own religious faith. Overall, she appeared to understand the nuances of the science and religious conflict but to demonstrate an empathetic nature for both cultures.

A disparity is apparent when Susan attempted to integrate opposing cultural ideas. The opposite or seemingly contradictory cultural ideas did not for her become a coherent idea that meshed with both systems of thought. She discounted any personal conflict but simply asserted that she maintained a measure of peace with the disparity between cultural ideas. An integrative approach by her demonstrated a distortion effect for certain cultural ideas. An example of this phenomenon was demonstrated by her in discussing Adam and Eve and a pre-Fall existence in light of evolution:

> I think of Adam and Eve as real people. And . . . I still can see as possible that . . . they weren't real people and you know the genetics is part of me of human evolution occurring in a group. So here is definitely a . . . disparity between my faith and between my science.

Her biggest disparity with science and religion seemed to be with this issue which was discussed in all three individual interview sessions. Susan had no clear reconciliation for Adam and Eve and early human evolution. She simply chose to live with the unreconciled cultural ideas. In fact she stated that she does not "try and reconcile it . . . because there are other discrepancies in it anyway . . ." It was clear that the ideas have to be separated and not integrated for her. When she attempted to integrate certain particular ideas, the cultural distortion of ideas took place:

> Yeah, so it just . . . all I know is I'm not ready to throw out Adam and Eve and the model and the relationship they had with God and I feel like that God doesn't want us as Christians to do that. But it could be totally possible that they weren't real people.

The possibility of Adam and Eve not being real or they're being simply allegorical would definitely conflict with her religious beliefs because of the moral implications from the story. The next excerpt more clearly demonstrated in detail the rationale that Susan had for keeping Adam and Eve as literal truth or fact:

> Eve believed the serpent as another source of authority or the serpent caused Eve to doubt God's commandment . . . and then Adam chose to believe Eve over God's commandment. . . . So there are moral lessons in there and . . . you know me thinking about the interactions between Adam, Eve, and God you know . . . effects your own relationship with God or it . . . impacts you know how do you respond to God's commandments.

This excerpt pointed to the idea that for her Adam and Eve represent ideas that correspond to her religious cultural identity and she did not want to give up that part of her identity. She went on to assert that Adam and Eve could simply be "early hominids" as far as their physicality is concerned. She did not want to integrate the hominid idea with "the conversation between . . . God and Adam and Eve" because "it just totally waters down this very deep lesson" concerning faith. She demonstrated that she simply lives with not being able to reconcile the opposing cultural differences. She seemed to keep the cultural ideas separate in her mind and accepted the biblical account by faith. By mentally integrating the ideas of Adam and Eve with the idea of being hominids, the religious cultural meaning was clearly distorted for her. Within the context of cultural integrative problems, Susan also demonstrated cultural distortion and conflict when discussing a reading from part of Genesis with her scientific ideas:

> I mean, it seems like a rough . . . correlation I suppose to the scientific account to the creation of earth. …you might try to interpret it as well . . . yes, the atmosphere or the galaxy was completed so the heavens and then

> the earth . . . yeah we assume the earth was completed but there were no plants yet. So in verse 5, it says no shrub in the field and no plant had sprouted. . . . You might have trouble with well there was no rain yet . . . because we assume in the early earth that there were all the elements present. . . . I mean water and then the periodic table of elements. . . . I don't know . . . enough about early atmosphere but I assume there was rain. . . . I know when I continue to try and match things up; I'm going to run into a disparity.

This excerpt demonstrates that when Susan tried to integrate religious ideas with scientific ideas a measure of cultural conflict or distortion took place. She ultimately responded with the basic idea that God is the creator and how He did it really does not matter. Overall, she could not reconcile certain religious ideas with her scientific knowledge. Within a similar contextual framework, a distortion of scientific ideas could also be seen in view of the next integrative approach:

> As someone who prays to God . . . for my day and thinking that God is acting in human history or current events. You've got to think that God is tweaking this molecule or that molecule. . . . So here's the distortion in evolution in me that I do . . . I mean God could've created particular environments. He could've moved the continents. . . . That would be demanding that science try to measure or prove that God had something to do with the movement of the continents.

This excerpt demonstrated for her a distortion effect for evolution when integrated with a God who would provide a possible mechanism for the process. All in all, while discussing specific cultural issues, Susan demonstrated an integrative approach which clearly created a distortion and conflict of cultural ideas.

The final issue that brought about a tensional effect for Susan was the religious culture itself. By virtue of her background, she displayed a tremendous amount of knowledge about evolutionary ideas and did not appear conflicted personally with the scientific knowledge. She also denied conflict with the issues surrounding religion and science. She simply asserted that she did not try and reconcile the issues. She did appear

personally conflicted more in dealing with religion itself. A possible personal conflict could be seen within the context of a discussion about Richard Dawkins's book, *The God Delusion*:

> And so . . . that's what I suspect with academics or people who cannot believe in God. In that they don't, they're used to controlling as much of their life as they can and that's the most important thing. And I don't mean that in a bad way like they are control freaks. It's just simply . . . you make a logical choice so why would you not make a logical choice for this good outcome in your life.

She basically seemed to question simple faith in God versus living out a logical life as one might do who is involved more in the academic culture. She also read a chapter that was not assigned for the study out of the same book based purely upon personal interest and went on to describe her conflict with religion:

> Okay, well, the hardest questions that I find is when my student ask how can a loving God send someone to hell for eternity. And so the theological part of me knows some kind of official answer like an official answer for suffering, and an official answer for what is good is determined by God's definition and all that. But you know just as a person it is very hard.

This excerpt clearly demonstrated that for Susan the religious cultural issues cause a certain amount of personal conflict. She went on to state in reference to the reading that "Now . . . that's the chapter that begins to wear you down. That you're like really like God what are you doing? . . . So that is where it does test your faith. I feel like that tests your faith." This chapter from Dawkins's book addressed the religious side of the argument rather than the scientific as to why there is no God. Terminology like "tests your faith" suggest an honesty and openness about personal tension within faith issues.

In conclusion, Susan appeared to be more personally conflicted in the area of her religious cultural ideas. She demonstrated that she has lived and, in some cases, lives with a certain amount of prejudice displayed in both cultures towards her ideas because

of her involvement in the opposing cultural community. She was also willing to live with certain conflicting cultural ideas that for her cannot be reconciled. The following excerpt demonstrated her overall opinion of being involved in each culture:

> I mean you're reminding me or you're making me realize that for people who have to absolutely be consistent with everything then they will not be able to do what I do. . . . So I suppose my hope is to reach people who are able to maintain a disparity.

For her, there seemed to be no clear and logical reconciliation between science and religion because of several issues. If she truly equated reconciliation with more of an integrative approach to cultural ideas, then her conflict was understandable. She thus demonstrated living with the conflicting cultural ideas without attempting to find a complete reconciliation.

Cultural boundaries. This category demonstrated the actual underpinning, demarcating principle between the religious culture and scientific culture. The demarcating principle could act as a source for reconciliation or as an impetus for conflict or disparity when violated. The underpinning principle which acted as the limitation or boundary between the two cultures was a naturalistic interpretation versus a super-natural interpretation of whatever reality was being investigated or discussed.

Throughout all of the individual interviews, Susan maintained that the difference between religion and science was one of outlook and not simply methodology. A major part of this cultural boundary between science and religion could be demonstrated by looking at the way Susan personally viewed the boundary in reference to the scientific culture. She discussed the limitation of science in reference to a naturalistic outlook:

> It limits the . . . valid purview of science so I think . . . a scientist will say science doesn't prove or disprove God. . . . . .I think the randomness of evolution is it just is and whether it's the mechanism that's used by God or not and . . . so I think that's the rub when people try to get . . . scientists to

> teach creationism as an alternative theory is that . . . we're not trying to say something about purpose or teleology were just trying to explain physical mechanisms for how something is or why it's cause and effect the physical cause and effect. But we can't say anything about the ultimate purpose.

Susan demonstrated that ultimate purpose belongs to the realm of religion and science does not by its very nature discuss ultimate purpose. Within this excerpt, she also demonstrated that science deals with the natural world and does not by its nature prove or disprove God. She went on to assert in the same interview that proof of the existence or nonexistence of God is not testable, therefore not scientific. This basic idea displayed a clear line of demarcation for her between science and the existence or nonexistence of God and even asserted that agnosticism would be the actual unbiased approach within science. Part of this outlook or boundary for science dealt with the idea that for Susan science espouses naturalism as an underpinning philosophy or belief system. This idea clearly demarcated science from religion for her. She stated that "any scientific explanation assumes that there's not a supernatural being. They're just trying to find a physical reason for what we see." Because Susan demonstrated throughout the study that she is a theist, her personal naturalistic tendency would be more functionally oriented within the realm of the scientific process rather than in a strict holistic personal belief system. This same outlook or boundary can be demonstrated further in reference to a scientist viewing a hypothetical biblical miracle. Susan stated that "official science which is natural assumption and not supernatural assumption is always trying to fit events into physical law and doesn't want to make exceptions to physical law." This statement once again demonstrated that for Susan science in and of itself displays the characteristics of naturalism in that it seeks for natural explanations for everything that takes place including hypothetical miraculous events. Another example for her that showed this

demarcating principle would be in the case of miraculous healings. Susan created a specific boundary by showing two different outlooks for the same event (faith and science):

> It would be a personal faith or . . . the scientist who . . . sees all that same evidence that the doctor . . . the medical scans and the patient with integrity and if they're going to go out and try to they're looking to go and disprove God basically.

The context of the above excerpt dictated that Susan did not mean that the scientists were trying to disprove the existence of God in this case but to disprove super-natural intervention. Overall, for Susan, the scientific community and culture did not foster super-natural explanations. This boundary line was further discussed within the context of the philosophical difference between Intelligent Design and science:

> I don't know what the official line … of intelligent design is. . . . There is proof of a God and the lesser extreme is just sort of open to I think intelligent design is trying to get science to be open to . . . supernatural explanations. And that's a line that science will not go over.

Susan in the above excerpt clearly demonstrated that intelligent design is not science because of an interpretive outlook upon reality. So for her, science could be demarcated from religion by the outlook which uses naturalistic explanations for reality instead of supernatural explanations for the same reality. Susan doubted that cultural outlook or purview would ever change.

The cultural boundary between science and religion could also be viewed within the context of the philosophical outlook or underpinning belief system fostered by the religious culture. Susan discussed a boundary between religion and science from both cultural perspectives:

> Religion cannot talk about physical things and . . . give physical explanations or it's limited. It's very limited. I'm going to trust science and its physical explanations more. . . . You know if we're going to talk

> about a physical phenomenon then I am going to base my mortgage on the scientific explanation. . . . But at the same time science needs to be humble about . . . if it's going to try and disprove God. You know it can't. . . . If it says well we have this molecular explanation for the burning bush… Then it needs to be humble enough to say that you can't . . . disprove God.

Susan demonstrated that physical explanations should not be primarily attempted within the religious cultural realm. At the same time, she asserted science should not be trying to disprove God even in reference to offering a physical explanation for a biblical miracle. In other words, she probably felt that because science associates with natural explanations, it should not cross over and make pronouncements within the realm of the super-natural. Within this context, Susan asserted a boundary for science by looking at the super-natural scientifically. She stated, "by definition religion is getting to know . . . God and accept the supernatural, and science is about getting to know the physical and quantitative methods and you can't . . . quantitatively measure the supernatural." For Susan, the super-natural could not be physically measured and religion by definition was separate from science. She even asserted that God could not be statistically proven or disproven. The following demonstrated this basic idea of proving God through science:

> And I might have mentioned it to you before. But a very wise . . . Christian said but yes as soon as you are able to scientifically prove God then people will automatically say well how can we use this God? …so and I think that's totally true.

These statements demonstrated a rationale for her religious cultural view as to why a boundary between science and religion should exist and that boundary has to do with controlling God through science. She asserted a higher viewpoint of God in relation to science and maintained this viewpoint throughout the study. Overall, for her God should be separate from scientific interpretations of Him.

In conclusion, Susan accepted the idea that the boundary between science and religion has to do with the philosophical idea that religion equates to a super-natural explanation of reality while science equates to a naturalistic explanation of reality. Although she did not necessarily like the term “boundary” as much as “identity elements” because of the flexibility of the latter term, she did affirm and demonstrated on occasion cultural conflict when the philosophical boundary between science and religion was not respected.

Reconciliation. For Susan, reconciliation started with a dichotomy of cultural ideas that were kept separate especially when a conflict was viewed among opposing ideas. This separation mechanism allowed her to be actively involved with both cultures even though there was a measure of conflicting cultural elements. However, she did create cultural bridges between different outlooks or viewpoints of reality which did not allow for a distortion of cultural ideas.

Susan created a measure of separation to exist personally as a reconciliation mechanism. She seemed to use a measure of separation at times because of apparent conflicting cultural ideas and used separation at times from more of a philosophical approach. Separation of cultural ideas seemed to have a prominent role in how she dealt with being actively involved with both cultures. The following was more of an overview statement about her beliefs in dealing with her major conflicting ideas of Adam and Eve, the pre-Fall, and evolution:

> So the scientist part of me . . . thinks oh well God must have made the current world through evolution but then the faith person like I still think of the Genesis account as a real account that applies to me. I still believe in the pre fall in an Adam and Eve as . . . a human model.

She demonstrated that the scientific cultural idea of evolution conflicts with the religious cultural ideas of Adam and Eve and the pre-Fall. In this context, she asserted not trying to reconcile these conflicting ideas but simply living with a disparity. She divorced personal conflict from herself by separating the ideas into different cultural viewpoints and described clearly both the scientific and religious viewpoints in relation to this topic. She stated in regard to the scientific view that "there are studies about when pre hominids became aware of death or an afterlife." She went on to state in regard to the religious viewpoint that "after the Fall there's . . . more laws and more awareness of nakedness and what's right or wrong." In both culturally ideated descriptions, a switch occurred creating either a human being or a fallen being, but no connection was attempted by Susan. She simply kept them as separate cultural ideas and may have separated the ideas because a complete reconciliation through some integrative means does not work. She stated, "And part of the reason why I'm comfortable with this . . . disassociation . . . is that I feel like it doesn't really impact my behavior." She demonstrated that her behavior, which is a major part of her religious cultural beliefs, is not affected by certain issues in Genesis, so she is able to live with a disparity between cultural viewpoints. Overall, she seemingly separated evolution (how humans got here) from religion (how humans should behave) and even asserted that the apparent randomness of evolution did not pose a problem for her theologically. She simply separated God from the ability of science to measure Him mathematically and possibly control Him. This separation acted as a reconciliatory mechanism for her in that it allowed God to exist apart from scientific investigation. The following excerpt further demonstrated a desired separation for her between having to scientifically prove God versus having faith:

> I have a friend who is a Catholic theologian at Notre Dame and . . . I don't know it could be a part of Protestant theology . . . but he is very good at explaining how. . . . he thinks that like the Christian, the church's effort to try to prove God or . . . any effort to try and prove God through scientific meaning is futile and actually works against the gospel. . . . The gospel is meant to be a mystery and . . . whatever conviction is going to occur in someone it has to be through themselves or between themselves and God. I don't know if I'm paraphrasing him correctly. But I really like his explanation. . . . There's a role for apologetics but I really like the Catholic theologians view that . . . trying to prove the gospel through scientific explanation is the wrong way to go.

Susan shared a possible philosophical separation about her friend in the way people view reality through scientific effort and the way they view reality through faith. For Susan, compartmentalization was frequently used in light of several issues surrounding religion and science.

Separation or compartmentalization could also be viewed as a way she related to other people about this issue. Susan stated, "there is an unnecessary tension between science and religion, and that the ongoing cultural wars regarding evolution in the classroom only forces both sides to deepen their own convictions." Susan believed the tension to be a cultural conflict and placed this conflict contextually within the realm of education. The next excerpt demonstrated a personal interest for her in facing the issues surrounding religion and science and relating to other people:

> I have a live faith and I think my science is also one of integrity . . . because I stick within the bounds of . . . main stream biology. I'm not trying to prove God or prove creation through anything. . . . I suppose my own personal interest is just in showing people of faith that you can still do science. It's not going to make you just slide down . . . into something. . . . And also the same thing for scientists that you can have a real faith but it's not going to make you a bad scientist.

At no point in the above excerpt did she attempt to integrate the two cultures. She kept them both separate with equal importance in her life. The next excerpt demonstrated a

separation for her in dealing with the idea of sharing with other people how to interact in either culture:

> I think . . . what is valuable is that . . . I understand the . . . culture of science and I also understand the culture of the church. …I even like had a slide that I was presenting to some of my . . . church members . . . you know we would have a seminar on I would tell them about the mechanism of evolution. And . . . I know that . . . they wanted to go out and convince scientists that evolution was wrong and . . . so I just had this slide showing that evolution is a deep part of biology's culture. So even if you don't agree . . . with evolution you're not going to convince a scientist by attacking their culture. . . . if a scientist is trying to convince students of evolution I would tell them yeah teach them evolution but don't tell them they have to not believe in God. . . . If their belief in God is part of their culture and identity and you require that they not believe in God in order to get evolution right then . . . you're going to fail. So . . . that's why I think it's an unnecessary tension.

Susan believed this to be a cultural issue and she used a form of separation in dealing with opposing cultural views. She never seemed to foster a conflict with the opposing culture by trying to convince the other culture that their view is somehow not correct thus crossing philosophical boundaries. She implied a compartmentalization of viewpoints that were equally respected. Within this same context, she demonstrated how she related to students within the context of an Intelligent Design class, which is offered at the university in which she teaches. She stated, "I tell them what I study; molecular evolution, but then I also describe how in my church . . . it's an evangelical church." In relating to other students who may have a similar religious culture, she did not attempt to integrate cultural knowledge. She simply built up her commitment to her religious culture, thereby implying a degree of separation from her scientific cultural involvement. She basically asserted desiring to reach out to people in both cultures who are either religious Christians who have a problem with evolution or atheists who have a problem with faith. She primarily separated or compartmentalized cultural knowledge in relation

to dealing with other people and their cultural questions and tried to create a cultural awareness for people in both the religious and scientific communities.

Susan also created cultural bridges between her scientific and religious cultural knowledge based in part on her ability to separate cultural ideas. These bridges would come about at times when she looked at an idea from two different cultural perspectives without a distortion taking place in either cultural domain. They could also come about when only one cultural view was primarily focused upon. Several cultural bridges will be explained in order to create a thick description of this phenomenon.

Susan demonstrated a cultural bridge that was used to rationalize the need for the supernatural when science seems to impinge upon that cultural phenomenon with physical answers to certain theological questions. In this case, the scientific culture considered the psychological basis for the physical characteristic while the religious culture looked at the same idea from a supernatural point of view (God-shaped hole in the heart). Neither viewpoint distorted the other because they both remained separate. The following excerpt was an example of this cultural bridge:

> Yeah . . . I'm saying that . . . when biologists have theories about . . . culture or human behavior that those theories could be correct. There could be . . . a gene for sacrificial behavior there could be a gene for a spiritual experience. . . . What are the endorphins that are being released when somebody goes through a spiritual experience? Like I really think . . . that is probably true. . . . So some church people often don't like that because that seems to disprove God. But again then I ask why does that disprove God? Right so if God made your body and He . . . is making you aware of something then why wouldn't He . . . communicate to you through neurotransmitters? So . . . in lay terms church members might just call it well you've made a God shape hole in my heart and neuroscientists might say well that God shape hole in your heart is . . . this . . . transmitter this healing of euphoria the deep seeded psychology of needing to be with other people and needing meaning in your life.

Susan's cultural bridge did not integrate concepts. The ideas of both science and religion were left within their respected boundaries and no distortion of cultural ideas for her emerged. Both ideas were simply viewed respectfully within their particular cultural context and simply informed each other without any impingement due to a forced integrative process. This cultural bridge was predominantly made up of ideas from her scientific knowledge, but the ideas did not seem to conflict with her religious cultural knowledge.

The next cultural bridge dealt with a similar problem of science seemingly explaining religious or moral ideas within a framework of naturalistic thought. Susan created a cultural bridge for this phenomenon by using her own religious beliefs that did not conflict with her scientific cultural ideas:

> I think that . . . when scientists are studying the gay gene or whatever it might upset some church people because it seems to us . . . to legalize what they think is immoral behavior. . . . …so I guess that's how I also separate it. It's still a choice. . . . We are all predisposed to behaving wrongly . . . and so it's just a choice. . . . I had a friend in graduate school who I guess . . . he was gay and actually I know another woman who was lesbian, and they had chosen not to practice. . . . And then even straight people . . . before you're married, you aren't suppose to have sex. And you know are you going to say well I . . . was just driven by my loins to have sex. I mean, no, you have a choice there is always a choice.

The above phenomenon dealt with primarily scientific explanations about moral behavior. What might have seemed like a possible conflict for her was interpreted through both cultural viewpoints with no distortion. She simply used an idea about human free will as a cultural bridge that did not conflict with her scientific knowledge regarding a genetic trait or her religious beliefs regarding morality. Both cultural interpretations were left within their respected boundaries and no conflict or distortion took place.

The next cultural bridge centered upon the scientific principle of photosynthesis as it related to a biblical miracle. Susan was able to interpret this principle through both a scientific and religious interpretation that for her did not distort either cultural viewpoint. She was asked in this instance about the biblical miracle of the burning bush and whether she could view that miracle through two cultural interpretations:

> I mean as a believing scientist I'm like, well, if you can come up with a physical explanation for it, does it disprove God? You know if God wrote the physical laws and he created photosynthesis then it is no sweat for him to create a bush that can burn and not consume the bush. . . . So you know even like with photosynthesis, is a miracle. . . . It essentially takes carbon molecules, gas out of the . . . and you can create a tree out of it. . . . But anyways, if that had happened within 5 minutes that would have been . . . said by anybody to have been a miracle. Because it happened over five years, you know it all happened through photosynthesis.

Susan used a scientific concept and viewed that concept with the framework of both the scientific culture in which it is a process and the religious culture in which it is a miracle. The scientific and religious meanings were kept separate and simply informed one another instead of replacing or changing one another. Photosynthesis became a cultural bridge that allowed her to accept biblical miracles in light of her scientific cultural knowledge. Photosynthesis was not the only scientific idea that was viewed in this way for Susan without apparent distortion because of the integration of ideas. She also demonstrated that there are other scientific ideas like evolution that "inspires a feeling of worship" because of primarily the beauty and elegance that is attached for her to what is being studied. In this same way, certain scientific ideas could be viewed as cultural bridges for Susan.

The next cultural bridge had to do with a theological idea for her that created a bridge with her scientific knowledge about the continuation of evolution. The creation of the world for her was seen as continuing as opposed to being static and already fulfilled:

> What I'm intrigued about is that I think creation is still going on. . . . Like creation is still going on right isn't that part of Christian theology and that . . . Christ return will complete that creation that someone said. Not just the redemption of humanity but complete the creation. So that roughly coincides with my . . . understanding of evolution too.

Susan in this section of the interview went on to read directly from the Bible in dealing with this idea about creation. For her, creation was not seen as static but ongoing. There would be a definite difference between her religious beliefs regarding an on-going nature of creation and a religious belief that required a completion of the creation cycle in a literal 6-day period. She used a theological idea to build a bridge with her scientific knowledge concerning the on-going nature of evolution. Within this context, she continued on with the same theological idea:

> Christ was necessary for creation to occur. Not just for humans to be atoned but for just creation itself. . . . [I] think of God as still creating the world. And I do think of God as acting in human history or current events. Current events are simply just current history. . . . So I don't know where . . . like creation did not stop in Genesis. . . . Creation is still going on and that is coherent with evolution is still going on.

She used a Christological hermeneutic to reinterpret more static and traditional religious views about creation. She even suggested the passages in the Bible that support both her theological and scientific ideas. During the discussion, she seemed unsure of her theological ideas because she demonstrated wanting support by asking questions. Her view of creation in this context was a cultural bridge for her that neither distorted evolution or her theological views involving creation.

The final cultural bridge dealt with the idea of inconsistency as a bridge between cultures. The following excerpt demonstrated how Susan attempted to reconcile part of Genesis with her scientific ideas:

> I take it as a matter of faith that Genesis 1 and Genesis 2 are there for me to learn something . . . even if they are inconsistent with each other and

> inconsistent with science. Not everything in science is consistent with each other either but that doesn't mean there's nothing to learn from it. So I think that's how . . . why I am able to be at peace with something. I mean nothing in . . . the law is never really consistent with itself.

Susan never gave a specific example of something in science that was inconsistent. However, she used the idea of inconsistency because of the fact that for her an inconsistent nature is present in both cultures. She may have alluded here to the idea that human cultural knowledge is limited at best and no knowledge should be looked to as the ultimate and only source.

All cultural bridges that were discussed in this section centered upon a main concept or concepts that could be used as a reconciliatory idea between discrepant cultures. In general, the ideas of a God-shaped hole in the heart, free will, photosynthesis, continuing creation, and inconsistency in both cultures were several of the concepts that created bridges for her between the religious and scientific cultures. Within this context, it should also be noted that Susan used the idea of God as a bridge with the scientific culture. She stated that "[we] shouldn't be afraid to ask the hard questions in science . . . because if God created this world . . . this theory maybe temporarily incorrect but if science is a tool from God then eventually you will bump into the truth." Her concept of God became a bridge between her community of faith that might not accept evolution and her scientific career. Within these cultural bridges, there appeared to be no integration of cultural ideas that led to distortion and conflict. These bridges were based in a separation between cultural interpretations and a retaining of a coherence of intra cultural ideas.

In conclusion, Susan reconciled science and religion by creating a separation between cultural ideas. She also reconciled science and religion by creating cultural bridges that allowed her to view an idea from two different cultural viewpoints without

conflict. When she maintained a compartmental attitude toward each cultural interpretation, no distortion occurred for either culture. But when she demonstrated more of a synthesis of discrepant cultural ideas as was viewed in the last category, a distorted effect was apparent. She was thus able to build bridges based in part upon this initial compartmentalization.

Conclusion

Susan's cultural knowledge and active cultural involvement in both science and religion appeared to be highly discrepant and inconsistent because of the extreme differences in cultural attachments based upon background and knowledge. This appearance was not completely true to reality. While maintaining an allegiance to both cultures, she created cultural bridges from several ideas while maintaining a measure of separation between cultures. However, she asserted that she is prepared to live with a disparity between certain discrepant cultural ideas. While asserting that she had no personal conflict over science and religion, she often demonstrated a distortion of discrepant ideas when she used an integrative approach during the interview process. The boundaries or identity elements for her for both cultures appeared to be both methodological and philosophical with the boundary of naturalism and the supernatural being the major philosophical line of demarcation.

Focus Group Session

Table 4 shows that both Mary and Bob used cultural bridges similar to those used during the individual interview sessions. However, Susan did not use any cultural bridges that were similar, and she appeared to have more apparent conflict with science and religion. Both Bob and Mary appeared comfortable in keeping separate both science and

Table 4

Emergent Patterns in the Data for the Focus Group

Overarching Themes	*Bob*	*Mary*	*Susan*
Cultural Boundaries	1. Affirms Naturalism as the boundary for science 2. Science cannot grasp religious issues. 3. Natural behavior can be quantified and viewed scientifically. 4. Religion does not attempt to be science.	1. Affirms Naturalism as the boundary for science 2. Neither science nor religion should attempt to explain the other.	1. Affirms Naturalism as the boundary for science
Cultural Conflict	1. Affirms conflict from more of an integrated approach	1. Affirms conflict from more of an integrated approach	1. Affirms conflict from more of an integrated approach 2. Hypothetical impingement using behavior as being genetically predetermined 3. Seems to question religious explanations for natural events
Cultural Bridges	1. Affirms Cultural Bridges 2. Uses the development of an organism as a bridge between God and evolution	1. Affirms Cultural Bridges 2. Uses theistic evolution to build a bridge	1. Affirms Cultural Bridges 2. No discernable bridge – keeps the ideas separate (behavior and evolution) 3. She may have started a bridge in using the idea of “details” but never elaborated.

religion while Susan questioned certain ideas related to cultural limitations. These ideas will be expanded upon within this section.

During the focus group session, the basic three thematic ideas that overlapped throughout this study were affirmed. The idea of a boundary for science based upon the philosophical belief system of naturalism was affirmed by using the definition of naturalism put forth by Kurtz (1990) within the focus group session. The idea of conflict or tension brought about by integrating cultural ideas where one specific cultural idea or concept is interpreted solely by another philosophically different culture was affirmed. Finally, the idea of cultural bridges was affirmed. To avoid redundancy, I do not present much of the data from the focus group session because of the similarity in meaning between that data and the data gathered from the individual interview sessions. In other words, all of the participants stayed within their normal categorical parameters which emerged during the individual interviews.

An example of this uniformity between the focus group data and individual interview data is demonstrated by a discussion dealing with a hypothetical question (suggested by the peer debriefing person) concerning reconciliation about theistic evolution. The three participants did not deviate from certain beliefs discussed in the individual interview sessions. In reference to a question concerning explaining to a child how God could use evolution, Bob went on to discuss his idea of reconciliation:

> I would immediately . . . direct you to the development of an organism. And say how did God use the orthogenesis of an organism to create something that looked like a grape and transform that into a human being. Well, in terms of evolution, it's the same kind of concept for me. That is you know that in terms of evolution, you don't know specific steps that were taken because you can't go there and see them. But the concept is the same that there is this series of transformations that occurred over some

> period of time. . . . So that . . . is there even though we don't know the intricate details of each cell the logic or the order of the logic is there.

Bob stayed consistent with his personal ideas concerning the development of an organism as an analogy in relation to the evolution of a species. Because he did not see any conflict with interpreting the birth process through both the naturalistic and super-natural interpretations, he also built a bridge between evolution and creation. Both interpretations were clearly seen within their own parameters, and he saw no conflict with a religious versus scientific interpretation of reality. For him, both interpretations seemed to inform and complement one another because of the logical order and consistency that they both engender. Within this context of uniformity, Mary also did not deviate from her foundational ideas that emerged from the individual interview sessions in light of the same question:

> My point of view, you know, God started it all. We don't have to understand or know that He planned it out from the beginning. Maybe He started it all . . . off with evolution built into the whole process and we hope to continuously improve on. . . . It's not our job to figure out what God's plan so you know and I hope I can just leave it at that. I don't have a problem with that. Like okay, it's God's beauty and God's design.

For her, God started the evolutionary process, and evolution was viewed as having its source in God and being beautiful. The uniformity between the focus group session and the individual interviews is finally demonstrated by Susan in that she did not deviate from earlier interview assertions:

> Oh, . . . I like to see it through my own set of lenses. . . . And actually . . . I suppose if I thought about it more I would probably just want to equip the child with the ability to handle differences. . . . And so part of me is like oh the Bible is not going . . . into all the details and we don't have to know all the details. . . . It would be the thing I would tell myself . . . there are some things that I wouldn't want to just be changing what the Bible tells us. Things that . . . would be okay to take a figurative interpretation. . . . But it boils down to behavior so I think that the slippery slope to me that's where we want to change things and conflicting behavior. I guess with

> evolution it doesn't matter that much, it's not going to change how I behave.

Susan wanted to help the child handle the disparities between the two cultural ideas that for her cannot be completely reconciled. She finally leaned upon her religious beliefs about morality and behavior to separate that from the scientific cultural process of evolution. In the above discussion concerning theistic evolution and trying to explain that to a child, each participant displayed a degree of uniformity with their earlier statements in the individual interview sessions. All three participants also demonstrated similar reconciliation mechanisms that did not seem to dramatically change over time.

The focus group session also demonstrated a synthesis of ideas related to the three overarching themes. In this interview session, the three participants discussed ideas involving boundaries and tensional aspects concerning reconciliation.

> Science makes no claim of being able to explain religion. As a matter of fact one of the things that you learn in terms of understanding science is that it doesn't have the capacity to grasp religious issues. So then I would tell that person . . . you blow it in the beginning by even trying to connect those two in that kind of . . . way. (Bob)

This conversation started off because of a hypothetical event with a person in their class raising his or her hand in protest because the substance of the lesson going against their religious tradition. Bob obviously treated both science and religion as separate ideas and the hypothetical conflict would be based upon science trying to explain or interpret religion. The supernatural versus naturalistic static way of interpreting reality which is a boundary line was further discussed at this point by Susan. She stated, "I mean so you . . . mean the boundary is what he just said that religion really has nothing to do with science." She then asked Bob a question concerning this idea:

> So, Bob, if a student . . . going to a biology behavior class . . . and learned from you that there is a religious mindset in human psychology that helps

> curve behavior. . . . so that was kind of rocking their world so this human psychology was genetically or developmentally set . . . therefore because it helped curb behavior . . . they were worried that their faith was really just gutted by genes and they come to you—

Susan here interrupted the interview flow to ask a question directed to Bob about conflict because Bob discussed the compartmentalized nature of science and religion. The question she asked seemed to relate to an area of conflict that science brings about in interpreting behavior in a scientific and naturalistic manner. Bob responded to the question in a manner consistent with his cultural beliefs:

> All you're saying is that there is this natural sort of a piece in humans that engage in religious or supernatural practices. Now does that mean that supernatural practices don't exist or do exist? I don't know. . . . I'm only talking about this natural behavior that which quantify and we can show that . . . does exist. That's still biological or natural or science or whatever you want to call it. . . . But now on the other hand I think religion is much closer to addressing natural events and . . . the boundary isn't nearly as high for religion to talk about natural events.

Bob went on to explain that religion does talk about natural events with regularity like the reason "why the sun shines" or an explanation for ribs in the body. Susan then responded by asking, "Does it do it well and truthfully?" Bob then continued the discussion:

> Well, okay, but . . . that's a whole different issue. Do they do it . . . from a standpoint of science? Do they do it from the standpoint of religion? That standpoint is something different. The boundary is there because religion doesn't attempt to be science.

The exchange between Susan and Bob clearly showed that Bob sees science and religion as culturally separate as far as interpretive viewpoints are concerned. In other words, Bob had a clear boundary that was maintained between science and religion. The boundary for Susan may not have been as static. This exchange may also have alluded to the idea that Susan did not see the cultural viewpoints as equally valid as Bob does. Finally, Mary also discussed the basic cultural boundaries within the context of the same discussion:

> But, of course, we can have beliefs we can see the beauty in God's work in a flower and say God's work is all around us. And I see it in the sun; it's a beautiful day today. But someone better than me that priest can actually use that to explain why the sky is the color blue. . . . They can say all they want but they really don't explain it. And for me that's where the boundary is. Neither one should try to step in and explain the other.

Mary demonstrated an understanding of the idea that explanations for both science and religion fit into a cultural interpretive outlook or philosophy. Either cultural explanation would be correct within the parameters or boundaries of its own outlook. Thus, the explanations did not conflict because they truly were separate ideas upon reality. This entire interview section demonstrated the idea that if the legitimate boundary between science and religion is one of cultural outlook, then multiple truths can be ascribed to any form of reality. These interpretations of reality are correct within the parameters for each culture. This clear boundary may also lead to a person's being able to create cultural bridges based in part upon a clear separation of interpretation. On the other hand, tension or conflict may result from a viewpoint that puts forth the idea that one cultural interpretation is more correct and truthful about a given form of reality.

In conclusion, the focus group session affirmed the original findings within the individual interview sessions. The focus group session also added a measure of depth to all three overarching ideas through a synthesis of issues surrounding boundaries and tensional areas. If tension or conflict begins when philosophical boundaries are taken away and thoughts begin to merge, then it is understandable as to why conflict happens. Integration allows for cultural ideas to be distorted from other cultural interpretive perspectives that should not be made. Separation seems to be the key ingredient for not only reconciliation but also a measure of mutual respect.

Summary

Three overarching themes or patterns emerged for all participants throughout the interview process. The themes or patterns are simply stated as cultural interpretive boundaries, cultural integrative conflicts, and cultural bridges. All three participants demonstrated a measure of conflict when cultural ideas of both science and religion were integrated thus distorting specific ideas. When scientific and religious ideas were kept separate within the limitations or boundaries for each culture, then cultural bridges could be created and used to have and maintain a measure of reconciliation for each participant. In the final chapter, I summarize the overarching themes that emerged from the interview sessions and present recommendations for the science education community.

CHAPTER 5

SUMMARY AND RESULTS

Three overarching themes emerged from this study to create a common context among all three participants. Cultural interpretive boundaries, cultural integrative conflicts, and cultural bridges all emerged with similar characteristics for each participant. The major categories from Chapter 4 offer a variety of different opinions and beliefs that support the three emergent themes or patterns. In this chapter, I summarize and interpret the overarching themes in light of the data, research literature, and theoretical lenses. This chapter also offers recommendations to the science education community for future practice and further research and finally presents my concluding statements regarding personal insights gained through the overall research.

Summary and Interpretation

All three participants held many different ideas related to both science and religion. These differences were due in part to the dissimilar backgrounds for each participant. For example, each participant had a different research interest (Embryology, Pathogenesis, Human Genetics) from each other in graduate school and in their teaching profession. While each participant held to more of a Christian cultural viewpoint, each person had a clear religious denominational difference (Baptist, Catholic, Presbyterian) from one another. These differences in themselves made this study more difficult to create a uniform cultural ideation of knowledge as well as beliefs. Keeping this variable nature in mind, three ideas or themes did emerge that held a measure of uniformity throughout the study and related to the overall purpose or goal of the study. The following summary and interpretation will focus on the three emergent themes that

carried a somewhat clear and contextually similar pattern among all participants. These three themes or patterns will in general be summarized and interpreted in reference to the research literature used throughout the dissertation process and the general purpose or major research question for the study. The following research question acted as the focus for this study throughout the research and interview collection process:

> How do college science professors describe the interaction between their faith and their scientific knowledge in reference to their transitioning between a naturalistic or scientific understanding and a super-naturalistic or religious understanding?

The three themes or patterns emerged because of the qualitative method employed throughout the data collection process. The emergent grounded categorical and case study design offered an in-depth analysis of three participants' mentally transitioning between their scientific culture and religious culture. The three themes are thus summarized and interpreted within a holistic framework that takes into account not only the main purpose and theoretical sensitivity of the study but also the meanings generated by all people involved including the researcher. Table 5 summarizes the overarching themes for each participant during the study.

Cultural Interpretive Boundaries

The term "cultural boundary" carries with it the connotation of a limitation or purview for a cultural interpretation. The cultural interpretation would be in general a distinct philosophical lens in which reality is viewed, thus giving the term a world view connotation. This idea of world view would create a sense of meaning for the cultural participants who adhere to the principles and limitations of the cultural viewpoint. All three participants discussed the boundaries for both the culture's of science and religion and the line of demarcation between the cultures. The major limitation, purview, or

Table 5

Overarching Theme Summary

Category	*Bob*	*Mary*	*Susan*
Cultural Interpretive Boundaries	1. Surface level difference equates to the final picture versus methodology for science and religion 2. Scientific culture ignored supernatural involvement because of bias	1. Surface level difference equates to factual basis for science versus faith basis for religion 2. Separated both cultural systems by a physical versus supernatural frame of reference	1. Surface level difference equates to the methods employed by both science and religion 2. Scientific culture uses a biased interpretive naturalistic lens
Cultural Integrative Conflicts	1. God interpreted naturalistically 2. Science replacing the need for God 3. Proving the supernatural	1. Interpreting the Bible through a scientific lens 2. Integrating the belief in a soul with neurobiology 3. Bias from the scientific community	1. Adam and Eve being hominids distort the religious meaning of the story. 2. Interpretation of Genesis in reference to science 3. Interpreting evolution supernaturally
Cultural Bridges	1. Created bridges from the concepts of human development, formation of life, order of creation, progression of life, a day, morality and truth, homosexuality, and theistic evolution. 2. Demonstrated faith in the biblical text	1. Created bridges from the concepts of human spirit, theistic evolution, and science. 2. Had fewest bridges 3. Her faith in scripture is limited (myth)	1. Created bridges from the concepts of God shaped hole in the heart, free will or choice, photosynthesis, continuing creation, God Himself, and inconsistency in both cultures. 2. Had strong faith in certain biblical passages (morality) and less literal approach to others (creation story)

boundary between science and religion not only creates a distinct cultural difference but also allows adherents from both cultures to create mechanisms for reconciliation.

The participants differentiated scientific knowledge from religious knowledge in predominantly two ways. The first way dealt more with overall methodology that would create the context for natural physical knowledge versus the methods that would create the context for religious faith. For example, Bob asserted that the overall big picture for scientific knowledge is very specific while the methods employed to reach that big picture are vague whereas religion has somewhat specific methods to reach a very vague final picture. Mary asserted a factual nature to the scientific pursuit versus a faith-based pursuit for religion. Susan offered an overall difference between the methods employed by science, such as the scientific method and proving or disproving a theory, versus the methods employed by religion, such as teachings, texts, subjectivity, and prayer. The idea of methodological differences offers clarity about the surface-level differences between the cultures with a somewhat limited reconciliatory mechanism associated with their knowledge. Cultural interpretive boundaries show a difference based upon a belief system. These boundaries offer a clearer understanding of the underlying differences within the cultures and create a context for cultural bridges to be formed within the individual.

Cultural interpretive boundaries offer a context of cultural interpretations or metaphysical outlooks as being the underpinning difference between both science and religion. These belief systems presuppose and help drive surface level methodologies for the advancement of each cultural pursuit. For example, during the focus group session all participants affirmed that the belief system of science was naturalism. In order to build a

measure of uniformity into the discussion about this underpinning belief in the focus group session, I read the following definition of naturalism put forth by Kurtz (1990):

> Naturalism . . . wishes to use the methods of science, evidence and reason to understand nature and the place of human species within it. The naturalistic outlook is skeptical of the postulation of the transcendental realm beyond nature or the claim that nature can be understood without using the methods of reason and evidence. (p. 7)

All three participants affirmed this definition as the belief system for science with an understanding that naturalism does not presuppose atheism but presupposes skepticism of a transcendental realm in order to explain the natural world. Naturalism does underpin the scientific pursuit with a belief system that puts forth an interpretation or outlook upon reality. This outlook or interpretation is very different from an outlook that presupposes a supernatural involvement with reality.

In dealing with this boundary, the participants demonstrated within the individual interview sessions an acceptance of naturalism. Bob asserted that the scientific culture ignored super-natural involvement because of bias. For example, at one point in the interview process, he went on to explain that science would not accept a hypothetical super-natural event like people rising from the dead but would try to explain it scientifically or naturalistically. He even admitted that both science and religion relied on a belief or faith in the methods for cultural practice. Mary, on the other hand, clearly separated science and religion by a physical versus spiritual frame of reference. She implied that the physical reality was better served through scientific understanding and that basic understanding could not and should not interfere with a spiritual realm. She used terms like “facts,” “truth,” and “prove” to describe her scientific cultural understanding while terms like “faith” and “belief” were used to describe her religious cultural understanding. These terms helped demarcate ideas surrounding a naturalistic versus a

supernatural interpretation of reality based upon specific cultural ideas like evolution (naturalistic) and guardian angels (supernatural). Thus for her a concept classified as something spiritual engendered a super-natural explanation while a concept classified as something physical engendered a naturalistic explanation. In other words, her interpretation of reality depended upon the context (physical or spiritual). While Susan allowed for certain supernatural realities to exist in the physical realm (God's intervention with Adam and Eve), she asserted that the scientific culture uses a biased naturalistic interpretive lens that offers cultural knowledge that works within its frame of reference being the physical world. She also went on to assert that any scientific premise assumes that there is no super-natural intervention into physical reality. Thus, the boundary for science when compared to religion would be a naturalistic interpretation versus a super-natural interpretation for all three participants. That interpretive boundary is a belief system with faith that the physical or natural world can be explained best through naturalistic methods and assumptions. This is a clear demarcation between science and religion.

If science can be viewed as a cultural pursuit like any culture that has certain symbolic meanings passed along to its adherents (Geertz, 1973), then scientific methods and knowledge as well as a belief system have also been used to develop meaning within the cultural community. Keeping this cultural analogy in mind, all scientists involved in this study affirmed the idea that science is a culture that has a belief system (naturalism). No one in the study differentiated methodological naturalism from philosophical naturalism like Scott (1997). The participants were not philosophers of science and none were atheistic. Thus, all participants held to a form of ontological naturalism similar to

Mahner and Bunge (1996a) while interpreting the natural world and denied that ontology when dealing with religious ideas and beliefs. This act of interpreting the world in two different ways would seem to constitute a dualistic world view framework for each person.

If both cultures of science and religion foster a separate interpretation of reality, then according to Kearney (1984) they would then be considered separate world view systems. To inform this study, I used Kearney's universal assumption of classification to understand how each participant classifies certain items as interpreted naturalistically, super-naturally, or both. Bob was able to separate the cultures of science and religion from each other as a whole. He believed science cannot interact with religion because of the lack of the appropriate methodology. He did have a measure of conflict when trying to interpret naturalistically ideas like "God" and "Jesus's resurrection". On the other hand, he could interpret religious ideas like the biblical text, biblical time, moment of creation from both a naturalistic and supernatural perspective creating cultural bridges.

Mary separated for the most part physical ideas from super-natural ideas and thus compartmentalized her world views according to context. Physical items or items that have a distinct physical reality were interpreted naturalistically and could not for the most part be interpreted also from a super-natural viewpoint. An example of this would be the Bible, which is a physical item. For her, the historical stories of the Bible could not be interpreted through a super-natural lens unless they are allegorized to contain deeper moral lessons or truths. The exception to this would be the idea of science used as a cultural bridge and interpreted as a process for understanding God's design. On the other hand, ideas that have no physical reality but would fall under a super-natural

classification for her, like God, angels, a human spirit could be interpreted through a super-natural lens and even used in some cases to produce a bridge between cultural interpretations.

For Susan, both the naturalistic idea of evolution and the super-natural idea of God can be separated and classified into differing interpretive viewpoints on reality. These two ideas were also viewed clearly and distinctly within their own cultural interpretation. For example, evolution was viewed naturalistically providing a rationale for the construct of variation. She had difficulty in combining the principle of evolution with the idea of a creative God. Evolution as a part of science was viewed as a naturalistic interpretive model that is efficacious for pragmatic results. In contrast, God was separate for her from a naturalistic interpretation that would somehow limit or lessen His omniscience. The two ideas were difficult for her to reconcile together as in theistic evolution. Other ideas that clearly have a naturalistic or supernatural interpretation like photosynthesis and an on-going or continuing creation were interpreted by both a naturalistic and super-natural viewpoint, creating cultural bridges. Susan as well as the other two participants seemed to have a dichotomy of world views that interpreted different ideas through different and multiple cultural lenses. These lenses seemingly offered for the individual either conflict or reconciliation depending upon the amount of either separation or integration.

In conclusion, the cultural interpretive boundary between science and religion is a naturalistic interpretation versus a super-natural interpretation of reality. These two distinct cultural interpretations created awareness for me of a dualistic set of world views for each person. Each person thus interpreted reality according to their individual world

views that allowed for a dichotomy of viewpoints centered upon certain specific cultural ideas. However, a purely supernatural idea like God was difficult for any of the participants to interpret through a scientific or naturalistic lens. God was viewed as separate from the cultural interpretation of God by science. This interpretive boundary centered upon the idea that God might have allowed for a certain measure of faith in the supernatural to be maintained by all participants while working in the scientific community.

Cultural Integrative Conflicts

Each participant demonstrated a measure of tension or conflict throughout the study when cultural ideas were not separated but integrated within each other. The integration usually fostered a distorted cultural viewpoint because of one cultural view being interpreted one way through the lens of the alternative world view. This integration tended to distort the original meaning of the cultural idea held by the participant. Conflict would thus come about through the changing or distorting of cultural meaning. Thus integration invariably leads to the judging of one cultural view through the ideas and processes of the different cultural viewpoint creating a cultural hegemony of ideas instead of a multicultural equality of viewpoints. For the participants, integration usually took place when the cultural interpretive boundaries of naturalism or super-naturalism were not maintained but used to pronounce judgment upon another opposite cultural idea.

For Bob, the cultural integrative conflict can be demonstrated by science interpreting the super-natural. Overall, he affirmed that blending or integrating cultural ideas would be counterproductive toward either cultural system. For him, God cannot be viewed naturalistically. This interpretive viewpoint brought a measure of conflict for him

regarding his faith. He discussed the idea of possibly going to a distant planet and seeding it with the genetic materials to have life evolve. Humans would then become the engineers of life on a distant planet. He viewed humans as mimicking God and then replacing Him. Science thus replaces the existence and need for a God. This was a clear distortion for his faith. He also discussed the possibility of naturalistically interpreting the resurrection of Christ by scientifically proving that it is true. He asserted the idea that by proving the resurrection, a scientist would place himself or herself as equal to God. In both above-mentioned cases, his ideas surrounding the supernatural were distorted by a hypothetical naturalistic interpretive idea. The boundaries of the natural versus super-natural were breached leaving an integrative approach in which one idea "God" is distorted by a scientific assumption. In both instances of integration, one cultural idea was placed in a higher more judgmental position over the other idea trumping and distorting the meaning of the idea for the individual. Bob views God in the super-natural realm apart from creation. Any trumping of this idea created a measure of conflict with his religious beliefs.

For Mary, cultural integrative conflicts can be demonstrated in a similar way to Bob. First of all, when Mary interpreted the Bible through a scientific or naturalistic lens, a tensional situation occurred. For example, Mary interpreted a reading of Genesis, Chapter 1, through her scientific lens and stated that she could not reconcile Genesis with science because it offered no proof for the events taking place. Her scientific interpretation of Genesis fostered a cultural hegemony of ideas that favored a naturalistic understanding that trumped a supernatural interpretation of the Genesis account. In this case, she attempted to integrate science with Genesis and the scientific explanation trumped the

Genesis account. In another example, when attempting to integrate a scientific understanding of early human fossils with the creation of humanity, Mary also placed a higher regard on the scientific interpretation therefore trumping a possible religious interpretation of the Adam and Eve story in Genesis creating a nonreconciliatory situation. Integration with the belief in a soul or spirit and neurobiology offered a similar situation of conflict when in this case her belief in a human spirit seemed to trump and distort more of a scientific interpretation of death. The integration between the super-natural interpretation of death and the naturalistic interpretation was never reconciled for her. Finally, even the bias that she received from the scientific community regarding religion was a clear demonstration of cultural hegemony in which one cultural interpretation or world view trumps the other viewpoint creating a tensional aspect for her within her own scientific cultural community. Thus, Mary demonstrated a measure of conflict when integrating disparate cultural views which allowed one viewpoint to trump another.

For Susan, cultural integrative conflicts can be seen for her primarily when she attempted to demonstrate a reconciliatory position between her religious beliefs and scientific knowledge. For example, she demonstrated repeatedly the disparity that arises for her when discussing the ideas of Adam and Eve, a pre-Fall existence without death, and the idea of death as a vehicle for evolution. In her discussions, her scientific or naturalistic interpretations tended to trump or pass judgment on her super-natural interpretation with regards to Genesis. For her, the story of Adam and Eve carries with it personal meaning for her in relation to God’s moral commandments. When referring to the possibility of both Adam and Eve being simply hominids, she admitted that this naturalistic interpretation of the Genesis story distorted the supernatural meaning of the

story. When also asked to discuss a reading from Genesis with scientific understanding, she demonstrated a disparity between both cultural understandings. She could not come away with a coherent explanation for part of Genesis, Chapter 2, when interpreted by science. The opposite effect happened as well when trying to interpret evolution religiously or supernaturally. She admitted that she distorted evolution because she believed that it is possible that God manipulated environmental change to bring about His plan for humans. Susan thus demonstrated the cultural distortion of meaning for one culture or the other by attempting an integrative response to reconciliatory type questions within the interview process.

For all three participants, cultural integrative conflict came about primarily because of a cultural hegemonic interpretation of a certain reality for each participant. For the most part it was demonstrated in the interview process by the scientific or naturalistic interpretation trumping a supernatural interpretation of something existing within the religious culture. This hegemonic dominance caused individual conflict or tension. This dominance because of a cultural inequality could be caused by not having clear and static limitations for each cultural perspective. Without cultural boundaries or limitations regarding certain cultural ideas, alternative interpretations can be allowed to distort meaning for each participant and allow a measure of tension to be demonstrated. For example, a complete naturalistic interpretation of the Bible could easily distort the super-natural meaning for the Bible's adherents. On the other hand, a complete super-natural interpretation of evolution would distort that naturalistic principle within the scientific community and make it used as a tool for God. A separation between cultural ideas and

beliefs seems to be the foundation for any type of hope for reconciliation based on a measure of equality between the cultures.

This particular theme that emerged within the study also may be somewhat informed by the research literature. The trumping of one cultural belief over another can be viewed in the literature regarding the interaction between religion and science. Of the four interactive categories borrowed by Colburn and Henriques (2006) from Nord (1999) to study the clergy and their views on particularly evolution and religion, two categories of cultural hegemonic dominance, “Religion trumps science” (p. 433) and “Science trumps religion” (p. 433) were used as lenses. Although only a few of the participants in Colburn and Henriques’s (2006) study viewed the major cultural ideas in question as conflicting, none of the clergy fell within the parameters of the above-mentioned categories where one culture trumps or has dominance over the other. The vast majority of clergy either fell under completely or demonstrated a combination of a category that espoused independence between cultural ideas or a category that allowed for an integrative approach to the particular issues. However, the categorical alliances showed an overall impression of clergy views on main issues surrounding evolution and creation. When the specific interactive ideas of natural selection, randomness, and purpose were discussed, the clergy were much more divided on how these concepts are reconciled. This last idea demonstrates that like the dissertation study, interactions between specific disparate cultural ideas can be difficult to reconcile.

Conflict can also be viewed in dealing with evolution and religion within the Jackson et al. (1995) study. In the following excerpt from the article, Dr. “I,” who also

espouses an orthodox Christian faith, discussed the conflict that he has in dealing with this subject:

> Many people will argue . . . that no real conflict exists because evolutionary history, as described by biologists and geologists, may simply be the means chosen by an all-powerful God to a special end, which is humanity. This goes along, of course, with a non-literal or "metaphorical" interpretation of Genesis. Theistic evolution, as it's called, is a compromise to such an extent that I think it is unacceptable from *both* sides. The Bible is effectively stripped of its authority, but scientific theory is also diminished. In fact, if you read the paleontologist's book [Gould, 1977], the spirit of scientific inquiry in this area is contradicted in a truly fundamental way, by retaining the idea of purpose, of direction. (p. 601)

The above-mentioned participant happened also to be one of the authors of the research paper. He demonstrated at times conflict with reference to this subject matter and even ascribed to a position "that religion must ultimately win out in his life whenever it comes into apparent conflict with science" (p. 602). In another example of conflict, the following excerpt from the article demonstrates how an evolutionary biologist who is also a practicing Christian fundamentalist (Dr. E) deals with issues surrounding this topic:

> The Bible has been kept intact—there have been word changes, but God has kept the *meaning* intact. But the Bible is not one literary type. I have a foot over the edge of the cliff here in the direction of denying strict literalism—I may face God one day, and He'll say, 'You were wrong,' . . . but I don't believe that God lashes out at people. I'm not really concerned whether I'm wrong or not. My standing with God has nothing to do with my stand on evolution. There's still a tension, it doesn't resolve . . . (p. 599)

The above scientist displays a tension because he believes in the inerrancy of scripture yet appears to take a more metaphorical look at the Bible in order to reconcile his position with science. He ends up separating science from religion in this section of the interview process. This separation of cultural knowledge could be a result from conflict where one cultural viewpoint trumps and distorts the other idea.

In the area of cultural integrative conflicts, the idea of collateral learning might offer insights into this phenomenon. The three participants in the dissertation study as well as the participants discussed from the Jackson et al. (1995) study demonstrated conflict when one form of knowledge based on one cultural allegiance seemingly trumped another form of knowledge based upon a different cultural allegiance. All three participants in the dissertation study as well as Dr. E in the above-mentioned research study also separated or compartmentalized cultural ideas in part because of the conflict over disparate cultural ideas. Bob has a difficult time blending cultural ideas and uses separation to avoid tensional ideas. Mary distances herself from the idea of integration of cultural ideas on a daily basis because of the difficulty associated with it and uses compartmentalization as her standard means of reconciliation. Susan keeps the basic ideas of evolution and the biblical story of Adam and Eve separate because for her there is no clear reconciliation and simply lives with the knowledge of a disparity between cultural ideas. This separation or compartmentalization is very similar to the beginning phase of parallel collateral learning as discussed by Jegede (1995). All three participants in the dissertation study held on to both their religious and scientific beliefs throughout the study. In other words, no one lost his or her faith in either personal cultural viewpoint. Because of this affinity to cultural ideas, participants could possibly over time progress on the continuum of collateral learning. Separation, independence, or compartmentalize-tion characterizes the parallel phase in Jegede's ideas of collateral learning. This phase of parallel collateral learning carries with it the connotation of a starting point upon a continuum of reconciliation leading potentially to a higher level form of convergence of meaning and reconciliation (Jegede). If an individual cultural integrative conflicting idea

could lead to a separation or a parallel form of cultural knowledge, then potentially the disparate ideas could be resolved later on with more of a higher level or convergent form of reconciliation which would not lead to distortion. For example, Susan could possibly through time learn to reconcile the reality of Adam and Eve with evolution in more of a convergent, deeper fashion instead of simply living with two disparate and separate ideas.

If mental conflict can be viewed as a possible starting point for more of a cultural compartmentalization which is a form of reconciliation, then faith perspective and world view literature informs this dissertation study as well. Both faith and world view carry with it a context of individual meaning making (Fowler, 1981; Kearney, 1984) and an internal mechanism for creating a coherent and harmonious system of meaning (Kearney, 1984; Muuss, 1996). If conflict through a cultural hegemonic dominance can be viewed as a beginning phase for reconciliation, then in the future, the participants might advance to a higher degree of understanding and reconciliation of distinct and disparate cultural views. For example, the conflict for Susan discussed in the above paragraph which leads to separation of disparate cultural ideas may create the context in the future for a possible higher-level acceptance or reconciliation of both her faith cultural ideas and her scientific ideas. This higher degree of reconciliation or higher level of cultural acceptance would thus correspond to a higher level or complex faith system, allowing for the possible reconciliation of paradoxical meanings (Fowler; Muuss). It is beyond the scope of this study to elaborate on the possibility of conflict leading to these higher levels of reconciliation for each participant, but the next category may offer a glimpse into higher levels of paradoxical reconciliation through the internal mechanism of cultural bridges.

In conclusion, when cultural integration leads to the trumping of one form of knowledge over the other form of knowledge, then mental conflict seems to occur for the individual. This conflict creates a context for the individual to keep separate disparate forms of knowledge. This separation or compartmentalization is a beginning type of reconciliation mechanism that might in the future lead to a more advanced and higher level form of convergent reconciliation that does not lead to the trumping of one cultural idea over the other.

Cultural Bridges

A cultural bridge can be defined as a concept or idea that can be viewed from two distinct cultural viewpoints without distorting the idea within the context of either view-point. No cultural distortion takes place because of the ideas of equal representation and separation. Equal representation is the idea that both viewpoints are equally represented according to a measure of cultural allegiance for the specified knowledge. Separation allows for the compartmentalization within a clear cultural interpretive boundary or limitation, such as naturalism or super-naturalism, which accounts for the cultural beliefs of science and religion. Both equal representation and separation are necessary for cultural bridges to be formed. These bridges equate to a higher level form of reconciliation for each participant.

All three participants formed cultural bridges from differing concepts. Bob created cultural bridges out of the concepts of human development, formation of life, order of creation, progression of life, a day, morality and truth, homosexuality, and theistic evolution. Mary created cultural bridges out of the concepts of the human spirit, theistic evolution, and science. Susan created cultural bridges mostly out of the concepts

of a God-shaped hole in the heart, free will or choice, photosynthesis, continuing creation, God Himself, and inconsistency in both cultures. All of the above-mentioned concepts could be viewed or used to view reality from both a naturalistic and super-natural cultural framework. Each participant used their own cultural knowledge to equally represent differing separated cultural viewpoints and created a convergence of meaning resulting in a higher level form of reconciliation.

A possible reason for this particular mechanism can be viewed more clearly in light of cultural belief or faith in the ideas of each culture. Within cultural bridges, both separation and equal representation occur which, unlike cultural integrative conflict, do not allow for the individual distortion of meaning. Both equal representation and separation allow for a multicultural viewpoint without trumping one form of knowledge over the other. The question then becomes, Why does one topic foster conflict in one person while the same topic for another participant fosters a bridge? The answer is possibly belief or faith in the cultural idea. For example, the Bible can be demonstrated with each participant as an object that can be used to help create cultural bridges or foster cultural conflicts depending upon the circumstances. Bob, who admitted not having a tremendous amount of religious knowledge, never displayed conflict in regards to biblical passages and science. He created cultural bridges from both his scientific knowledge and his biblical knowledge because of the equality of faith that he had in both systems of thought. In regards to religious ideas, he even admitted that his faith created a natural context for cultural bridge building. In contrast, Mary did not build as many bridges as Bob and had much more conflict over biblical passages. Mary does not view the Bible as necessarily true like Bob, so her view is more metaphorical. However, she does have faith in God

and a human spirit and thus created bridges between her strong faith in science and in those concepts. Susan has a strong faith in the Bible as far as a moral ground and certain doctrines like Christ and the atonement but is willing to take a less literal approach to the actual creation story described in Genesis. Therefore, she is able to create cultural bridges out of concepts like free will, continuing creation, and God in general but not the actual creation story from Genesis. All of the cultural bridges demonstrated by the participants called for a measure of belief or faith in the separate cultural ideas and this faith helped allow the participants to create both an equality of representation and a separation or boundary of interpretation.

If cultural bridges can be viewed as a more desired form of reconciliation because of the equality of culturally represented views believed in and discussed by the individual, then this type of reconciliation can be further informed by the research literature, especially in regards to collateral learning. Secured collateral learning is the last phase of a reconciliatory continuum which Jegede (1995) proposes. The idea of cultural bridges is similar to the idea of secured collateral learning in that in secured collateral learning people can create ways in which conflicting ideas interact to such an extent that one schema helps support another schema resulting in a uniformity of meaning for a new idea (Aikenhead & Jegede, 1999). Cultural bridges create a context in which differing cultural ideas are accessed simultaneously to view an idea or concept, thus creating a convergence of meaning that does not conflict with either cultural perspective. To create the bridges, the participants have to interact with the different cultural ideas and consciously create bridges of meaning for the concept. In a way, both

cultural ideas help to support and reinforce the meaning of the main concept or idea which is similar to one way of achieving secured collateral learning (Jegede, 1995).

Both cultural bridges and secured collateral learning are similar and can be understood more clearly in light of specific examples. One example of the similarity would be the concept of photosynthesis being regarded by Susan as both a scientific process and a super-natural miracle. She can view the concept through both lenses simultaneously creating a deepening concept for photosynthesis and a higher order reconciliatory viewpoint for her belief and adherence to the supernatural. Each of the cultural bridges created by all participants allowed for the idea of multiple interpretations of meaning centered primarily upon one main idea or concept allowing the participant to hold on to distinct cultural views that do not conflict. Another example would be, Aikenhead and Jegede's (1999) use of Todd from an original study conducted by Roth and Alexander (1997). Todd demonstrated secured collateral learning, according to Aikenhead and Jegede, and also demonstrated a similarity to cultural bridges in the way that he constructed different meanings or interpretations around one idea. Overall, secured collateral learning and cultural bridges can be said to each have a high degree of explanatory power in relation to the reconciliation between two differing cultural viewpoints.

Another example of a similar idea expressed in the research literature is contained within the study conducted by Shipman et al. (2002). A participant named Lana is said to fit into a convergent category. This category is similar to secured collateral learning in that both foster a more convergent or integrative form of reconciliation. The following discussion illustrates Lana's beliefs regarding science and religion:

> That's what I wrote my English final on this semester. A lot of people believe that you either have to be a creationist or an evolutionist and that there is no in-between. I'm very religious and have been brought up that way but yet you can't deny scientific facts. I don't see why the two can't work in harmony. Because I questioned what created the Big Bang and what was there before that. For that, the astrophysicist has no answer. So I mean, when you get down to it, neither . . . makes sense in and of itself. It needs the other one to make sense. (Shipman et al., 2002, p. 537).

This idea of Lana's is very similar to the cultural bridge that both Bob and Mary created around the concept of theistic evolution. It would also be similar to a secured form of collateral learning because of the convergence of meaning fostered by the two cultural perspectives that seemed to reinforce each other.

Faith perspective and world view also inform this reconciliatory concept. Both science and religion are underpinned by differing world views which are combinations "of basic assumptions that an individual or a society has about reality" (Kearney, 1984, p. 42). The idea of cultural bridges demonstrates that an individual can have a different combination of world view ideas when approaching a given reality. This interaction between world views creates in certain situations a paradox of beliefs. This paradoxical element relates to certain ideas centering on a stage of faith progression that for Fowler (1981) is more advanced. According to Muuss (1996), stage 5 for Fowler's faith stage theory

> accepts, appreciates, and combines multiple perspectives of many of the important issues and seeks truth in a multidimensional, dialectic, dynamic way. The possibility for appreciating and resolving opposites, polarities, and paradoxes emerges at this level and contributes to a higher level of meaning-making . . . (p. 276)

By no means does a higher amount of cultural bridges relate to a higher or better type of faith. But in my study, each participant created cultural bridges, demonstrating a higher type of reconciliatory process that allows them to engage actively in discussion with

reference to both world views. However, the participant with religious ideas that were more liberal and ideas that did not appear to conflict with her scientific ideas too often created the fewest cultural bridges. The ability to construct bridges relates to a higher ability to look beyond a possible conflict and discover a commonality of meaning between different world view ideas. This ability also takes a certain measure of faith in both cultural systems of thought. I believe overall that cultural bridges as processes are similar to ideas expressed by Fowler, signifiying a higher stage of faith progression.

In conclusion, each participant was able to create multiple perspectives of meaning based upon cultural bridges. These cultural bridges demonstrated a higher type of reconciliatory method similar to secured collateral learning and a faith perspective that is rather complex and paradoxical. Cultural bridges represent reconciliatory mechanisms for each individual that allows that person to view reality from two world view systems of thought. Each participant taken holistically does not fall into any preexisting theoretical construct completely. Cultural bridge only gives a small glimpse into the way individuals might reconcile their scientific knowledge and religious faith.

Recommendations for Educational Practice

Throughout the research study, underpinning beliefs or ontological presup-positions emerged that were vital to an individual's perception of reality. These world views offered explanations for reality in general. At times, each participant displayed a dichotomy of world views in relation to both naturalism and supernaturalism. These world view interpretations by all the participants demonstrated the multifaceted and holistic way humans deal with the issues presented in this study. If scientists have conflict and resolution schemes for this particular issue, then many among the general

population may also have similar conflicts and resolution schemes. The reason for this generalized effect would be because of the multicultural involvement of many within the scientific community (science classroom) and particular religious community (church). With this in mind, an educational agenda that would address these world view issues might go far in making not only the general populace aware of the conflict but also aware of their own natural ability to reconcile the differences.

Nature of Science can be used to inform this educational agenda. As NOS has been described as "scientific knowledge is tentative; empirical; theory-laden; partly the product of human inference, imagination, and creativity; and socially and culturally embedded" (Lederman, Abd-El-Khalick, Bell & Schwartz, 2002, p. 499), then NOS could certainly be coupled with a deeper understanding of the ontological presuppositions of science. These ontological presuppositions would easily link and inform NOS research, especially in the realm of the social and cultural aspects. According to Lederman et al.,

> science as a human enterprise is practiced in the context of a larger culture and its practitioners are the product of that culture. Science, it follows, affects and is affected by the various elements and intellectual spheres of the culture in which it is embedded. These elements include, but are limited to, social fabric, power structures, politics, socioeconomic factors, philosophy, and religion. (p. 501)

The idea of a cultural aspect of science in reference to a scientific world view or world views would help students to understand science's sphere of influence, the natural world. Another example of a NOS concept that can be linked to world view is in the area of the theory-laden nature of science. According to Lederman et al., "observations (and investigations) are always motivated and guided by, and acquire meaning in reference to questions or problems, which are derived from certain theoretical perspectives" (p. 501).

Naturalism is the ontological presupposition of science (Mahner & Bunge, 1996a) tied to the theory laden nature and perspective of science as scientists are humans interpreting the natural world. NOS learning could also allow for the exploration of the similarities and differences between these two areas (naturalism and super-naturalism) going beyond simple methodologies. Purposefully selected readings, similarly to this research, can be discussed in science classrooms helping students to see how science studies the natural world while religion delves into the supernatural.

This by no means suggests that religious belief be necessarily discussed or promoted within a science class. The class discussion about science and other forms of knowledge is also not the same as opening up the classroom to ideas that pose as scientific but are actually not scientific, such as creationism or intelligent design. By differentiating between science and other forms of knowledge, science can truly be differentiated from religious ideas that people attempt to make into a scientific form. In other words, because scientific world view is naturalistic and empirically based, it cannot take into account any form of super-natural causality that is faith based. That specific outlook upon reality does not grant science the right of trumping another form of knowledge but just taking the form of a different cultural perspective. Students might then better understand both cultural conflict in reference to the blending of world views and cultural reconciliation in reference to creating bridges by valuing different perspectives about reality. This valuing of different perspectives might bolster the ability not only to border cross because of the possible retention of self identity (Aikenhead & Jegede, 1999) but also to construct knowledge within a cultural connection thereby creating a meaningful learning experience (Cobern, 1994).

The recommendations for educational practice calls for honesty and a willingness to discuss certain issues, creating the context for a shared learning experience. These recommendations would not lead to a weakening of instruction on evolution but simply a more holistic and honest approach to the sometimes difficult topic. Years ago when discussing religion, science, and reconciliation with the student mentioned earlier in this dissertation, I wish that I would have understood more clearly the limitations of scientific knowledge. Science does not equate to the only form truthful knowledge. It is one of many different forms, cultural perspectives and world views. I hope that this approach might lead to more acceptance of scientific ideas by people from many different religious backgrounds and cultural communities of faith.

Educational Recommendations for Research

This dissertation study was very limited with respect to the quantity of participants but very deep with respect to the data regarding personal issues surrounding both conflict and reconciliation. Further research into personal reconciliation mechanisms and zones of conflict would be needed to verify the limited nature of this study. With these general ideas in mind, there are a few specific research ideas that can be used to better inform the science education community as to the value of research into the interaction between science and religion.

One certain issue that emerged from this dissertation study was the lack of knowledge for the most part that the participants had in regards to theology or religion. To my knowledge, none of the scientists were professionally trained in theology or ministerial duties. This created the context of a disproportion of cultural knowledge. An equality of cultural knowledge would have been better preferred in order to understand

the dynamics of higher order reconciliation mechanisms. For example, Colburn and Henriques's (2006) study involved professional clergy, individuals who had more knowledge favoring one cultural ideology more than the other, like the participants in my study. While interesting as far as religious ideas and beliefs were concerned, no specific potentially conflicting scientific ideas beyond the general concept of evolution were introduced. For example, no reconciliatory mechanisms for the concept of natural selection were mentioned or elaborated upon. Overall the basic interaction between God and evolution was never made too specific by any clergy in the study. The clergy used their religious knowledge more often than their scientific knowledge to bring about a form of reconciliation. These issues signify the one dimensional nature of the study. Likewise, the dissertation study was one dimensional to a point with respect to the equality of cultural knowledge. A research study using people who are both professional scientists and clergy or theologians would be a significant move toward equalizing cultural knowledge and learning more about reconciliatory mechanisms.

Another recommendation of further research is in the area of specific problems with the interaction between science and religion. As discussed earlier, members of the clergy in the Colburn and Henriques (2006) study appeared to have a more difficult time reconciling in any concrete fashion natural selection with the idea of purpose. This lack of specificity in regards to reconciliation within one type of specific interaction between scientific and religious ideas is similar to the problem of specific interaction discussed by Mahner and Bunge (1996a). In my dissertation study, specific examples of reconciliation were discussed (cultural bridges) but specific cultural ideas like natural selection were never truly targeted exclusively along with their potentially conflicting counterparts in

order to build a network of ideas and concepts that are culturally mutually exclusive. A study that would target the specific interactions of conflicting ideas alone might better expose the reasons behind the conflict and allow for higher levels of reconciliation to be demonstrated by the individuals. In other words, narrowing down the focus of the research to only specific topics that seem to conflict might further inform the science education community of multicultural interaction.

The final recommendation would come in the form of expanding the participant base as far as both science and religion is concerned. Using other scientists beyond the biological sciences would allow for an expansion of topics beyond just evolution. Reconciling other topics like Plate Tectonics or the Big Bang theory with religious ideas would allow for a comparison to be made between reconciliatory frameworks and potential zones of conflict in other scientific fields. Expanding participants to other religious groups would demonstrate any similarities and differences between conflicts and reconciliatory mechanisms brought about by doctrinal differences and degrees of religious faith. Even examining the participants' cultural, racial, and ethnic backgrounds in a similar study could additionally bring forth new ideas and perspectives that this dissertation did not focus upon. With this in mind, I do not necessarily call for a numerically broader perspective but a qualitatively broader perspective which would still fit within the original research goal for this study.

Concluding Remarks

The interaction between religious ideas and scientific ideas is best understood as a multicultural pursuit of understanding. I began this pursuit of understanding the interaction between these two cultures several years ago and discovered within this

undertaking my own personal perspective. In 2003, I conducted a study dealing with the issues of science, religion, and faith. The discovery of the ability to integrate different forms of knowledge due to differing types and amounts of scientific background emerged from the data after analysis. In the present study, the area of scientific knowledge was made somewhat more constant by the virtue of using scientists themselves within the study. The use of scientists in relation to this issue is discussed in the science education literature. According to Anderson (2007),

> scientists deal with these matters in very different ways. Some compartmentalize their thinking, others truly integrate the results of the various epistemologies they have adopted, and others adopt a single epistemology to the exclusion of others. (p. 675)

Within the present study emerged the idea that humans have beliefs and allegiances to certain cultural outlooks or perspectives that do not change dramatically over time. Sometimes beliefs and world views conflict within a single person's cognitive framework. Depending upon the individual, humans create reconciliatory mechanisms that allow for a multicultural or multifaith perspective. In my own life, I see that I, too, represent to a certain degree the findings that did emerge. I, too, have different interactions of cultural beliefs that sometimes conflict and are sometimes reconciled. This study then in a way was an outward expression of my own struggles and my own sense of inferiority with the bigger questions of this life.

Several years ago, I started this research journey trying to make up my mind concerning the issue of science and religion. In this process, the easier road would be to take a position on the extreme on either side. In other words, to believe that based upon science alone there cannot be an interactive divine creator or to take the other opinion that religion by faith alone trumps anything conflicting, especially scientific ideas like

evolution. In my opinion, neither extreme side is correct or accurate in regards to reality. I feel that scientific ideas alone demonstrate the interconnectivity of natural processes that stagger the human imagination and leave humanity groping with the feeling of inferiority as to the weight of responsibility for getting explanations correct or close to correct. Religious ideas alone demonstrate the need that humanity has for the idea that we in effect are not alone, that there is purpose for our existence, and that there can be an ultimate expression of love that humanity can emulate. Both cultures teach true humility and are needed, especially in current times. Both cultures are also expressions of who individuals are as people, still struggling to make sense of one's place and position in this universe.

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APPENDIXES

APPENDIX A

Scientific and Religious Background and Opinion Questionnaire

Directions: Please provide answers to the following questions. For those questions requiring a yes/no answer, feel free to make a comment.

1. Please indicate your highest present degree and please describe the field of knowledge and the university in which you obtained the degree.

   Associate Degree _____
   Bachelors Degree _____
   Masters Degree_____
   ED. D._____
   Ph.D. _____

   Description:

2. Were you raised with any religious affiliations as you were growing up during childhood?

   - Yes _____
   - No _____

   Comment:

3. Are you currently affiliated with any religious organizations?

   - Yes _____
   - No _____

   Comment:

4. Do you think that there is a tension that exists between science and religion?

   - Yes _____
   - No _____

   Comment:

5. If you answered yes to number 4, do you think a person could negotiate through this tension?

   - Yes _____
   - No _____

   Comment:

6. Have you experienced any tension between science and religion?

   - Yes _____
   - No _____

   Comment:

7. If you answered yes to number six, have you found a measure of compatibility between scientific knowledge and your religious faith?

   - Yes _____
   - No _____

   Comment:

8. What makes scientific knowledge different from religious knowledge?

9. Do you believe that science and religion are both infused with cultural values?

10. Do you have faith in a personal God or with a God that interacts with humans on an on-going basis?

- Yes _____
- No _____
- I do not know ____

APPENDIX B

The Use of NOS within the Scientific and Religious Background and Opinion Questionnaire

Because scientists were the participants within the study itself, the nature of science research questions adapted for this study were used to better understand the boundaries of scientific knowledge. Thus, the nature of science research questions offered insight into the scientists' understanding of the limitations of science allowing for a further insight into the demarcation of science from other forms of knowledge like religion. NOS generally "…refers to the epistemology and sociology of science, science as a way of knowing, or the values and beliefs inherent to scientific knowledge and its development" (Lederman, 1992 as paraphrased in Lederman, Abd-El-Khalick, Bell & Schwartz, 2002, p. 498). Even though "…philosophers, historians, and sociologists of science are quick to disagree on specific issues regarding NOS" (Lederman, et al., 2002, p. 498), there seems to be a general shared opinion regarding certain important ideas of NOS (Smith, Lederman, Bell, McComas & Clough, 1997; Lederman, et al., 2002). According to Lederman, et al., (2002) those certain important ideas were used in the developing of the Views of Nature of Science Questionnaire or VNOS. The VNOS espouses the following ideas:

> …scientific knowledge is tentative; empirical; theory-laden; partly the product of human inference, imagination, and creativity; and socially and culturally embedded. Three additional important aspects are the distinction between observation and inference, the lack of a universal recipelike method for doing science, and the functions of and relationships between scientific theories and laws (Lederman, et al., 2002, p. 499).

For this study, the tentative nature of science and the socially and culturally embedded nature of science were explored more through the borrowing of certain ideas from VNOS-C instrument.

The VNOS form is a paper and pencil evaluation "…developed with an interpretive stance in mind, and aims to elucidate learners' NOS views and generate profiles of the meanings they ascribe to various NOS aspects…" (Lederman, et al., 2002, p. 517). Two questions were borrowed and modified from the VNOS-C form in order to expose the issues surrounding this study. The Views of Nature of Science Questionnaire form C was used because it specifically targets the tentative nature of science by eliciting a possible response about the difference between science and religion (Lederman, et al., 2002). Specifically, question number one targeted this area by stating the following:

> What, in your view, is science? What makes science (or a scientific discipline such as physics, biology, etc.) different from other disciplines of inquiry (e.g., religion, philosophy) (Lederman, et al., 2002, p. 509)?

This question was modified and listed as number eight on the questionnaire form to be used in this study (Appendix A). The modified question reads as follows: What makes scientific knowledge different from religious knowledge? The limitations or demarcation of science from religion was explored with this question. According to Lederman, et al., (2002), scientific knowledge is tentative by nature and "…although reliable and durable, is never absolute or certain" (p. 502). If this is true, then a distinction can be made between this form of knowledge and a religious form which would seem to be more absolute and certain within the area of faith for each individual. The second question that was borrowed and modified is VNOS-C question # 9 and it addresses the issues surrounding culture and world view by stating the following:

> Some claim that science is infused with social and cultural values. That is, science reflects the social and political values, philosophical assumptions, and intellectual norms of the culture in which it is practiced. Others claim that science is universal. That is, science transcends national and cultural boundaries and is not affected by social, political, and philosophical values, and intellectual norms of the culture in which it is practiced.
> - If you believe that science reflects social and cultural values, explain why. Defend your answer with examples.
> - If you believe that science is universal, explain why. Defend your answer with examples (Lederman, et al., 2002, p. 509)

The modified question was listed as number nine on the questionnaire to be used in this study (Appendix A). The new question reads as follows: Do you believe that science and religion are both infused with cultural values? Lederman, et al., (2002) used the VNOS-C question in reference to science being embedded in the larger cultural context and that could mean many different cultural ideas. For this study, the larger scientific cultural reference was viewed within the area of naturalism and the religious culture was viewed within the area of super naturalism. By exploring the cultural significance of both science and religion through this question and the subsequent interviews, an understanding of the philosophical underpinnings or world view of the scientific and religious culture was enlightened with regard to the opinion of each individual scientist. All in all, the nature of science questions was modified to help better expose the interaction between faith and science.

APPENDIX C

Chart Comparing the Questionnaire with the Main Research Question for the Study

Component of Research Question	Questionnaire Element
College Science Professors	Question # 1
The Interaction Between Faith and Scientific Knowledge	Question # 2 Question # 3 Question # 6 Question # 7 Question # 8 Question # 9
Transitioning Between a Naturalistic and Super-naturalistic Understanding	Question # 4 Question # 5

APPENDIX D

Brief Introduction to the Study

My name is Chad Barner and I am working toward a PhD in science education from Georgia State University. My dissertation research in general deals with the interaction between the scientific and religious realms by trying to understand how a few scientists themselves find compatibility between their religious faith and scientific knowledge. I am asking a few professors of science from Kennesaw State University who have faith in a personal God to participate in this qualitative study. The study should start during the Spring 2009 semester and possibly finish during the Summer of 2009. The study will also involve three individual interview sessions and one group discussion among the participants. There will be a limited amount of reading required for each professor in order to initiate dialogue during the last two individual interview sessions. The reading will consist of one journal article and a total of two chapters from two different books. Professors who involve themselves in this study will be able to participate with research that allows a measure of reflection on issues that concern personal faith and professional knowledge. While remaining anonymous to the public except for one another in the last session, those scientists involved will receive a measure of satisfaction by realizing that their contribution to this research will help aid in the understanding of science education as a cross-cultural endeavor.

Note: This document was used during the beginning phase of this research study.

APPENDIX E

General Overview of the Stages of Research and Data Development

The study had several phases of development. These phases are generally outlined in figure five. Phase one took place in conjunction with a questionnaire entitled, "Scientific and Religious Background and Opinion Questionnaire" (Appendix A). The questionnaire was emailed out to 25 individuals within the department of biology after the study was introduced at a department meeting. During the department meeting, a fellow professor in the university who is also on the doctoral dissertation committee requested participation in the study from a few individuals by first allowing them to read a brief introduction to the study (Appendix D). The same professor also approached several individual professors privately about participating in the study. Because of the sensitive nature of the study (religious beliefs of scientists), the professor acted as an insider to the academic and scientific culture thereby sponsoring the researcher into that culture. The questionnaire was attached to a Microsoft Word document in order to facilitate participant ease in the answering of the questions. Overall, the questionnaire was designed to elicit information pertaining to the focus question for the study (Appendix C).

Specifically, the questionnaire form was designed to gather initial information regarding the academic background coupled with the unique religious background and current religious affiliation for each individual. Two questions were asked about the possibility of a tension existing between science and religion and if the individual has experienced any tension. Two follow up questions to this tensional idea were asked concerning the individual's own perception of whether or not he/she thinks a person could negotiate through a tension between science and religion and whether or not the individual has found a measure of compatibility between scientific knowledge and his/her religious faith. Two of those questions were directly contingent on the response for the previous question on the form. All together, those four questions offered a measure of insight into certain tensional and compatibility aspects for science and religion. Two further questions elicited responses dealing with certain aspects of the nature of science. Each individual's particular understanding of certain aspects of the nature of science was explored in relation to the demarcation of science from other forms of knowledge and the cultural or non cultural aspects of science. Finally, there was one question dealing with individual faith in God. This allowed clear insight into each participant's views on the existence or non existence of a personal God that interacts with people on an ongoing basis.

The questionnaire was emailed out to certain faculty members and four responded by filling out and sending back the questionnaire. Three professors for this study were chosen who have both faith in a personal God and work within the scientific community. One out of four professors did not have faith in a personal God. The term "personal God" for this study carried with it the connotation of interactivity. In other words and according to Erickson (1983), God "…is an individual being, with self-consciousness and will, capable of feeling, choosing, and having a reciprocal relationship with other personal and social beings" (p. 269). Three professors were individually interviewed three times and collectively once in order to create an emergent grounded design that provided an

understanding of the rationale they have for maintaining faith in God while actively taking part in the scientific culture.

The first interview took place after reading the questionnaire used to select the individuals for the study. During the first interview, the professor's answers from the Scientific and Religious Background and Opinion Questionnaire (Appendix A) were discussed. Answers concerning his or her professional academic background, religious background and current religious affiliations, thoughts about the tension and compatibility between science and religion, ideas about the nature of science, and descriptions of faith in God were made more explicit in this part of the interview. At the very end of the first interview session, each participant was given a copy of the article by Mahner and Bunge (1996a) entitled "Is religious education compatible with science education?" Each participant was asked to read this article prior to the second interview session. This article was also used in a study conducted by Loving and Foster (2000) to start a discussion and an intervention plan dealing primarily with the examination of conceptual change and its relationship to the topic of science and religion. Because of the dogmatic nature of the article being one that demonstrates the incompatibility between science and religion, it was hoped that this article would elicit individual responses from those who try to find compatibility between their respective cultural communities.

The second interview took place after the first interview session was analyzed through the qualitative process known as open coding. Since the first interview session was recorded with audio tape, the recorded version of the interviews was transcribed and open coded according to the procedures outlined in the data analysis section of chapter 3. Open coding initially allowed for emerging categories to be developed after the first interview. Throughout the majority of the second interview, certain major categorical ideas that emerged from the first interview were discussed allowing for individual feedback to take place. The feedback for this study was very similar to the idea of "member checking" proposed by Lincoln and Guba (1985, p. 314). For this study, major categorical ideas and understandings from the first interview session were discussed and explored with each participant throughout much of the second interview session allowing for a measure of member checking too take place. This feedback helped focus the second interview within the parameters of the emerging categories and gave impetus for exploring other ideas and questions that emerged during the coding and second individual interview.

Other specific methods were used during the second interview session. First of all, the article by Mahner and Bunge (1996a) was discussed during the second interview with two of the participants in part to help better explore each scientist's view of the compatibility between science and religion. One participant had not read the article by the second interview session. Several ideas and specific sections of the article were discussed with the participants who had previously read the material. Since all the participants would be considered to be within the Christian community of faith, part of the creation story from the Bible was also read to each participant. This method was used primarily to elicit responses about how the individual reconciles his or her personal faith and scientific knowledge. Both methods allowed a glimpse as to how the individual answers questions concerning the compatibility between science and religion.

Specific selected readings out of two different books were assigned to each of the participants at the very end of the second interview session. A discussion of Kenneth

Miller's (1999) book, *Finding Darwin's God*," and Richard Dawkins's (2006) book, *The God Delusion*, took place in the third interview session. One selected chapter from each book was assigned to elicit responses from the participants.

The third interview session took place after the second interview had been analyzed within the same framework as the coding process for the first interview session. An overview from the previous second interview transcriptions were summarized for each emergent category during the coding process and discussed with the participants throughout much of the third interview session. A certain measure of interpretation was also discussed throughout this portion of the interview section. This allowed member checking to continue on throughout the study. Thus the major categories and understandings from the second interview session were further discussed and explored with each participant during the third interview.

The third interview also explored the participant reactions to specific readings from the books by Miller (1999) and Dawkins (2006). Each participant had been asked to read the last chapter in Miller's book and the fourth chapter of Dawkins's book ("Why there almost certainly is no God"). Both authors have been the subject of recent science education literature dealing with world view (Anderson, 2007). Specific excerpts from each text were read and discussed with the participants. This method proved beneficial in that it allowed the participants to reflect and respond to what other scientists wrote about within the context of similar issues.

The final interview took place after the third interview was analyzed within the same framework as the coding process for the first three interview sessions. The final interview was a collective interview or focus group session. In this study, the focus group was used in order to collect data in a group setting that allowed for the social interaction between participants in response to the member checking of data especially in regard to the overarching patterns. Accordingly, Esther Madriz (2000) says,

> The singularity of focus groups is that they allow social scientists to observe the most important sociological process-collective human interaction. Furthermore, they enable researchers to gather large amounts of information about such interactions in limited periods of time (p. 836).

The overarching patterns emerged from the individual categories and demonstrated themselves as overlapping qualities for all participants. Those dominant ideas were discussed at the beginning of the session within the interaction of a group thus member checking with individualistic accounts generated by previous interview sessions. Two hypothetical scenarios were used also to illicit responses in relation to the emerging patterns. The first scenario dealt with the scientists hypothetically explaining to a child how God could use evolution. The second scenario dealt with a hypothetical in class situation of a student protesting that evolution goes against his or her religious tradition. The scenarios helped allow the participants collectively to explore the issues surrounding the conflict and resolution of science and religion. This final session proved beneficial in that it helped enlighten the overall research question in regards to a collective understanding of the data. This focus group session was later transcribed and coded within a similar framework as all of the individual interviews.

APPENDIX F

Readings and Examples from the Data for Bob

The readings included an edition of the New American Standard Version of the Bible, Mahner and Bunge (1996a), Dawkins (2006), and Miller (1999). The following selections from the data will demonstrate a portion from each reading along with a portion of the response from Bob.

Reading: New American Standard Version, Genesis chapter 1: verses 1-12 – 2nd Individual Interview Session

> Researcher: In the beginning God created the Heaven and the earth. The earth was formless and empty. Darkness covered the deep waters and the Spirit of God was hovering over the surface of the waters. Then God said let there be light and there was light. And God saw the light was good. And He separated the light from the darkness and He called the light day and the darkness night. And evening passed and morning came marking the first day. And God said let there be space between the waters to separate the waters from the heavens from the waters of the earth. And that is what happened. God made this space to separate the waters of the earth from the waters of the heavens. God called this space sky. And evening and morning passed and evening passed and morning came marking the second day. And God said let the waters beneath the sky flow together in one place so that dry land should appear. And that is what happened. And God called this dry land and waters seas. And God saw that it was good. God said let the land sprout with vegetation and every sort of seed bearing plant or tree that grows seed bearing fruit these seed will then produce the kinds of trees from which they came. And that is what happened. The land produced vegetation, all sorts of seed bearing plants and trees with seed bearing fruit. Those seeds produced plants and trees of the same kind. And God saw that it was good. . . .
>
> Bob: If I keep these separate, I've got to interpret them as totally separate concepts. If I can do it from the religion standpoint, I've got to look at it from the same point that God did all of these things. He said it, and I'm not to question it and that's just it. . . . But where I am internally, when I hear that I hear well that's just the exact story that science tells in terms of creation of the earth the formation of life and all of those things.

Reading: New American Standard Version, Genesis chapter 1: verses 24-27 – 2nd Individual Interview Session

> Researcher: And God said let the earth produce every sort of animal each producing offspring of the same kind. Livestock, small animals that scurry along the ground wild animals. And that is what happened. God made all sorts of wild

animals, livestock, and small animals which were able to produce offspring of the same kind. And God said that it was good. And God said, let Us make human beings in my image to be like us. They will reign over the fish of the sea and the birds of the sky, the livestock and the wild animals of the earth and small animals that scurry along the ground. So God created human beings in His own image, in the image of God He created them male and female He created them. . . .

Bob: Now . . . there's a point to make there. If you go back and look and see what you just said there, God created the earth, the rain, separation of day and night, the plants, the animals, the humans. You know what you just defined? Evolution.

Reading: Mahner and Bunge (1996, p. 108) – 2nd Individual Interview Session

Researcher: If there is any point to a religious belief that goes beyond just assuming a transcendental world that makes no contact with the natural world and goes beyond mere subjective feelings or merely the pragmatist view of religion, the religious realm must overlap with the scientific one. Only thus can humans be connected to a different level of reality. For example, to a supernatural or spiritual realm, we maintain that the main point of the religious beliefs of most religionists consists of assuming, exploring, finding or establishing some relation between the supernatural and themselves. Since religion … is just part of the natural world, any such assumption amounts to making a cognitive claim about the world. . . . As soon as such a cognitive claim is made, religion is bound to conflict with scientific competence. . . .

Bob: If I see that's a part that should have been clearer to me. . . . I've got to come over here and get in this and only this because if I go over there then science is going to want some empirical evidence. So I shifted over here. If that's what he's saying then yes, I agree with that.

Reading: Dawkins (2006, p. 116) – 3rd Individual Interview Session

Researcher: Feminism shows us the power of consciousness raising. And I want to borrow the technique of natural selection. Natural selection not only explains the whole life it also raises our consciousness to the power of science to explain how organized complexity can emerge from simple beginnings without any guidance. A full understanding of natural selection encourages us to move boldly into other fields. It arouses our suspicions in those other fields to the false alternatives that once in the pre Darwinian day beguiled biology. Who before Darwin could have guessed that something so apparently designed as a dragonfly's wing or eagle's eye was really the end product of long sequence of non-random purely natural causes? . . .

Bob: Well I was going through that and trying to make sure I understood exactly where he was going with the whole concept. …I didn't come to an absolute understanding of how he was using it. He was saying . . . there is almost certainly . . . no God.

Reading: Dawkins (2006, p. 158) – 3rd Individual Interview Session

Researcher: …the ingenious and the most powerful crane so far to have been discovered is Darwinian evolution by natural selection. Darwin and his successors have shown how living creature with their spectacular statistical improbability and appearance of design have evolved by slow gradual degrees from simple beginnings. We can now safely say that the illusion of design in living. . . .

Bob: …to say that there is no design in nature must mean something more because almost every natural organism . . . has . . . a design feature in it.

Reading: Miller (1999, p. 290) – 3rd Individual Interview Session

Researcher: If he chose, if he so chose a God whose presence is taught by most western religions could have fashioned anything, ourselves included, ex nihilo, from his wish alone. In our childhood, as a species that might have been the only way in which we could have imagined the fulfillment of his will. But we've grown up and something remarkable has happened. We've begun to understand the physical basis of life itself. If the persistence of life were beyond the capabilities of matter, if a stream of constant miracles were needed for each turn of the cell of a cycle for each flicker of the cilium, the hand of God would be written directly into every living thing. His presence at the edge of the human sandbox would be unmistakable. Such findings might confirm our faith but they would also undermine our independence. How can we fairly choose between God and man when the presence and the power of the divine so obviously so literally controlled our every breath? Our freedom as . . . creatures require a little space, some integrity, a consistency in self-sufficiency to the material world. . . .

Bob: In other words, the miracles they . . . say they want to see to believe you couldn't do that. Because everything would require . . . even from the beating of the cilium those kinds of things would be miraculous events.

Reading: Miller (1999, p. 273) – 3rd Individual Interview Session

Researcher: Clearly many people look at the string of historical . . . leading to our species as something that diminishes the special nature of humankind. What they fail to see is the alternative, the strictly determined chain of events in which our emergence was preordained would require a strictly determinant physical world.

> In such a place, all events would have predictable outcomes and the future would be open . . . neither to chance nor independent human interaction. The world in which we would always evolve is also a world in . . . we would never be free. . . .
>
> Bob: …I didn't quite understand the statement . . . about . . . a world . . . in which we need in which we would always evolve…

Reading: Miller (1999, p. 280) – 3rd Individual Interview Session

> Researcher: Darwin can hardly be criticized for pinpointing the biological origins of these drives. All too often in finding the sources of our original species and fixing the reasons why our species displays the tendencies it does, evolution is misconstrued as providing a kind of justification for the worst aspects of human nature. At best, this is the misreading of the scientific lessons of sociobiology. At worst, it is an attempt to misuse biology to abolish any meaningful system of morality. Evolution may explain the existence of our most basic drive and desires but that does not tell us that it is proper to act on them. . . . Evolution explains our biology but it does not tell us what is good or right or moral. For those answers however informed we may be by biology, we must look somewhere else. . . .
>
> Bob: Yeah. That's . . . exactly right there. When we think about biology, we think about the physical world. When we look at science, we look at this physical world. But again that could be just a vehicle that God used in terms of this world. And so we look at the stars . . . and God put the stars there. We look at the . . . water and the wind and all these kinds of things and they are all things that God's put there so that we can look at those things and understand . . . what their physical interaction. And that's okay. That's a good thing. . . . So what we are saying is that you science folks, you go over there and do your thing. You religious folks you come over here and do your thing. Wait a minute. It's the same story.

APPENDIX G

Readings and Examples from the Data for Mary

The readings included an edition of the New American Standard Version of the Bible, Mahner and Bunge (1996), Dawkins (2006), and Miller (2009). The following selections from the data will demonstrate a portion from each reading along with a portion of the response from Mary.

Reading: New American Standard Version, Genesis chapter 1: verses 3-13 – 2nd Individual Interview Session

> Researcher: Then God said let there be light and there was light. And God saw that light was good. And He separated the light from the darkness and He called the light day and the darkness night. And evening passed and morning came marking the first day. Then God said let there be space between the waters to separate the waters from the heavens and the waters of the earth. And that . . . is what happened. God made this space to separate the waters of the earth from the waters of the heavens. God called the space sky. And evening . . . passed and morning came marking the second day. And God said let the waters beneath the sky flow together into one place so that dry land should appear. And that is what happened. God called this dry land and waters seas. And God saw that it was good. And God said let the land sprout with vegetation and every sort of seed bearing plant or tree that grows seed bearing fruit… And that is what happened. The land produced vegetation, all sorts of seed bearing plants and trees with seed bearing fruit… And God saw that it was good. And evening passed and morning came marking the third day. . . .
>
> Mary: …this is why Genesis is so hard because . . . you can look at it as . . . thousands of years passing and all these events and this being the process of evolution of God or . . . the generation of His earth. . . . You know some people use the big bang as God sparking all these event to occur. …I have no reconciliation for Genesis whatsoever.

Reading: New American Standard Version, Genesis chapter 1: verses 26-27 – 2nd Individual Interview Session

> Researcher: Let Us make human beings in my image to be like us. They will reign over the fish in the sea and the birds . . . the sky, the livestock and the wild animals on the earth and the small animals that scurry along the ground. So God created human beings in His own image, in the image of God He created them. Male and female he created them. . . .

Mary: That's when I believe the writers of this Bible interjected their own thoughts and beliefs or what . . . their hopes into this. . . . The bible says that man is created in God's own image and things like that. …do we not take what we look like today as what we looked like then? . . . But we know we have documentation of Neanderthals and different forms of man that has come. Where did they come from?

Reading: Mahner and Bunge (1996, p. 106) – 2nd Individual Interview Session

Researcher: However truth is looked on by religionist as absolute or ultimate, scientific truth is partial or approximate. . . .

Mary: …religion is absolute or ultimate. While religionist may think it is the ultimate truth but scientific truth is not partial. . . . It . . . well there . . . are degrees. There are degrees where we have partial understanding and it's acknowledged as that.

Reading: Mahner and Bunge (1996, p. 108) – 2nd Individual Interview Session

Researcher: If all this were actually the case there might be no conflict indeed. Yet there is conflict: If there is any point in a religious belief that goes beyond just assuming a transcendental world that makes no contact with the natural world, that goes beyond . . . subjective feelings and a mere pragmatist view . . . of religion. A religious realm must overlap with a scientific one. Only thus can a human being be connected to a different level of reality, for example, to a supernatural or spiritual realm. . . . Since the religionists are part of the natural world, any assumption amounts to making a cognitive claim to the world. As soon as the cognitive claim is made, the religion is bound to conflict with the scientific competence. . . .

Mary: Yeah well I mean I did kind of . . . agree with . . . religionist trying to establish some type of relationship between the supernatural world and themselves. But I don't think that . . . they are trying like that should be a point of conflict. . . . You know when I talked about the spirit and things like that and going on… Yeah I'm striving for that . . . connection there. …I can't actually prove that my spirit is actually here or your spirit is in your body. . . . I think they are making an argument that doesn't necessarily have to be made.

Reading: Mahner and Bunge (1996, p. 108) – 2nd Individual Interview Session

Researcher: …you must consistently adopt a minimal teleological or design view point that is most positive that the evolutionary process has been guided from

above and that it has a definite purpose . . . to establish a relationship between humans and a supernatural entity.

Mary: Yeah, I did believe in the spark and things like that. . . . Saying definite purpose that's kind of speculation a little bit but you can't really say for sure. It's like trying to figure out God's reasoning… I don't have a problem with this part, no. Plant it and guard it.

Reading: Mahner and Bunge (1996, p. 115) – 2nd Individual Interview Session

Researcher: Science and religion can only coexist if one of them is distorted.

Mary: Well now I'm here to say I don't feel like. I have a . . . coexistence of my science and religion. And I don't feel that either one of them is distorted in either way. And so I have to believe that I am not alone.

Reading: Dawkins (2006, p. 116) – 3rd Individual Interview Session

Researcher: Feminism shows us the power of consciousness-raising, and I want to borrow the technique of natural selection. Natural selection not only explains the whole of life; it also raises our consciousness to the power of science to explain how organized complexity can emerge from . . . beginnings without any deliberate guidance. A full understanding of natural selection encourages us to move boldly into other fields. It arouses our suspicions in those other fields as the kind of . . . alternatives that once . . . beguiled biology. . . .

Mary: On using natural selection . . . people should be more aware of the role. . . . And how it helps explain evolution. . . . It's basically . . . evolution.

Reading: Dawkins (2006, p. 154) – 3rd Individual Interview Session

Researcher: …several discussants at Cambridge . . . claimed that God spoke to them inside their head just as vividly and as personally as another human mind. I have dealt with delusion and hallucinations in chapter 3… First, that if God did really communicate with humans, that fact would emphatically not lie outside of science. God comes bursting through from whatever other worldly domain is His natural abode, crashing through our world where His messages can be intercepted by human brains. That phenomenon has nothing to do with science?

Mary: How could he say if that was the case? God spoke to these individuals. They heard him loud and clear. Is he saying that there is a scientific explanation for what you heard?

Reading: Miller (1999, p. 273) – 3rd Individual Interview Session

Researcher: When examined closely, the notion we must find historical inevitability in a process in order to . . . the intent of the Creator makes absolutely no sense. Yes the explosive diversification of life on the planet was an unpredictable historically contingent process. So, for that matter . . . Western civilization, the collapse of the Roman Empire, the winning number in last night's lottery. We do not regard the indeterminate . . . nature of any of those events in human history as antithetical to the existence of a human Creator. So why should we regard similarly indeterminate events in natural history any differently? There is no reason at all. If we can look at the contingent events in the families that produced our individual lives as being consistent with a Creator, then certainly we can do the same for the chain of circumstances that produced our species.

Mary: I like that . . . this one is in stark contrast to what Dawkins is saying and his natural selection. How he's saying that chance and could happen but that doesn't mean the creator doesn't have a role in it. . . . I think that . . . I don't want to say sums up but it is very close to how I kind of view things.

Reading: Miller (1999, p. 273) – 3rd Individual Interview Session

Researcher: …people look at the string of historically contingencies leading to our species as something that diminishes the special nature of humankind. What they fail to appreciate is that the alternative, a strictly determined chain of events which our emergence was preordained would require a strictly determinate physical world. In such a place all events would have predictable outcomes and the future would be open . . . neither to chance or independent human action. A world in which we would always evolve is also a world in which we would never be free. . . . Seen this way, I think it is only fair that the religious people view the contingency and the improbability of our origin as something deeper. This special nature of the particular history that . . . led to us can made us understand how truly remarkable we are, how rare is the gift of consciousness, how precious is the chance to understand and to the believer how great are the gifts and expectations of God's love. . . .

Mary: …I like that and it reminded me of a book. And it's totally a fiction book but by one of my favorite writers. She writes science fiction, Anne Wright. . . . And her point of view . . . was basically kind of similar to what I think. That set things in motion and just set back and said wow look what's happening, look at this.

Reading: Miller (1999, p. 282) – 3rd Individual Interview Session

Researcher: In Chamber's view a Creator who could set up a process driven by natural law that would drive continuing creation for millions of years was clearly more clever that a designer who had to do all personally and specially one species at a time.

Mary: …that's one of those things from the Bible . . . God is the Alpha and Omega. The beginning and the end and He was just that intelligent.

APPENDIX H

Readings and Examples from the Data for Susan

The readings included an edition of the New American Standard Version of the Bible, Dawkins (2006), and Miller (2009). The following selections from the data will demonstrate a portion from each reading along with a portion of the response from Susan.

Reading: New American Standard Version, Genesis chapter 2: verses 2-7 – 2nd Individual Interview Session

> Researcher: On the seventh day God completed his work which He had done. And He rested on the seventh day from all his work which He had done. God blessed the seventh day and sanctified it because in it He rested from all his work which God had created and made. This is the account of the heavens and the earth and when they were created in the day God made the earth and heaven. Now no shrub of the field was yet in the earth. And no plant of the field had yet sprouted. For the Lord had not sent rain upon the earth and there was no man to cultivate the ground. But a mist used to rise from this earth and water the whole surface of the ground. . . .
>
> Susan: …I take in information better by reading it. I don't know why. . . .
> Researcher: I went to six. You can read seven.
>
> Susan (reading and response): So the Lord formed man from the dust of the ground and breathed into his mouth the breath of life. . . . I mean it seems like a rough . . . correlation I suppose to the scientific account to the creation of earth. . . . So in verse 5 it says no shrub in the field and no plant had sprouted. …you might have trouble with well there was no rain yet . . . because we assume in the early earth that there were all the elements present. . . . I know when I continue to try and match things up, I'm going to run into a disparity.

Reading: New American Standard Version, John chapter 1: verses 1and 3 – 2nd Individual Interview Session

> Susan (reading and response): …in the beginning was the Word and the Word was with God and the Word was God. …all things came into being by him, apart from him nothing came into being. . . . So . . . Christ was necessary for creation to occur. Not just for humans to be atoned, but for . . . creation itself.

Reading: New American Standard Version, Genesis chapter 1: verses 5-11a – 3rd Individual Interview Session

> Researcher: …God called the light day and He called the darkness night. There was evening and morning one day. And God said let there be an expanse in the

midst of the sky, waters. And let's separate the waters from the waters and God made an expanse and God separated the waters which were below the expanse from the waters that were above the expanse and it was so. God called the expanse Heaven and it was evening and morning a second day. Then God said let the waters flow together in one place and let dry land appear and it was so. God called the dry land "earth" and the gathering of the water "sea" and God saw that it was good. . . .

Susan: I take it as a matter of faith and . . . I guess some Christians, they need to be able to believe the order and everything in that passage. Obviously I must be . . . okay with both Genesis 1 and Genesis 2, the detail of it not being completely meshed with one another. I think there is something to learn in there.

Reading: Miller (1999, p. 273) – 3rd Individual Interview Session

Researcher: …people look at the string of historical contingencies leading to our species as something that diminishes the special nature of humankind. What they fail to appreciate is the alternative, a strictly determined chain of events in which our emergence was pre-ordained, would require a strictly determinant physical world. In such a place, all events would have predictable outcomes... A world in which we would always evolve is also a world . . . we would never be free.

Susan: …I think I have to read the rest but I do recall . . . there were some small differences and if I remember correctly, he was open to . . . us having evolved into something else but still being a creature of God, a worshipping creature of God. . . . Um and I tend to think that God meant for evolution to occur exactly the way that it did.

Reading: Dawkins (2006, p. 116) – 3rd Individual Interview Session

Researcher: Feminism shows us the power of consciousness-raising, and I want to borrow the technique from natural selection. Natural selection not only explains the whole . . . also raises our consciousness to the power of science to explain how organized complexity can emerge from simple beginnings without any deliberate guidance. . . .

Researcher: You've got a lot of marks in that book. Anything that kind of jumps out at you . . . from chapter 8, I mean it could be anything.

Susan: …I don't think any of it is hair-raising. …I suppose I got a little bored with . . . Dawkins because he just kept going on and on about . . . he obviously believes that evolution equals disproof in God.. . . . It's like well here I am and I'm reading some of his explanations about evolution and I'm like yep . . . I agree that's how evolution works but it doesn't create a problem for me.

APPENDIX I

Guiding Ideas for a Portion of the Major Categories for Bob

During the 1st three individual interviews, major categorical ideas were developed. After the second interview was transcribed and coded, different summations of a few categorical ideas and interpretations were developed. The summations were the basis for the majority of the third individual interview. The following excerpt took place during the third individual interview for Bob and it is a portion of the transcripts dealing with the evolving topics of conflict and reconciliation. This excerpt also demonstrates some of the guiding ideas and questions that became particular for each participant.

Conflict

Researcher: The next category is . . . conflict. . . . You're not conflicted with the apparent tensions of science and religion. …between evolution or creation. You don't seem to be conflicted at all with that. It's not even an issue. . . . You are conflicted when cultural beliefs are merged or integrated . . . because of the distortion effect. If science can explain the supernatural then the supernatural isn't supernatural anymore. . . .

Bob: Right.
Researcher: If we can go and produce life on another planet, have we become God ourselves?

Bob: Right, yeah.

Researcher: …your answer is to keep the cultural practices separate even though in your mind, you want to blend the ideas. Is that a pretty good synopsis of how you feel?

Bob: And . . . I was . . . peace at that point. That was one of those peaceful, we keep everybody calm and peaceful. If you ask me today, I . . . don't feel so much like that. I want to merge them. Let's make them get together and tear down these walls and get into it. And . . . come to one . . . accord. . . .

Researcher: How would you do that? How would you do that?

Bob: …it would take a person with a mindset of saying okay I yield myself. I open up myself completely

Researcher: To . . . what?

Bob: To whatever it is . . . that you have to offer. . . .

Researcher: Are you saying that to the Lord or are you saying that to yourself?

Bob: Well I'm saying that between the two cultures. To bring these two cultures together it takes people to be ready to open themselves up and say

Researcher: To the alternate.

Bob: To the alternate culture okay come in and I will deal with you whole heartedly 100%. And we'll see where this lies.

Researcher: But it would also, would you agree with this? But it would also take people to really get in and study both cultures.

Bob: That's what happens when you open yourself up and you let. . . . Okay and now I understand that. . . .

Researcher: And another section dealt with trying to prove Jesus' resurrection or tying to prove the miracles in the Bible. They both had a similar response from you. You felt conflicted in . . . what we become. First of all, when we go to that planet, we become like God ourselves. And then . . . we understand the supernatural and now we can mimic the same thing. Is that what you feel like?

Bob: Well see now, in . . . terms of the personal conflict . . . right now I'm still naïve enough to want to take religion on it's . . . word. . . . I I don't have to understand it. Okay God said it, I believe it and that's it. That's the kind of attitude I want for religion. . . . Science is the opposite. . . . If it's there, I want to know everything about it, every single detail. . . . Okay. Now personally in my . . . quest to become a servant of God

Researcher: Uh hmm

Bob: It almost feels like I don't trust him. It's . . . not enough for me to say okay here it is and just go with it. You got to go and . . . get evidence on it. You got to test it…

Reconciliation:

Researcher: Throughout your last interview, you've come together . . . in the form of these conceptual bridges. …I'll define it and I well read to you my interpretations. . . . The cultural idea, a conceptual bridge is the cultural idea that creates a bridge between the science cultural view which is a natural interpretation of the reality and the religious cultural view which is a supernatural interpretation of reality, without distorting either cultural viewpoint for the individual. . . . The boundaries have to be solid and fixed before a bridge can be attempted. . . . If the boundary is supernatural versus the natural, they're fixed. . . . Okay if they're fixed then you can create these bridges. . . . These ideas that you can view from two different perspectives, one idea and they can be true. Do you agree with that?

Bob: I love it. As a matter of fact I want to steal that from you. . . . That's . . . a brilliant concept. . . . I've never thought about that. …but I can see it. . . .

Researcher: Theistic evolution, you . . . talked about that and you . . . went through evolution shows religion this progress through plant life, animal life, human life in the Bible. You said that's a direct reflection of evolution. . . . And see you take evolution and say why couldn't there be . . . a mechanism to start it, the whole process? . . . You said that evolution

Bob: Uh hmm

Researcher: Could occur, does occur but God basically could have started it all along. It had to have that mechanism of starting it. Why couldn't that mechanism . . . God? Can you kind of explain that…

Bob: Well one of the things that science will do for this conflict that I talk about sometimes is alright we are going to go with a blend of the two. . . . God created everything. We use science as a vehicle to create all of this. . . . Okay, go back to the day that God started the creation.

Researcher: Okay

Bob: Okay explain exactly what happened. Okay alright I got that. Now go back before that.

Researcher: You can't explain it.

Bob: Right so you get at a point now where it's getting real fuzzy. So at that point of Him starting it, it's already fuzzy. . . . But you can sort of conceptualize the fact that okay what if He had been there to start it. . . . And this is the mechanism that He used to do this.

Researcher: That's a bridge.

Bob: Yeah.

Researcher: Because you . . . did not invalidate . . . the scientific

Bob: Right yeah

Researcher: You can go all the way back to the Big Bang Theory itself.

Bob: Yeah you could.

Researcher: And . . . that could be the way God used it.

Bob: Right

Researcher: And that doesn’t invalidate God at all.

Bob: Right nor science.

APPENDIX J

Guiding Ideas for a Portion of the Major Categories for Mary

During the 1st three individual interviews, major categorical ideas were developed. After the second interview was transcribed and coded, different summations of a few categorical ideas and interpretations were developed. The summations were the basis for the majority of the third individual interview. The following excerpt took place during the third individual interview for Mary and it is a portion of the transcripts dealing with the evolving topics of conflict and reconciliation. This excerpt also demonstrates some of the guiding ideas and questions that became particular for the participant.

Conflict

> Researcher: …you have no reconciliation for Genesis. You try to integrate the two cultural ideas. . . . And you talked about the fact that . . . I read you verses about how God formed man out of the dust of the earth. . . . And He breathed into his nostrils the breath of life. . . . You started discussing . . . they're a Neanderthal. Isn't the Bible dealing with humans didn't they look like they do now? . . . And so when you started talking about that it really became a tense . . . would you agree with that?
>
> Mary: Yeah I mean . . . that just doesn't help out the whole Adam and the Garden of Eden. You see Adam supposed to be in the likeness of God which totally mimics us but yet you've got a clear fossil record. . . . So you know that . . . just doesn't help out but
>
> Researcher: Okay
>
> Mary But I think again those lessons that we were supposed to learn from Adam in disobedience. Well I don't even like the disobedience. . . . But you know their morals and things like that . . . really living a good life and so. . . .
>
> Researcher: …when I asked you about Jesus a little bit you said . . . what is important for you is the moral guide, his life. . . . How the Lord spoke about Hell also and you didn't have a reconciliation for that either. …there was a tense moment there… Does that make sense?
>
> Mary: …yeah I vaguely remember that part to be honest. But you know . . . the story about Adam and Eve . . . was supposed to give us some kind of moral compass to get started with how to live life. Jesus' story gets us back on track. . . . Maybe now okay you guys were really cutting up before so now let's introduce hell into this so there's going to be consequences for not living or fulfilling . . . portion of life.

Reconciliation

Researcher: It's a cultural idea that creates a bridge, and it's a metaphor between the scientific cultural view which is a non supernatural interpretation of reality and the religious cultural view which is a supernatural interpretation of reality without distorting . . . the cultural view point for the individual. Now I'm going to give you some examples.

Mary: Okay. I was just going to say because good luck with that. . . . I'm ok with the term but finding that idea that would make that bridge. . . .

Researcher: …your personal bridges consisted in the human body, birth . . . human spirit. You talked about animation of the human spirit last time. . . . In fact it was interesting because you believe this is the area in which science and religion can intersect. You said that last time. The human body is the area in which science and religion can intersect. Which was fascinating.

Mary. That is fascinating. What was I thinking? . . . Yeah yeah because it has to deal with the soul. You know the soul in a . . . lot of ways it's supernatural.

Researcher: Okay, Okay. You can't prove it.

Mary: Right. You can't scientifically record the soul as far as I know yet. Something is in us that animates us that also leaves once our body is no longer able to function.

Researcher: And that's a bridge. What you just said will not distort your scientific views at all. Science doesn't, can't explain the soul.

Mary: Right

Researcher: On the other side it didn't distort your religious views at all either because you believe in a soul. Does that make sense?

Mary: Yeah it makes sense. . . . When you first said it I mean it makes sense but an actual idea until you gave me clear examples I thought it'd be trickier. . . . But it isn't.

APPENDIX K

Guiding Ideas for a Portion of the Major Categories for Susan

During the 1st three individual interviews, major categorical ideas were developed. After the second interview was transcribed and coded, different summations of a few categorical ideas and interpretations were developed. The summations were the basis for the majority of the third individual interview. The following excerpt took place during the third individual interview for Susan and it is a portion of the transcripts dealing with the evolving topics of conflict and reconciliation. This excerpt also demonstrates some of the guiding ideas and questions that became particular for the participant.

Conflict

Researcher: You take evolution and you interpret it by theology which means evolution couldn't be true because if I look at it through theology . . . certain theologies I should say . . . what you'd have is you'd have a six day creation which would assume that the earth is very young. But evolution teaches that the earth would have to be at least four and half billion…

Susan: Uh hmm

Researcher: …so you interpret by . . . those cultural beliefs therefore you have a distortion.

Susan: Yeah

Researcher: And the same thing is true by science. By Dawkins interpreting God via natural selection and saying that obviously there can't be a God because obviously we can explain it all. Does that make sense? Do you agree with that?

Susan: Yeah yeah.

Researcher: That's what I'm learning in this . . . study. It's when we do that the borders come down, the boundaries come down and that's when we start having these conflicts because we don't get into . . . right places. . . . Would you agree or disagree with that?

Susan: I mean I agree… I guess I'm a little surprised . . . I mean we live with the knowledge that there is this disparity so… It's not like a new thing. It's not . . . when I sit and think about it… It's been there all this time. . . . Just like knowing that you're brother, he's a good guy but he's got his faults. But that doesn't mean he's a terrible guy. This . . . is just the way it is. . . . Well . . . just from your

question it sounded like . . . when I try to think about science through theology lens or theology through science lens

Researcher: Uh hmm

Susan: I am forced to see the conflict. And I am saying that I am aware of the conflict all along and it's not new when I start doing that. . . . So even when I was just reading these books too, I'm like yeah . . . very familiar with the issues. . . . So probably when you are challenged the most are in just conversations. And maybe that's just with me and I'm lazy. . . . But you know when there are genuine questions then yeah I suppose therefore you are forced to face the conflict.

Reconciliation

Researcher: You created reconciliation points, I'm going to call them bridges with your ideas of photosynthesis, with the burning bush. . . .

Susan: I do remember. I liked my answer. I told my husband. He liked it to. . . .

Researcher: But my only question though . . . it almost felt as though you were saying that there's a gap in your understanding and your knowledge of photosynthesis because . . . it's a miracle. Look at what happens. These things take place during photosynthesis. And you're making a case that . . . if God can create photosynthesis where Dawkins would say that photosynthesis is just a natural occurrence that happened because of x, y, and z. Are you saying that when you look at photosynthesis in terms of your faith, you see logical order that needs a creator, has to have a creator or just bolsters your faith? Makes sense?

Susan: …I'm not using photosynthesis to try to prove God. . . . To me I just see it as another example of oh that's so cool. Look at what God does. And so when I bring about the example that photosynthesis being a miracle

Researcher: Yeah

Susan: I'm pointing out that modern society doesn't see photosynthesis as a miracle even though it rightfully is because you're making something out of nothing. Science says . . . it's not nothing it's carbon dioxide molecules turning gas into a solid and it's going from a . . . energy state to a high energy state carbon molecules.

Researcher: So you're not saying it has to have a God, you're saying that from the way you interpret photosynthesis it . . . is so cool that this came about.

Susan: I'm saying that as a scientist I'm aware of the molecules and all the scientific process that occurs.

Researcher: Uh hmm

Susan: So I'm able to see what God is doing at a molecular level. …when you ask me how do you explain the burning bush? To me it's not a weird thing that God who can create photosynthesis molecules could also sustain a fire with consuming a bush.