Barriers and Enablers of Interdisciplinary Research at Academic Institutions

Leslie Suzanne Thornton Butler

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BARRIERS AND ENABLERS OF INTERDISCIPLINARY RESEARCH

AT ACADEMIC INSTITUTIONS

by

Leslie S. T. Butler

Abstract of a Dissertation
Submitted to the Graduate School
Of The University of Southern Mississippi
In Partial Fulfillment of the Requirements
For the Degree of Doctor of Philosophy

December 2011
ABSTRACT

BARRIERS AND ENABLERS OF INTERDISCIPLINARY RESEARCH
AT ACADEMIC INSTITUTIONS

by Leslie S.T. Butler

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This research study examines the factors that motivate and lead to the success of faculty members who conduct interdisciplinary research. Because a comprehensive study of the research patterns of interdisciplinary researchers has not been conducted, the main intent of this research project was to create an instrument that would measure research habits and attitudes. It is important that such research be conducted using individuals who are interdisciplinary researchers as well as disciplinary researchers. One intent of the research study was to provide comparisons between disciplinary researchers and interdisciplinary researchers. Another intent was to provide university administrators with a better understanding of the factors that motivate and lead to the success of interdisciplinary researchers so that they could make policies that would support and encourage interdisciplinary research at their institution.

A national survey was conducted to test the reliability and validity of a research instrument designed to examine different factors that were illuminated in a literature review and focus group study: administrative financial support, graduate training, team work and disciplinary affinity. Demographic data were also examined to determine if there were specific characteristics of interdisciplinary researchers that administrators would benefit from understanding. Purposeful sampling was conducted so that both interdisciplinary and disciplinary researchers were surveyed. This strategy was used so
that comparisons between the two groups could be made. No differences were found between the different types of researchers on factors that lead to the success of or motivate faculty to conduct interdisciplinary research.

An important finding of the research is that there were no significant differences between the demographic characteristics of individuals who conduct interdisciplinary research and those who do not. This finding is contrary to what is found in the literature. Because of this, administrators cannot make assumptions that an individual faculty member will conduct interdisciplinary research based on presumed demographic characteristics such as race, ethnicity, age or gender.

An additional important finding of the research study is that there were no correlations between whether individuals who identified themselves as conducting applied or basic research and how interdisciplinary their research was. This is an important finding because, like demographic characteristics, the literature suggests that interdisciplinary researchers tend to be more applied in their research focus than disciplinary researchers.
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<tr>
<td>CERI</td>
<td>Centre for Educational Research and Innovation</td>
</tr>
<tr>
<td>COSEPUP</td>
<td>Committee on Science, Engineering and Public Policy</td>
</tr>
<tr>
<td>IDR</td>
<td>Interdisciplinary Research</td>
</tr>
<tr>
<td>IGERT</td>
<td>Integrative Graduate Education and Research Traineeship</td>
</tr>
<tr>
<td>ILSP</td>
<td>Interdisciplinary Life Sciences Building</td>
</tr>
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<td>UWB</td>
<td>University of Washington, Bothell</td>
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CHAPTER I

INTRODUCTION

Faculty members at academic research institutions conduct interdisciplinary research in efforts to answer multifaceted questions. Interdisciplinary research provides the methods and theoretical perspectives to respond to such large-scale societal issues as global warming, the BP oil spill, or cultural habits that harm the environment. By responding to an issue interdisciplinarily, researchers are able to tackle the whole problem rather than simply bits and pieces of it because interdisciplinary research allows researchers to look at an issue through multiple lenses. In doing so their research can have a broader impact and higher chance of making significant changes in the world.

The National Academies of Science’s (2005) report on interdisciplinarity points out that the business world actively engages in interdisciplinary research and work on a daily basis—not because they think it is “hip” but because they see the necessity in doing so. A problematic point, however, is that the people who become employees in their companies or researchers in their laboratories often do not have the experience or understanding that the world is interdisciplinary and must be looked at from the perspective of “solving the problem” rather than from discrete disciplines, areas of content knowledge, or methodology.

Academic institutions have responded differently than the business world to interdisciplinary researchers creating an environment that can be either inhibitive to or supportive of interdisciplinary research. For example, the University of Washington, Bothell, (UWB) was established in 1990 to fulfill the legislative mandate for expanding access to higher education to the citizens of Washington state. In an effort to comply
with this mandate, UWB was established as an interdisciplinary campus with the stated mission to “encourage and support collaborative, interdisciplinary, and cross-program initiatives” (UWB, 2010). Since its establishment the UWB has initiated efforts to continue the commitment to interdisciplinary education by encouraging faculty to conduct interdisciplinary research and participate in interdisciplinary research circles.

The National Science Foundation established the Integrative Graduate Education and Research Traineeship (IGERT, 2010) program in 1997 to focus on significant interdisciplinary research opportunities while still giving graduate students the opportunity to gain deep disciplinary knowledge and skills. Such education, the National Science Foundation argues, will generate substantive changes in graduate education in the sciences such that collaborative interdisciplinary efforts will become expected in higher education.

Texas A&M University, College Station, opened the Interdisciplinary Life Sciences Building (ILSB) in September 2009. The building is 220,000 square feet of office space, laboratories and an auditorium. It was designed to house scientists from the fields of biology, chemistry, psychology, computer science and statistics to focus on several interdisciplinary efforts. The lay-out of the office space and laboratories was specifically designed with collaborative research in mind.

These three examples demonstrate attempts to transform research and graduate education at institutions of higher education to include and encourage interdisciplinary research. With some of the programs and campuses having been in place for over 15 years, these efforts demonstrate a concerted effort to enable interdisciplinary research through programs, policies and infrastructure. However, as the literature review will
demonstrate in Chapter II, interdisciplinary research is still difficult to pursue in higher education. Graduate students and new faculty believe that they need more interdisciplinary research opportunities but do not have access to them during traditional graduate training (UWB, 2010). Likewise, the higher education organizational structure inhibits interdisciplinary collaborative efforts by erecting rigid departmental boundaries and creating tenure and promotion criteria based on disciplinary activities (National Academies, 2005).

This research study is an exploration of the factors that enable interdisciplinary research in higher education research institutions. The study is limited to higher educational institutions in the United States that require research for faculty members to attain tenure. The study, however, focused on both interdisciplinary and disciplinary faculty researchers because the literature has persistently focused only on the skills and barriers that interdisciplinary researchers have. This limitation in former research cannot make research-based comparisons and elucidate the differences between researchers who pursue interdisciplinary research and those who pursue strictly disciplinary research.

Research Questions

1. What factors motivate interdisciplinary researchers to pursue interdisciplinary research projects?

2. What are the factors that differentiate successful interdisciplinary researchers from unsuccessful interdisciplinary researchers?

In order to answer these research questions, the researcher developed a survey questionnaire that was administered to 199 faculty members at academic research
institutions in the United States. Both descriptive and inferential statistical tests were conducted to determine the differences between types of researchers.

Introduction to Interdisciplinary Research

Interdisciplinary research and teaching are grounded in our need to answer questions, solve problems and find new and interesting applications. Humans do not approach problems with the framework or expectation that one single disciplinary content area or methodology will solve them; we approach problems with an eagerness to find the solution and will take whatever method, content or knowledge area works best for obtaining the best results (National Academies, 2005).

Organizational structures at academic institutions, however, do not necessarily support such interdisciplinary research efforts. Because of a variety of historical issues, academic institutions have become increasingly organized into discrete content area units called “disciplines” (Lattuca, 2001). This organizational structure helps to facilitate everyday running of the university, to manage its employees and to educate and graduate its students, but it sometimes lacks in its abilities to easily answer the needs or problems found in society or nature (National Academies, 2005). As the concept of disciplines has become more ingrained into our expectations of the academic institution, we have invested more power into the disciplines (or departments) themselves, resulting in an organization structure that inhibits, or at least makes more difficult, the formation of interdisciplinary research teams or projects.

Simply knowing that problems need to be solved from an interdisciplinary perspective and then doing so are two different things. Academic institutions have been performing such research for several decades; however, doing so often creates problems
for the individuals undertaking the research. The organizational structure and reward system do not always reward research that occurs outside of set departmental boundaries, thus causing a professional conundrum for the researcher who wants to pursue interdisciplinary research (Lattuca, 2001).

Interdisciplinary research is, furthermore, difficult. It requires people who are trained deeply in one discipline to learn each others’ languages, methods, approaches to solving problems and bureaucracies endemic to their departments (Lélé & Norgaard, 2005). Therefore, discovering the motivating factors, as well as the factors that aid in success for interdisciplinary research teams, may help develop a model that can be implemented by academic institutions so that they can better support interdisciplinary research throughout their organizations.

Definitions

This section defines the terms used in this dissertation. While many interpretations of these terms are possible, the definitions here provide an operational understanding and context for the terms used in this study.

Administration. Higher education administration, when mentioned in this study, includes individuals at the highest levels of the administrative structure: president, vice presidents, and provosts. These individuals are the ones who create the policies and mission for the institution. A more detailed discussion of administrative structure is included in Chapter II.

Disciplines. Disciplines are the discrete units of study that make up the departmental organization of higher education (Klein, 1996). Disciplinarity is the foundation for graduate education and is the “first principle” (p. 6) that faculty adhere to
when discussing their professional career. Disciplines are the organizational unit of higher education, the foundation upon which tenure and promotion is granted and the de facto basis for knowledge production and dissemination in the developed world.

**Faculty.** Faculty are the individuals in an institution of higher learning who are the producers of research and the teachers of content. They share in the governance of higher education by providing input on the policies set forth by the administration and by reviewing tenure and promotion bids. They are the purveyors of content knowledge and disciplinary understanding.

**Interdisciplinary.** Interdisciplinarity is the combining of two or more disciplines to answer a specific problem. The Centre for Educational Research and Innovation (CERI) (OECD, 1972) places the following criteria on interdisciplinary work:

- Interdisciplinary research combines the methods, knowledge or theories from two or more disciplines,
- Interdisciplinary research is focused on solving a single problem using the combinations above, and
- Communication between the disciplines is continuous throughout the problem solving.

The CERI definition allows for a continuum of interdisciplinary efforts, yet, is specific enough to be useful as an operational definition for this study.

**Research.** Research is part of the work that faculty do. Boyer (1990) refers to research as the scholarship of discovery. It is a disciplined process of discovery that advances knowledge by expanding and creating new knowledge. Research can be basic (knowledge creation for the elemental understanding of a topic) and applied (knowledge
creation with the intent to be used). Research in academic institutions can be conducted alone or in groups or teams.

_Tenure and Promotion._ Tenure and promotion is the structural reward system in higher education. Faculty are expected to publish research, provide service to the institution and teach students in order to receive tenure and promotion. Guidelines are different at different institutions.

_Rationale for Creating a Survey Instrument_

A survey instrument was created with the intent to develop a model for successful interdisciplinary research that will provide groundbreaking understanding about how interdisciplinary research works in the academic institution and will help university administrations create environments in which interdisciplinary research can flourish. Previous studies (Latucca, 2002; Spanner, 2001; Klein, 1996) have investigated the research habits or patterns of interdisciplinary researchers and made claims about interdisciplinary research habits, but they have not conducted empirical studies about individuals who were strictly disciplinary researchers. Thus any comparisons they make to disciplinary research only carry the weight of the statement; there are no actual research data to back up such claims. This survey investigated the behavioral and motivational attributes of both types of researchers as well as institutional characteristics and made comparisons in order to determine what is different about interdisciplinary research. Thus a model for successful interdisciplinary research based on the differences of disciplinary and interdisciplinary researchers can be developed.

Several researchers (Spanner, 2001; Robinson, 1996) claim that interdisciplinary research is particularly difficult for non-tenured assistant professors because of the
disciplinary organization of the academic institution and evaluation for tenure and promotion. Robinson goes so far as to state that “the only practical solution for most faculty, especially those in line for tenure and promotion, is to make sure that publication in disciplinary journals continues” (p. 91). Such difficulties, as identified by the literature, would suggest that many faculty defer interdisciplinary research until after they have received tenure and promotion. This is a problem that could be compounded because of the faculty work life cycle (Blackburn & Lawrence, 1995) that suggests that once faculty reach tenure their research productivity slows down. The model developed from this survey instrument may, therefore, be used to address issues of tenure-track assistant professors who wish to conduct interdisciplinary research and suggest ways to make that academic leap one that is not simply a leap of faith but one that enhances their careers as well.

Furthermore, an interdisciplinary research model may be useful in helping university administrators create policy within their institution that will create an environment—social and organizational—that will support and recognize the contributions of interdisciplinary researchers. Such actions by administrators will create a “literacy event” (Tierney, 2008, p.123) that demonstrates their commitment to the remainder of the institution, thus legitimating and rewarding interdisciplinary research throughout the institution (Salter & Hearn, 1996). Another area that administrators will be able to address is the need for better interdisciplinary training at the graduate level (Golde & Gallagher, 1999). An interdisciplinary research model, therefore, may pave the way for more interdisciplinary graduate training.
Finally, the interdisciplinary research model helped explain what motivates faculty to conduct interdisciplinary research despite the difficulties identified in the research literature. Lattuca (2002) argues that the social context in which a faculty member works is inseparable from the faculty member, thus, creating a symbiotic relationship between the faculty member and his/her academic institution. As such, determining motivational factors helped to illuminate how interdisciplinary researchers initially get interested in doing interdisciplinary research and how they maintain that interest. The model, therefore, created a guideline for enhancing the social context in which faculty members work which will in turn enhance the success of interdisciplinary research projects at an institution.
CHAPTER II

LITERATURE REVIEW

This chapter is a literature review of the many faceted components of interdisciplinarity. A simple literature review looking at the research and theories focused only on interdisciplinarity would not begin to flesh out this very complex story. In order to gain a full understanding of interdisciplinarity one must start with general theory (social constructionism and social exchange theory). With that theory base in mind, one then turns to organizational theory and how it applies specifically to higher education institutions. Once the organization of knowledge and bureaucracy is understood, then the researcher can begin to delve into the factors that interdisciplinary research faculty claim contributes to or creates barriers to their success.

This discussion begins with social exchange theory. Social exchange theory is a motivational theory that explains both the intrinsic and extrinsic factors that motivate people to take on projects. Social exchange theory posits that people engage in an activity only when they get something out of it. Social exchange theory helped the researcher to explore motivational issues of faculty researchers who engage in interdisciplinary research despite that it appears to be difficult to do, has diminishing rewards and often relies on teams for its production. Next, social constructionism theory provides a grounding in the understanding of the basis for the concept interdisciplinary. Social construction theorists contend that individuals build their understanding of truth in the world through social interactions. By confirming what we see, hear or speak through others, we develop meaning, and the meaning becomes fixed through multiple people affirming it. Interdisciplinarity and disciplinarity cannot exist in definition without one
another, and as such, the truth of each depends on what appears at first glance to be the
contradictoriness of the definitions. Only by exploring the social constructionism of the
term disciplinary can one relieve it of its claim to Truth and see that it is one explanation
of knowledge and knowledge production. The term “interdisciplinary” enters, then, to
provide context and to dismantle the power position of disciplines and the organization of
knowledge around the term.

Following the theoretical discussions, the literature review addresses the different
components and factors of this study. Faculty are the focal point of the study and as such
merit a review of the literature. The researcher begins with the importance of graduate
training on faculty socialization. Discussed in this section are the activities of faculty,
what motivates them to perform despite seeming minimal extrinsic rewards, and how the
tenure and promotion process works and affects faculty research choices. The researcher
then explores the organization of higher education and how it is structured to both
promote and inhibit interdisciplinary research.

The literature review changes focus slightly at this point to focus on knowledge
production and how it is that certain knowledge is given credence while other knowledge,
or research methods, are not. The understanding of knowledge production leads directly
to the organization of knowledge into disciplines, so a discussion of disciplines and
disciplinarity follows. The chapter ends with a comprehensive literature review of
interdisciplinarity which ties together the components leading up to it and allows the
reader to understand the important questions being asked in this research study.
Social Exchange Theory

Social exchange theory explains how individuals in social relationships “trade” resources that they value with each other. Blau (1964) and Emerson (1962) provide a foundation upon which to understand group dynamics, both at a macro and micro level. Furthermore, social exchange theory provides a conceptual framework upon which to understand the complexities of interdisciplinary research at the university level.

According to D’Amour, Ferrada-Videla, Rodriguez and Beaulieu (2005), social exchange theory assumes that “social structures can be understood through an analysis of interpersonal transactions” (p. 123). Social interactions occur through two basic principles: exchange and negotiation. Muthasamy and White (2005) further differentiate social exchange theory into components. Reciprocal commitment imposes a sense of group norms in which individuals are expected to contribute due to “a sense of duty to the venture and the other partner” (p. 419). They also discuss the importance of power as a phenomenon in group dynamics. If an individual thinks that there is an imbalance of power they will not view the group dynamic as proceeding fairly and may feel less inclined to participate or contribute (Muthasamy & White, 2005). Because much interdisciplinary research at universities occurs between individuals who bring something to the partnership, social exchange theory can help explain how this relationship works, or does not work, and how the administration can set up a reward structure that will encourage more participation in interdisciplinary research.

What follows is a general literature review of social exchange theory, divided into sections: the basis of the theory, the multidisciplinary uses of the theory, how emotion
should be included in the discussion of the theory and how knowledge can be viewed as having value.

The Theory

Social exchange theory developed from economic exchange theory, but instead of relying on an economic exchange, social exchange theory posits that individuals value social resources such as power, trust, status and commitment. Individuals are mutually dependent on each other for success of the social exchange, and both want to feel that they benefited from making the exchange (Stolte, Fine, & Cook, 2001). Resource value and availability determine who holds power in the exchange. The individual in power is the one who controls the terms and length of the interaction. This does not mean that the individual lacking power cannot negotiate. They can do so by:

- Creating a joint plan for solving the problem,
- Conforming consistently to norms,
- Withdrawing from the exchange, and
- Searching for new sources of resources. (Stolte, Fine, & Cook, 2001)

At the forefront of current social exchange theory, Molm (2003) identifies the key terms and premises of social exchange theory. *Actors* are participants who exchange *resources* (things or abilities valued by others) in an *exchange network* (the group within which an exchange takes place). *Power advantage* occurs when one actor has better opportunities and choice in the exchange network. Social exchange takes place within the processes of power, inequality, trust, commitment and fairness (Molm, 2003).

According to Molm (2003), there are two forms of exchange. A *direct exchange* involves “A” giving something to “B,” and “B” giving something to “A.” An *indirect*
exchange is when “A” gives something to “B,” and then “B,” who learned something from the exchange with “A,” gives something to “C.” Direct exchange is further broken down into two types. Negotiated exchange is a formal agreement between parties for the terms of exchange. A reciprocal exchange occurs when actors perform separately and do not negotiate. This is typically seen as a series of actions over a long period of time (Molm, 2003). Negotiation and reciprocation are distinguished by three dimensions:

- **Contingency**—important to reciprocal exchange because individuals act by themselves (unilaterally) and without restrictions of time,
- **Information**—reciprocal actors act without knowing specifically what they will receive in return for their actions, and
- **Timing**—during reciprocation, equality balance develops over time, not immediately. (Molm, 2003)

Molm (2003) further elucidates that negotiated exchange, while more structurally clear, is more subject to conflict because of the bilateral flow of resources. She argues that this affects actors’ perception of the exchange and creates actors who are acting out of self interest because they can compare outcomes more easily, the costs are more transparent, and inequality is more likely to be perceived as intentional.

Molm, Peterson, and Takahashi (2001) further explore the use of power in social exchange theory. The basic premise of power-dependence theory in social exchange is

- Actors are dependent on each other,
- Benefits obtained are contingent on benefits given,
- Exchange occurs over time,
• “actors are motivated to obtain more of the outcomes they desire and others control, while minimizing costs and losses.” (p. 160)

When an imbalance of power between actors occurs, inequitable exchanges result. The actor with the least power can seek alternative resources and, therefore, increases in power relative to the focal partner (Molm, Peterson, & Takahashi, 2001).

*Emotions in Social Exchange Theory*

Lawler and Thye (1999) further social exchange theory by examining how important emotional responses are to the context, process and outcomes. Identifying specific norms for business (emotional neutrality) and personal relationships (emotion is exchange commodity), they demonstrate how emotion works in social exchange theory. In the structural/relational approach, an increase in power results in an increase in positive emotions (Lawler & Thye, 1999). It is important to understand that power and status are defined relatively depending on the social situation. In other words, someone may have power in a relationship with her children but not have power in a relationship with her boss. Negative emotions resulting from lack of power or status are both stronger and longer lasting than positive emotions resulting from rewards or gain in power. Therefore, high status individuals are less likely to be criticized or challenged and, as a result, experience more positive emotions during the exchange (Lawler & Thye, 1999).

Emotional responses in social exchange theory are important for creating meaning of an interaction which is done through sensory/informational approaches. These approaches signal the self’s attempt at seeking consistency between meaning that is tangible, and thus constant, and meaning that is felt emotionally, and thus transient or changing. Emotions reflect whether consistency is achieved or not (Lawler & Thye,
Conflict results when actors become self-interested: “such actors can never reap the benefits of collaboration even when it promises greater rewards in the long run” (p. 229). Emotions, specifically negative ones such as shame or embarrassment, help curb self-interest.

Lawler and Thye (1999) examine how emotional responses from other interactions carry over into exchange context. Cognitive approaches can be used to look at how emotional states influence how we encode and report information and how we predict the outcomes of a negotiation. For instance, when an individual’s child is sick, his/her feelings of worry for her will still be present during negotiations at work and may result with the individual feeling badly towards an exchange about which he/she would otherwise feel happy. Another component of the cognitive approach examines how positive attitudes result in “lazy accounting”: basically, actors feel that they experienced a more cooperative, trusting, and mutual negotiation when they are in a positive mood—which may be why children try to compliment their parents before asking for something (Lawler & Thye, 1999).

The next approach that Lawler and Thye (1999) examine is attributional approaches which state that an individual acts according to the attributes that others believe about them regarding specific behaviors. Further, individuals involved in social exchange experience global emotions (generalizable feeling about a specific event) that motivates them to reproduce or avoid such exchanges in the future (Lawler & Thye, 1999).

The final approach that Lawler and Thye (1999) examine for overlaying emotions on social exchange theory is the social formation approach. In this approach greater
interdependence results in a greater acknowledgment that results are produced jointly. The social formation approach states that as groups develop rituals and a collective identity, they create a boundary within which actors have a responsibility to one another.

*Learning in Social Exchange Theory*

Hummel et al. (2005) experimentally tested incentive mechanisms to encourage voluntary learning by participants. They used social exchange theory to devise the following incentives:

- Personal access—user receives useful information,
- Personal reputation—user gains status,
- Social altruism—user does good for others, and
- Tangible rewards—user gets tangible asset in return.

They find that users will increase participation in a learning network when and after an incentive is given. The incentive does not have to be repeated for continued participation.

In examining mentoring relationships, Ensher, Thomas and Murphy (2001) use social exchange theory to explain mentoring choices and satisfaction with the mentoring process. They claim that mentors are more likely to choose mentees that the mentors think will be high performers. Mentors do this because they believe that they will benefit from the relationship by having a mentee who can provide something back in exchange for their expertise. The mentee, likewise, benefits from the exchange by accessing networks and critical information. The mentee gives to the exchange by working hard and providing a fresh perspective. Ensher, Thomas and Murphy (2001) found that:

- The degree of reciprocity increased mentees’ satisfaction with mentors,
- Mentees were more satisfied with step-ahead mentoring, and
- Matching mentor/mentee based on reciprocity of needs created a more satisfying exchange relationship.

Knowledge as Resource

Knowledge can be considered a socially intrinsic resource. Emerson (1987) posits that people become the valued outcome by holding within themselves a valued resource, in this instance knowledge. For this reason, interdisciplinarity depends on the knowledge of other actors in order to succeed. An exchange of knowledge must take place between people in order to create a new idea, field of study, grant proposal, research article or course, for example. By exchanging their valued goods, the actors create something larger than they could on their own (Molm 2003).

Kankanhalli, Tan and Wei (2005) use social exchange theory to explain the costs and benefits of people who voluntarily share knowledge in electronic repositories. Because knowledge sharing is a reciprocal exchange, there is an assumed long-term relationship among participants. If A shares knowledge today, he/she may not need knowledge shared by B until months later. Organizations that expect workers to share knowledge need to be cognizant of the costs of sharing the knowledge (time to upload information, for example) because, if these costs are too high, individuals will be reluctant to participate (Kankanhalli, Tan, & Wei, 2005). However, knowledge contributors can receive many different kinds of rewards. Organizational rewards (increased pay, leave time, for example) may help, but are not necessary. Many knowledge contributors find satisfaction from having a boosted image or self concept.
They also find benefits in the idea of reciprocity. Kankanhalli, Tan and Wei (2005) suggest policies for encouraging knowledge sharing at an organization:

- Raise self-efficacy by showing how knowledge sharing benefits organization,
- Maximize enjoyment of knowledge sharing,
- Provide rewards,
- Highlight reciprocity opportunities, and
- Make sharing easy by reducing technical barriers.

Hall (2003) further examines how social exchange theory is important in information/knowledge sharing in “large, distributed organizations” (p. 288). Citing Cross, Parker and Prusak, Hall (2003) highlights how important it is that individuals within an organization understand what knowledge is readily available and how to access it:

…the whole network’s ability to create and share knowledge is dependent on individuals’ metaknowledge of network members’ expertise, ready access to such expertise, the willingness of members to actively engage in problem solving, and the ease with which safe relationships can be formed. (p. 294)

Interdisciplinary research occurring in universities fits this model. Faculty members must know about the expertise of other individuals within their institutions—or at other institutions. Complicated networks, both formal and informal, are created in higher education institutions and fields to create these knowledge networks.

Another key component of knowledge sharing that Hall (2003) highlights is the concept of intellectual property. Because researchers and faculty members believe that they own the knowledge they have discovered, their willingness to share that knowledge
depends highly on the social exchange context and process. When organizations encourage the sharing of ideas and ownership of knowledge, individuals are more likely to share (Jarvenpaa & Staples, 2001).

Finally, individuals share knowledge because they have access to rewards that they would not if they did not participate in interdisciplinary research. For instance, access to funding often requires intricate teams in order to provide the knowledge and expertise needed to meet the funding agency’s requirements (Hall, 2003). Hall further argues that achieving a scholarly reputation or acknowledgement often is the only needed reinforcement for many people to participate in knowledge sharing. Boisot and Griffiths (1999) explain that when an organization makes it easier for employees to share knowledge and they provide an incentive structure for them to do so, employees are more likely to seek opportunities to collaborate.

**Conclusion**

Social exchange theory provides a solid basis for discussing and researching interdisciplinary research teams because it explains the components of relationships based on exchange of goods—whether tangible or intangible. Since what most faculty possess is knowledge, they bring to the exchange process knowledge that can be combined with others’ knowledge to help create a program or concept that is both different than and more than, and, even more importantly, potentially better than, what they had by themselves. Social exchange theory provides a lens through which to examine the factors that contribute to successful interdisciplinary research and can assist in creating policy to help universities, funding agencies and (inter)disciplinary networks disseminate important and significant results from these exchanges. Finally,
conceptualizing knowledge as possessing value is vital to the work on interdisciplinary research because it helps solidify what takes place when several faculty members get together to create something new—a novel way of teaching a biology lab using computer gaming technology, for instance.

Social Constructionism Theory

The second theory used to provide a foundation for understanding interdisciplinary research is social constructionism theory. Social constructionism theory is based on the concept that understanding of the world is shaped through language. Because language is a social process, our understanding of the world is influenced by our social relationships. As K. J. Gergen (2003) states: “From the constructionist position the process of understanding is not automatically driven by the forces of nature, but is the result of an active, cooperative enterprise of persons in relationship” (p. 15). Social constructionist theorists can claim many disciplinary influences, including philosophy, sociology, and linguistics, and is applied in many other disciplines such as psychology, literary theory, and education (Burr, 2003). According to Gergen’s (2009) history of social constructionism, the original theorists are Wittgenstein, Saussure and Derrida. Wittgenstein (2003) coined the term “language game” (pp. 18-19) which refers to the manner in which humans use language to create our world; therefore, what we know of as truth is created through language.

As an outgrowth of postmodernism, social constructionist theorists critique the positivist and realist traditions of truth telling, good reasons and good evidence by pointing out that these concepts are “from within a tradition” (Gergen, 2009, pp. 12-13). Postmodernist critiques of reason, objectivity and scientific truth establish that such
concepts privilege certain groups, usually the dominant group, and as a result, scientific inquiry can become an oppressive ideology. Therefore, postmodern and social constructionist theorists look for ways to explain the world that would be more inclusive of other groups, reject metanarratives and explore the “co-existence of a multiplicity and variety of situation dependent ways of life” (Burr, 2003, p. 12).

*Semiotics and Linguistics in Social Constructionism*

Saussure (1916, 1974) and Derrida (1997) were instrumental in establishing the linguistic theory of social constructionism. Saussure’s theories are the basis for the discipline, semiotics. A basic understanding of two of Saussure’s proposals is important to understanding social constructionism. There is an important distinction in Saussure’s (1916, 1974) linguistics between the “signifier” and the “signified.” The signifier is a word (or some signal) which we believe refers to an object, the signified. The first proposal that is important to social constructionism is that the signifier and signified are arbitrarily related. This is not to mean that we can use any utterance to mean an object, but if a group of people agree that an utterance (signifier) refers to a particular thing (signified) then that utterance means something to that particular group. This explains how different languages have different words for the same thing. It can also explain the existence of twin-speak, where two children learning to talk create a mutually agreed upon language for understanding that they use only between themselves. The second of Saussure’s concepts that is important to social constructionism is that language, or sign systems, is ruled by an internal logic. In other words, social groups understand each other because they have grammar and syntax that governs how their vocabulary can be used. We make meaning from these signs.
Derrida’s (1997) view of language is based on differences. We make meaning of words by comparing them to what they are not. Gergen (2009) further explains that we understand language by speaking of presences, that which is designated by the word, and pushing to the background absences. The presences, since they are what are talked about, become privileged, but the absences, though they are only there by implication, are what allows the presences to exist. This view of language builds upon Chomsky’s (1971) structuralist theories about relational communication and deep grammatical structure. In terms of this study, disciplines are the privileged terms; however, disciplines could not exist without the concept of interdisciplines upon which to base the distinctions of individual disciplines. In Derrida’s (1997) view of linguistics, words defer their meanings to other words; therefore, we are always in search of meaning.

Science as a Social Construction

A very important critique by social constructionist theorists is that science is a social construct. Karl Mannheim’s work *Ideology and Utopia* (1951) poses four principles upon which social constructionism builds to establish that science is indeed based on social processes:

- Scientific theories come from the scientist’s social group;
- Scientific groups are organized around theories;
- Disagreements about theory are group conflicts; and
- Scientific knowledge is, therefore, a byproduct of a social process.

Using Mannheim’s logic, positivism and realism come into strong critique by social constructionists. If social constructionists can undermine the Truth telling authority of Science, then the entire basis of our academic tradition becomes vulnerable to different
theories about knowledge and knowledge creation and opens the door to new methodologies and avenues for disseminating research.

Like Manheimm, Kuhn (2003) also theorized about the social nature of scientific paradigms. He stated that science is created by a community of people who have a specialized language, agree upon appropriate methodology and train new people into their community. When encountering a paradigm shift, the community of scientists argue among themselves about the appropriate approach and agree upon what can become accepted use of vocabulary, knowledge and methodology. As such, science is created by a community of humans, and Truth is defined by that same community.

Using the writings of Manheimm and Kuhn, social constructionists question the following premises of empirical research:

- That research measures the phenomenon as accurately as possible,
- That research removes personal bias,
- That research can predict and control,
- That observations can be converted to numbers, and
- That research finds THE answer.

Social constructionists critique these views on the basis that the premises are value-laden and based on social tradition. As such, research is never “objective” and bias free. This is especially true when conducting research about humans because they are independent thinkers and actors and can manipulate the study, not conform, or behave in unexplainable ways. Truth in research is only true because we agree for it to be so, and, as such, researchers need to be aware of their own social positioning and make it clear in
their research what that social positioning and influence may be. In Gergen’s (2009) words “Let us not mistake the word for the ‘world’” (p. 172).

Cultural Critique and Social Constructionism

Because social constructionism holds that our understanding of the world is based on social perspectives and relationships, it follows that theorists will begin to question long-held “societal truths” such as the normalcy of heterosexuality, superiority of males, or white supremacy. Gergen (2009) asserts that social constructionism allows us to question our assumptions and value other cultures and, as such, is a generative theory that invites us into action. Teachers and professors have used social construction theory to change education from a top-down approach to a more student centered approach using such methods as service learning (Gergen, 2009; Kafai, Desai, Peppler, Chiu, & Moya, 2008). Lee (1999), and O’Shea (1998) argue that social construction theory (among other social theories) provide an important key to understanding sociological phenomenon and should be incorporated into cultural studies in sociology. Geography also benefits from social constructionist theory by allowing an understanding of the different cultural perceptions of the world (Dittmer, 2006). Likewise, feminist scholars (Crowley, 1999), minority scholars (Berbrier, 2002) and gay and lesbian scholars (Abes, 2008) have all promoted the use of social constructionist theories.

Research Methods and Social Constructionism

Social constructionists question the “overarching power” of the positivist experimental method because knowledge is a social construction and, as a result, is not finding Truth but is instead one version of a truth. According to Gergen and Gergen (2003): “A method is only accurate or objective in terms of the particular conventions
shared within the community” (p. 60). As a result, a researcher must choose among a range of methods to achieve the most holistic view of their study as possible. Such explorations include: a narrative examination of a subject (M. Gergen, 2003); autoethnography (Tillmann-Healy, 2003); a compilation of multiple voices to provide views on a topic (Lather & Smithies, 2003; Fox, 2003); fictional accounts of social situations (Diversi, 2003); and participatory action research (de Roux, 2003).

As a result of the critique against positivist empirical research, social constructionism has made heavy use of qualitative methods and mixed methods research. This is not to say that there is a laissez faire attitude regarding the quality of evidence or that there is a diminished rigor in social constructionist research. Freeman, deMarrais, Preissle, Roulston and St. Pierre (2007) argue that the use of qualitative evidence in educational research not only provides significant insight into the phenomena studied but does so with exceptional quality by working from the intellectual standpoint of each researcher in a project. They insist that qualitative research be heterogeneous, meet quality standards, require expert judgment, be based in a theoretical framework and acknowledge the relationships between researcher and subject. A rigorous qualitative approach to academic research redefines what constitutes knowledge and knowledge production in higher education and how that knowledge should be organized in the academic system.

*Higher Education, Interdisciplinary Research, and Social Constructionism*

Institutions of higher learning are large organizational structures in which environments define and are defined by the participants in those organizations. Tierney (2008), in his book *The Impact of Culture on Organizational Decision Making*, explores
the metaphor of a biological environment as it relates to higher education. He claims that the constantly changing environment in higher education affects the departments and programs within it. These environmental changes occur through various influences and are fluid in their dynamics. Change can happen from within or without, from the top down or bottom up, or from long-held traditions or newly formed ideas. He further states, “By noting that organizations not only respond to, but also help define, their environment through selective attention and interpretation, we observe once again that organizations are less social fact and more ongoing social definition” (p. 13). Thus, it is important for higher education administrators and leaders to understand the social construction of the organization and work with the dynamics of such an organization when trying to direct or implement change.

Tierney (2008) further argues that communication is paramount to creating a culture at an institution; furthermore, once the culture is created, the governance structure of the university follows. Because organizational cultures work like a biological environment and change is constantly happening, both from within and without, it is important for all members of the institution to communicate in ways that will effect the change they would like to see happen. Tierney (2008) encourages faculty to pay attention to their communicative strategies in their quest for structural reforms. Likewise administrators and higher education leaders need to pay attention to their communicative acts in order to ensure that they are achieving “buy-in” from the faculty and staff constituents and that the message they are trying to convey is actually conveyed. Discourse is ever present in all actions in which individuals participate. Tierney (2008) suggests that the ways in which groups communicate illuminate the organizational
culture at that institution. Likewise, the organizational culture influences the methods of

group communication and governance at the institution. The culture of an organization is

created by its constituents which in turn creates the governance structure of the

organization. These two components of an organization are constantly being defined,
redefined and tweaked to create the image of what is known as higher education.

Becher and Trowler (2001) further explore the organization of the academic

institution through the anthropological analogy of tribes and territories. This analogy
helps to point out that “The globalized landscape has fundamental consequences for
higher education. It is creating new patterns of incentives and disincentives, new
opportunities and dangers, new structures and constraints” (p. 2). By defining higher
education’s organization in terms of academic tribes and territories, Becher and Trowler
are able to define how disciplines became the basis for the departmental organization at
universities and how this departmental organization becomes the basis for knowledge
creation within the university. Academic tribes function much like human (sociological)
tribes. They have a territorial stance where they are hostile to outsiders and protect their
geographic space. They have idols and artifacts that are displayed proudly. They have a
language and a cultural identity. In a Foucaultian-type discourse analysis, Becher and
Trowler (2001) elucidate how the current discipline-specific organizational structure
(such as departments) of academic institutions has become accepted as “the norm.” Peer
review, shared governance and collective assessment and evaluation have taken on the
standard governance of higher educational institutions. Such a move has cemented the
idea of the discipline-specific department and resulted in an organization where it is
difficult for faculty to establish a broad interdisciplinary career.
Because the organization of higher education is based on discipline-specific
departments and knowledge creation, Klein (1996) argues,

All interdisciplinary work is critical in that it exposes the inadequacies of the
existing organization of knowledge to accomplish given tasks….When
intellectuality is premised on rediscovery and rethinking, resocialization and
reintellectualization, interdisciplinarity becomes not just a way of doing things but
a new way of knowing. (pp. 14-15)

Klein’s (1996) analysis of the restructuring power of interdisciplinary research and
knowledge is fundamental to the understanding of how higher educational institutions
function today in a world where the outside communities (business, government) are
expecting applied research that addresses all aspects of a particular problem and attempts
to solve it.

Salter and Hearn (1996) further examine the disruptive nature of
interdisciplinarity on higher education’s organizational structure. They describe
interdisciplinarity as rebellious because it not only examines, but also confronts, the
assumption that research within disciplines is the only way to conduct research. In their
analysis of interdisciplinarity and how it functions in higher education—how it is both
successful and suppressed—Salter and Hearn (1996) not only describe interdisciplinary
research as being confrontational, but it also challenges, conflicts with, and breaks down
barriers. They suggest that academic warfare is on-going and that the organizational
structure of higher education will change as a result of the conflicting images that
interdisciplinarity creates. For Salter and Hearn the concept of describing
interdisciplinary research is transformative, but since it takes place within higher
educational institutions, it requires the participation (or capitulation) of the organizational system to become truly successful.

Lattuca (2001) states that poststructuralist and other theories began in the humanities. She posits that interdisciplinarity is the only way to dismantle the inherent power structures created by disciplinary boundaries and definitions. She traces the changing definitions of discipline to explain how content, method and historical and cultural dimensions have developed our understanding of interdisciplinary research. Toulmin’s definition of discipline is focused on methods, concepts and aims, whereas Foucault moved the definition of discipline to include power structures. Others have focused on language as the most poignant component of disciplines. Kuhn, as described above, focused on paradigm shifts that define the problems to be solved. Lattuca (2001) examines the concept of disciplines as cultures and how such perceptions can affect faculty’s understanding and behaviors regarding interdisciplinary research.

Moving her theory forward, Lattuca (2002) focused on the sociocultural aspects of learning and how learning in context applies to faculty, particularly as faculty wish to participate in interdisciplinary research. Because the term “discipline” refers both to the sociocultural methods and language of the discipline as well as the community of individuals who participate in the discipline, it is important to examine this dimension of faculty life as it pertains to interdisciplinary researchers. Lattuca (2002) focuses on using mediational means of accomplishing change (such as common language, art and maps) to bring about a transition in thinking among faculty. Mediation changes faculty because they learn to think about their discipline in terms outside of their discipline; however, it also changes the organizational structure in which faculty work. Therefore, Lattuca
(2002) argues, faculty who wish to participate in interdisciplinary research must be changed by the culture of the discipline but also change the system in their efforts to conduct interdisciplinary research.

**Conclusion**

Social constructionism provides a powerful theoretical framework for understanding and examining interdisciplinary research in higher education institutions. By exposing the political and power structures inherent in the organizational structure of higher education based on disciplines, social constructionism opens up a dialog about new ways of understanding knowledge production, faculty research, and higher education. Thinking about interdisciplinary research through a social constructionist lens allows the researcher to envision new ways of doing research and guiding faculty research agendas; therefore, social constructionism paves the way for new policies and model development that acknowledges the plurality of research possibilities in universities.

**Faculty**

Faculty are the subject of this study, and, as such, warrant a discussion about how they became faculty, who they are and what they do. Since the primary focus of this study is on higher education faculty who have research as a major component of their tenure decision, this literature review will focus on that aspect of their career rather than spanning the entire spectrum of faculty responsibilities which include teaching and service in addition to research.
Doctoral Education and Training

The first doctoral program in the United States was founded at Yale University in 1861 (Haworth, 1996). The original intent of doctoral training was to produce gentlemen scholars—individuals who spent their time thinking and researching, but not working in the sense that we know it today. Many nineteenth century American intellectuals traveled to Germany to attain a doctoral degree. The German model focused heavily on independent, basic research. American university administrators quickly desired to add prestige to their institutions by recruiting individuals with Ph.D.s as college teachers. Over time, the “scope and character” (p. 378) of the Ph.D. as we know it was cemented, and by the mid 1950s what we know of doctoral education was well-defined.

According to Haworth (1996), there were several factors which contributed to the growth of doctoral education in the mid- to late-1900s:

1. Sputnik in 1957,
2. Federal legislation that put money into doctoral education and research,
3. Non-academic demand for doctorally trained researchers,
4. Financial aid programs aimed at assisting graduate students,
5. Shift to a knowledge based society, and
6. Universities desiring prestige by hiring more doctorates.

Growth and demand for a particular type of degree usually breeds innovations in it; however, the Ph.D. has been slow to change and innovate. This could be due to several factors, but researchers agree that “the generally conservative nature of university faculty, administrators and professional associations” (Haworth, 1996, p. 396) have made it difficult to change the content of and the manner in which doctoral candidates are trained.
Innovations in graduate education have focused on several different areas: preparing better teachers (Nyquist, Woodford & Rogers, 1994), preparing better researchers in non-academic arenas (Wiesbuch, 2004), preparing better disciplinary stewards (Walker, 2004) and preparing better interdisciplinary researchers (Nerad, Aanerud, & Cerny, 2004). Graduate students desire opportunities for interdisciplinary education and research (Fagen & Suedkamp Wells, 2004; Nerad, Aanerud, & Cerny, 2004; Golde & Dore, 2004); however, these researchers find that many students (especially those in humanities and social sciences) do not have access or encouragement to interdisciplinary education and as a result are not prepared to take on interdisciplinary research once they become faculty members at academic institutions.

Innovations in doctoral education recently have included a move towards some interdisciplinary programs. Haworth (1996) points out that interdisciplinary programs tend to be dynamic and meet the needs of a global community as well as the demands of an information/knowledge based society. In fact, a study conducted at the University of Washington finds that Ph.D. graduates in all sectors want interdisciplinary experience during their doctoral training, even if they are receiving their degree in a strong disciplinary based program (Re-envisioning the Ph.D., 2010).

Graduate education is important to understanding faculty lives because graduate education can socialize students into the role of faculty (Wulff, Austin & Associates, 2004; Austin & Wulff, 2004; Fagen & Suedkamp Wells, 2004; Pruitt-Logan & Gaff, 2004; Austin & McDaniels, 2006). In their essay about the Preparing Future Faculty program initially funded by the Pew Charitable Foundation in collaboration with the Council of Graduate Schools, Pruitt-Logan and Gaff (2004) point out that faculty
members must be “effective teachers, active researchers, good academic citizens who contribute to the betterment of their departments, campuses, and communities” (p. 179). As such, graduate education should prepare students for a variety of academic positions including those at community colleges and teaching intensive universities. What the research shows, however, is that graduate students are often trained to be clones of their major professors—who are researchers at major research institutions. The likelihood that the students will end up in a like position is less than 10% (Golde & Dore, 2004; Fagen & Suedkamp Wells, 2004).

Faculty Scholarship

Once graduate students are socialized into being faculty members, they are expected to research, teach and provide service to their institutions (Bieber, 1999; Blackburn & Lawrence, 1995; Dunn, Rouse, & Seff, 1995; Fox, 1985; Metzger, 1987). But, what do each of these activities entail and how do faculty manage their time to accomplish all they need to do and provide important scholarly contributions to society? Dunn, Rouse and Seff (1995) point out that even though graduate school is assumed to be the site of faculty socialization, it often fails to accomplish that task, and new faculty members find themselves in a stressful job where they have difficulty managing their time and work expectations. New faculty worry about obtaining tenure; have difficulty performing their duties adequately when they are not defined clearly; lack mentoring and social support; do not have enough time to do everything they are expected to do; and grapple with a myriad of personal issues including marriage, family and personal health (Dunn, Rouse, & Seff, 1995). As a result, they often turn to their department chair for guidance and support since he/she is the individual who provides annual feedback in the
form of annual reviews, funding allocations and disciplinary guidelines. New faculty who were enthusiastic about the potential of collegiality when they became faculty members sometimes find themselves isolated and turn to their discipline “writ large” to set the guidelines for their academic success (Dunn, Rouse, & Seff, 1995). This more cosmopolitan view adopted by many new faculty creates difficulties for the institutions who wish to instill a more localized loyalty among the faculty (Dunn, Rouse, & Seff, 1995).

Boyer (1990) further addresses the issues of evolving faculty life in his groundbreaking work Scholarship Reconsidered. Academic work evolved from a focus on teaching civic and religious leadership to one that included trade preparation. Over time service was added as an expectation of faculty. Boyer (1990) points out that by the mid-1800s, scientists were enthused by the German model of education which included a heavy reliance on research as part of faculty work. Furthermore, by the time of World War II, the federal government saw academic institutions as a rich resource for cutting-edge research and began funding projects and using faculty members to enhance the war effort and improve the American scientific endeavors.

Boyer (1990) encourages an enlargement of the professoriate to include:

- The scholarship of discovery,
- The scholarship of integration,
- The scholarship of application, and
- The scholarship of teaching.

Boyer (1990) argues that each of the components is absolutely critical to the success of higher education. The scholarship of discovery focuses on the seeking out of new
knowledge, what many call basic research. He claims, “The intellectual excitement fueled by this quest enlivens faculty and invigorates higher learning institutions, and in our complicated, vulnerable world, the discovery of new knowledge is absolutely critical” (p. 18). Boyer (1990) encourages further examination of meaning by making connections across disciplines through the scholarship of integration. By broadening the scope on one’s research, a faculty member will enhance his/her original research and create something that has meaning outside of disciplinary boundaries. Boyer states, “It is through ‘connectedness’ that research ultimately is made authentic” (p. 19). By making one’s research broader and more meaningful, one begins to see how application begins to flow out of academic activities. The scholarship of application includes service to one’s university as well as service to the community and world at large. Finally, the scholarship of teaching must also derive from the research activities of professors and introduce students to the scholarly life.

Writing to academic leaders, Boyer (1990) further urges mandates that should apply to all faculty: faculty should be researchers, be current in their field, be held to the highest standards of integrity and be assessed with clear guidelines. Additionally, Boyer (1990) urges, university administration must remember that faculty members should be encouraged to be creative and venture beyond the domains of their discipline. He states that only through integration of knowledge will universities of all types begin to fully develop their core missions, be that research, teaching or service to the community.

In his article focusing on cultural capital in academic settings, Bieber (1999) argues that past assessments of academic culture and faculty life have failed to address the elements of power that are related to faculty life and academic institutions. Drawing
heavily on Pierre Bourdieu, Bieber (1999) points out that education is rife with cultural power and socializes students to think about how they are being socialized which leads to education perpetuating social class distinctions; therefore, rather than leveling the playing field, education tilts it in its favor. In this manner, education becomes a form of cultural capital. Focusing this discussion to faculty, Bieber (1999) points out that the norms, values, beliefs and symbols in the institution become value-laden: cultural capital resides in disciplines, positions and access to administration and, therefore, becomes something to struggle and fight over. He states:

The tensions that exist between groups of faculty are palpable. So, too, are the tensions that exist between faculty and administrators on many college and university campuses, lending evidence of the significance of the struggle over culture and control of the cultural arbitrary. These tensions exist for very real reasons. Not only do they often have implications for monetary issues and fiscal resources but they also have implications for defining the essence of faculty work, what of that work will be valued, as well as why and how it will be valued. (p. 383, emphasis mine)

Bieber (1999) further argues that through cultural capital, university administrations can control the faculty that work for them by creating expectations for tenure that include a stronger emphasis on research and lesser emphasis on teaching. Over time faculty are co-opted into researching because they think they are achieving cultural capital through it, when they are in reality self-regulating to the point that they lose their cultural capital and turn it over to the institution. Bieber (1999) points out that the attempt to maintain one’s cultural capital creates strife and conflict within the university for internal resources,
outside of the university for external resources and between disciplines for both internal and external resources.

In contrast to Bieber’s picture of faculty life as one filled with conflict and symbolic violence is the interdisciplinary faculty community at The University of Washington, Bothell (UWB). UWB was established as an interdisciplinary university campus (University of Washington, 2010). In order to achieve this mission, the Vice-Chancellor for academic affairs started a research circles program to enhance the scholarly activities of all faculty on campus, but particularly the new faculty (Gillespie et al., 2005). Gillespie et al. (2005) claim that young professors are often attracted to university life because they see a place where collegiality, interdisciplinarity, and lively exchanges would be the norm. What they found, however, is quite different: isolated research and dogged determination created rigid disciplinary boundaries and specialization that was often discouraging. Gillespie et al. (2005) assumed that new faculty often focus on issues not directly related to their true research and teaching goals in order to meet the excessively high bar of tenure. They focus instead on quantity not quality. As a result, the research circles focused on good writing, good research and interdisciplinary communities of support.

The research circle is a group of three or four faculty members who meet once every other week with three pages of good writing. They share this writing with the group, and the group provides constructive feedback, insights and suggestions (Gillespie et al., 2005). Over time, the groups gained an identity and began to develop a cohesiveness not found at typical universities. They were interested in institution building and development, not in divisive activities that would cause potential conflict
between faculty in different departments. Gillespie et al. (2005) point out that new faculty were able to gain a sense of the writing process which demystified the publication process. Therefore, they were able to become successful researchers as a result. One research circle participant stated, “Steadfast in our commitment to meet regularly over the year, we brought into existence an intellectually stimulating, interdisciplinary community, one that helped to keep the potentially fragmenting demands on us at bay” (p. 155).

While faculty are expected to perform many different tasks, research seems to take precedence in tenure decisions—more is expected at research intensive institutions, but some is still expected even at teaching intensive institutions (Fox, 1985). As a result, many faculty have stronger affiliation for national recognition among their disciplinary colleagues rather than their university colleagues. Fox (1985) argues that graduate training and current institutional affiliation are the strongest correlates to scholarly publication. Freedom to choose research topics is also correlated to higher levels of production. Anderson and Louis (1991) argue that the increased reliance on external funding to conduct research has robbed faculty of that freedom and creativity.

_Professionalization_

Faculty research activities are conducted within an institution; however, it is argued that their true affiliation and professional identity rests in the disciplines (Metzger, 1987; Finkelstein, 2006; Becher & Trowler, 2001). Finkelstein (2006) points out that the beginning of faculty appointments based on discipline began in the 1860s. Metzger (1987) furthers this point that disciplines were firmly established in the 1870s by detailing the facts that most subjects in the academic curriculum had a national
disciplinary organization tied to them. The disciplinary organization defined acceptable research topics, published research from academics in the field, determined appropriate sequencing of courses, created a network of individuals in the field and added prestige.

Metzger (1987) defines the four tenets of the academic profession: the field of higher education, the institution, the faculty within the institution and the discipline. Unlike the medical or law professions, academics are not likely to associate with the “faculty profession.” Instead, they are more likely to associate with their disciplines and spread their loyalties nationally rather than within the institution. Finkelstein (2006) terms these divided geographies of loyalty, cosmopolitan and local. In fact, Metzger (1987) argues that the affinities of the discipline are so profound that “a viable profession-across-the-disciplines” (p. 164) is the nemesis of professionalization within the disciplines and as such has been the reason for the lack of strength in interdisciplinary research.

Motivation Theories

Motivation theories help university administrators understand how to manage the activities of individuals, faculty and staff, for most productivity within the institution. These theories are especially important considering that most faculty feel stronger affiliation for their discipline instead of their institution. Both extrinsic (external) and intrinsic (internal) factors affect motivation. Motivation theories are grouped into two categories: needs-based and process-based theories (Bess & Dee, 2008).

Maslow, McClelland and Herzberg are needs-based motivational theorists (Bess & Dee, 2008). These theorists posit that individuals have needs that proceed upwards in a hierarchy which must be “filled” before moving to the next level. Individuals desire to
achieve the highest level of motivation (for Maslow that is self-actualization), and it is at these higher levels of motivation that the best creativity and most productivity take place. Bess and Dee (2008) state that higher education administrators need to manage the lower level needs (safety, environmental conditions) so that faculty can focus on their research and achievements. These lower level needs can include such things as good work space (lighting, adequate room, equipment) to collegiality. Administrators also need to focus on providing faculty with enriching jobs that have challenges and variety (Bess & Dee, 2008).

Process theorists focus heavily on the external, environmental conditions in which people work and how that affects their internal, cognitive processing of a work situation. In the expectancy model (Bess & Dee, 2008), three cognitive motivators affect the outcomes of work: expectancy, instrumentality and valence. Expectancy refers to the belief that a project is capable of being done well. Instrumentality refers to the worker’s belief that if the job is done well then he/she will receive rewards compensatory to their efforts. Valence refers to the worker’s appraisal of the rewards—are they worth the effort needed for the completion of a project.

Motivation theories focusing on faculty life have examined whether faculty are more intrinsically or extrinsically motivated (Bieber, 1999). Blackburn and Lawrence (1995) thoroughly examine faculty productivity and motivation in their book *Faculty at Work*. The basic reward structure in academia is tenure and promotion. In order to determine if faculty are motivated by tenure and promotion, Blackburn and Lawrence (1995) used data from their national survey conducted by the National Center for Research to Improve Postsecondary Teaching and Learning. They found that
institutional goals and rewards structures must meet with the tenure and promotion guidelines in order for faculty to feel that their work is valued and worth spending the effort on it. If one talks about valuing good teaching and service but does not back that up with appropriate recognition, then such talk can actually be negatively motivating to faculty. Blackburn and Lawrence (1995) suggest that institutions set clear goals so that faculty understand what kind and how much research they need to do. Support in the form of grant writing assistance and informal and formal conversation opportunities with other faculty on campus are just two of the suggestions for demonstrating, through action, the value of research. Blackburn and Lawrence (1995) also encourage rewarding faculty for being good teachers. Evaluation of courses should be more comprehensive and formative than student end-of-term evaluations. Another motivating reward is to provide faculty with time to create new courses (Blackburn & Lawrence, 1995). Faculty can also serve the university through shared governance. They are motivated by the ability to manage “up” to the administration and set goals and missions for the university. Overall, Blackburn and Lawrence found that faculty are motivated both intrinsically and extrinsically. They also found that faculty members’ behaviors follow what they believe they are good at and what will have the biggest impact on their career at their institution and within their discipline.

Tien and Blackburn (1996) further studied faculty motivation as it directly related to tenure and promotion. Believing that tenure and promotion did serve as a motivating factor for faculty, they examined faculty research productivity by year and compared that to when they should receive tenure or promotion to see if there was an increase in productivity just before the rewards were to be given. They found that high ranked
faculty publish more than lower ranked faculty, assistant and associate faculty publish at about the same rate, that there is higher variation in publishing at the higher ranks and associate faculty produce more as promotion time nears. Their theory that tenure and promotion acts as an extrinsic motivator was partially supported, lending credence to the idea that faculty are both intrinsically and extrinsically motivated to research and publish.

Conclusion

Understanding the complicated work life of faculty is very important to understanding how interdisciplinary research is conducted at academic institutions. Graduate training provides specialized disciplinary education, and, as a result, leaves many new faculty members feeling unable to perform interdisciplinary research upon beginning their jobs. Additionally, new faculty members are often under a great amount of stress and fear whether they will be able to meet the expectations for tenure. As a result, they tend to be more conservative in their research approach, and interdisciplinary research often is held off until later. Motivational theories about faculty work as well as understanding the power structures and struggles within the academy are important to making sense of the reluctance of many faculty to engage in interdisciplinary research. Finally, (as will be discussed in more detail in the next section) the organizational structure of academic institutions into departments based on discipline inhibits faculty from participating in interdisciplinary research because of struggles over resources and access to administration as well as the social stigma of stepping outside of one’s academic home.
Organizational Structure of Academia

This section of the literature review begins with a general overview of organizational structure and moves to specifically focus on organizational structure in academia. Moving into a discussion of organizational culture, the literature poses an explanation for the formation of departments based on disciplines as the building block of academic institutions in the United States. Understanding the framework in which faculty work and do research helps the researcher understand how interdisciplinary research functions, or fails to, in academic institutions.

In his book, *Images of Organization*, Morgan (2006) examines the different metaphors that are applied to organizations. He asserts that viewing organizations as metaphors allows managers to understand different difficult situations and respond in ways that improve the situation and the organization as a result. The different metaphors explored by Morgan (2006) are

- The organization as a machine (bureaucracy),
- The organization as an organism (needs and environment),
- The organization as a brain (learning organization),
- The organization as a culture (values, ideas and beliefs),
- The organization as political (conflicts, power, interests),
- The organization as a psychic prison (where we are trapped and unable to be creative),
- The organization as flux and transformation (society is always changing, feedback loops), and
- The organization as domination (exploiting labor, power).
By understanding the paradox of metaphor, organizational theorists can learn to “read” situations and respond to them.

Bess and Dee (2008) provide a comprehensive overview of higher education organization with a strong emphasis on understanding how theory explains the practices involved in administering universities and colleges in America. In their two volume work, *Understanding College and University Organization*, they explore the foundations of higher education organization with an emphasis on three paradigms for approaching higher education organization: positivist, social construction and postmodern. While most of their work is focused on the positivist perspective, they do provide insights into the other theories so that one can have a solid understanding of all the influences and explanations occurring in higher education organization.

First, it is important to understand the basic structure of higher education organization. While it is impossible to describe the function of all universities in America within the limitations of this study, it is possible to provide a basic overview of the functions of most of the components of higher education organization. Beginning at the funding level, public universities are governed by either a governing board or a coordinating board. These boards are responsible for setting the budgets, making policy decisions, selecting higher administrative leaders, and ensuring quality at the institutions under their control. These boards have a macro level while a board of trustees functions at each university to provide micro level guidance and decision making specific to its institution (Bess & Dee, 2008).

At each institution there is a president or chancellor who is responsible for ensuring financial security at the institution. The president usually is not involved in the
daily running of the institution, whereas the provost is. The president will also hire several vice presidents who perform specific functions at the university. These include:

- Vice president for research,
- Vice president for student affairs,
- Vice president for enrollment management (or recruitment),
- Vice president for administration and finance,
- Vice president for development,
- Vice president for planning, and
- Vice president for academic affairs. (Bess & Dee, 2008)

Below the vice presidents sit the deans of the colleges, then the department chairs, and finally the faculty and staff of the institution. While making the bulk of the employees at a university, faculty are usually heavily involved in the organizational decision making and governance of the university through faculty senates and the hiring of new faculty and awarding of tenure. Faculty ranks are assistant professor, associate professor and full professor. More and more universities are hiring adjunct, or part-time, faculty as well as lecturers on long-term non-tenure track lines (Bess & Dee, 2008).

Bureaucracy and Structure of Universities

Bureaucratic organizational structure is the basis for most university organization. However, as Blau (1973) points out, “bureaucratic rigidity and discipline are incompatible with scholarship, which requires a flexible, imaginative approach to teaching that stimulates student interests and the freedom to explore original ideas and depart from established practices in the pursuit of knowledge” (p. 2). How then are
faculty members, as members of a massive organization, able to be productive researchers within an organizational structure that could squash creativity?

First, it is important to understand the basic premise of bureaucracy. Weber (1924, 1946) defined the following elements of bureaucracy:

- Division of labor into specialized tasks,
- Procedural specification,
- Rules,
- Impersonality,
- Selection and promotion based on objective criteria,
- Hierarchy of authority,
- Fixed ranges for salaries and pensions,
- Assured and visible career track,
- Technical training of officials, and
- Appointment by merit.

Universities generally follow many bureaucratic organizational structures because they are very efficient and effective for carrying out everyday activities. Bureaucratic structures do not, however, respond well to rapid change (technology for instance) and can result in boredom from over-specialization and fatigue with routine. Tierney (2008) states that “Bureaucracy in colleges and universities was legitimized in decentralized units such as departments. Power existed in a decentralized fashion through the present assumptions that a socialized cadre—the faculty—had internalized before joining the academy” (p. 151). Thus, current perceptions and understandings of the academic bureaucracy have been ingrained in our historical understanding of the institution.
In order to understand how academic scholarship can function in bureaucracy, Blau (1973) examined the decentralization of authority, institutional innovation and academic performance of faculty. He found that while academic institutions follow some concepts of bureaucracy (division of labor) they do not follow others (direct supervision of work).

The organizational structure of universities is influenced by both internal and external pressures. Bess and Dee (2008) illuminate these pressures further by stating that external pressures come from constituents’ (state government in the case of a public university) expectations to reduce costs and be accountable. Student dynamics and market are other external pressures. Internal pressures at universities come from the faculty level. While faculty are at the lowest level of the organizational structure, they are very influential because of the concept of shared governance and thus exert influence over organizational decision making and structure. By “adopting new pedagogies and instructional technologies…[and] exploring interdisciplinary research” (p. 174) faculty change the way that academic institutions function from within.

Organizational Culture, Organizational Communication and Organizational Learning

Organizational culture, according to Cameron and Ettington (1988), is something that an “organization has (not is)” and is focused on “values, beliefs and assumptions” (p. 362). Tierney (2008) points out that knowledge production is the main activity in academic institutions resulting in an organizational structure based on departments and disciplines. He further argues that higher educational institutions function within an organizational culture that is both shared among other higher educational institutions and is unique to each one. By learning the individual academic institution’s culture, an
administrative leader is able to set the course for the institution and meet the demands from within the organization as well as those from without. It also follows, according to Tierney, that socialization occurs within the organizational culture and involves a give-and-take that combines the hopes and dreams of what the organization may become while making sense of the backgrounds and contexts in which it currently resides.

Tierney (2008) also asserts that organizational communication functions to govern the institution and is often underestimated or ignored. Organizational communicative strategies include all forms of communication such as web-sites, speeches, memos, lectures and formal or informal protests. Tierney (2008) points out that the “culture of the organization determines communication, and that communication helps constitute governance” (p. 120). By tightly connecting organizational culture, organizational communication and governance, Tierney makes a strong argument for the need for all constituents in higher education to pay attention to the manner in which they understand the power of communicative acts in order to advance and strengthen their institution.

Bergquist and Pawlak (2008) outline six competing cultures within higher education organization: collegial, managerial, developmental, advocacy, virtual and tangible. They urge readers to understand that these cultures are often in conflict with one another, but that it is important to understand the whole of academic organization by examining these competing cultures. Higher education’s macro culture benefits from the interactions of the six micro cultures. Maturity in the organization is gained only through conflict and management of that conflict. Therefore, Bergquist and Pawlak (2008) urge
higher education administrators to gain a sense of appreciation for all cultures in order to use them as a force for improvement.

Organizational learning occurs when the entire organization is “receptive toward and ready to utilize new knowledge to improve core processes” (Bess & Dee, 2008). It is an interactive process that involves all constituents, internal and external, and becomes embedded in the organization’s culture. The four stages of organizational learning are knowledge acquisition, information distribution, information interpretation and organizational memory (Bess & Dee, 2008). According to Huber (1991), there are five processes by which organizations learn:

- Congenital learning—knowledge passed down through the generations;
- Experiential learning—knowledge gained from experiments, pilot projects, for example;
- Vicarious learning—knowledge gained by imitating other similar organizations;
- Grafting—knowledge gained from adding new units onto the organization; and
- Searching and scanning—knowledge gained through research.

Bapuji and Crossan (2004) added a sixth process to organizational learning: interorganizational learning, which is a way of learning through collaboration and partnerships. It is important to note that organizational learning is not easy: “Leaders and other organizational members must understand that learning may challenge cherished beliefs, relationships, and accustomed patterns of behavior” (Bess & Dee, 2008, p. 669).

Disciplines and Department

Bess and Dee (2008) point out that differentiation and integration are basic issues in organizational design. Differentiation is extremely important for functioning of
organizations because it allows certain groups to specialize in their function: faculty focus on curriculum and research while student affairs focuses on student recruitment and extracurricular activities. Differentiation occurs in universities not only in subdividing tasks involved in educating, managing or recruiting students, but also in the subdividing of knowledge into disciplines and departments. However, differentiation can create problems in a large organization because members tend to “suboptimize; that is, they identify with and work toward the goals of their own unit rather than the goals of the organization as a whole” (Bess & Dee, 2008, p. 177). For this reason it is imperative that organizations also integrate and coordinate the functioning of the institution so that members can be involved in the goals of the organization, not simply their unit, and so that constituents are served as best as possible.

Disciplinary structures at universities are necessary for fostering academic scholarship and creativity, according to Blau (1973). Scientific advancement requires specialization in fields, not broad, general knowledge. In order to encourage such scientific pursuits, universities need to be flexible in their structure. Such flexibility would allow the addition of new departments and disciplines physical space as well as the faculty needed to conduct research and teach new knowledge to students. Because faculty are more aligned with their discipline than their university (Blau, 1973), universities have responded to this by being more flexible in departmental and disciplinary structure, thus allowing scientific inquiry in specialized areas and at the frontier of knowledge. As specialties develop at the periphery of disciplines, a situation often arises where faculty are working together or on similar research but are in different departments. This interdisciplinary search for knowledge often challenges the university
structure and the collegiality of the existing departments. Blau (1973) claims that universities often respond by creating new departments or centers of research for these academics.

Blau (1973) also asserts that universities respond to external forces when managing its organizational structure, not only by creating new departments, but also by eliminating out-dated departments. Such changes can occur because of faculty initiation or because of external pressures from outside constituents (such as government or community needs). Students also play a role in creating needs for new departments or specializations by expecting their education to prepare them for a career or desiring to learn about new technologies (Blau, 1973). However, tradition at institutions can inhibit change and as a result the institution may flounder or diminish in prominence. It is thus imperative that university organizations be flexible in order to maintain prominence and competitiveness (Blau, 1973).

Friedkin (1978) responded to Blau’s assertion that departmental structure is the basis for social interaction and scientific inquiry at universities. Friedkin (1978), instead found that research communication does not necessarily function primarily within the departments, but instead is multidisciplinary in structure, forming a network of communication based on content of the research being conducted. Friedkin (1978) concludes that inter-university communication is more tightly meshed than communication within a university because academics are more tightly bound to their discipline than their university.

Gumport and Snydman (2002) argue that the knowledge production occurs in universities, that the organizational context in which knowledge production takes place
affects the knowledge produced, and that academic institutions do respond to changes in knowledge. Since university structure legitimates knowledge, it is important to understand the formal structure of academic institutions (Gumport & Snydman, 2002). Departments are the central organizational unit to control the organization of knowledge (both that researched and taught through degree programs) and, over time, demonstrate the changing cultural understandings of knowledge. Current economic pressures have necessitated that administrations change the organizational structure of academic knowledge, sometimes by pruning/weeding departments, combining departments or otherwise changing the organizational structure of departments to reflect societal concerns (Gumport & Snydman, 2002).

Knowledge Production

In addition to teaching, the work of faculty is knowledge production through research. Faculty researchers examine areas at the periphery of knowledge and expand it so that new knowledge is created. Jacob (2000) argues that the shift from an industrial society to a knowledge society has created new importance to the work of faculty. Knowledge production in universities is increasingly being funded by outside constituents (both government and industry) and as such has become more application oriented and less discipline based. The potential outfall of this is a sense of vulnerability in the university because of outside influence on previously “pure” research endeavors, and a relationship between university and industry that has not been present in the past.

Jacob (2000) explains two different types of knowledge production. Mode 1 is characterized by the following:

- Problems are set and evaluated by the academic community,
• Knowledge is discipline based,
• Knowledge producers are a homogeneous group,
• Evaluation is done by peer review, and
• Emphasis is placed on individual creativity.

In contrast, Mode 2 knowledge is heterogeneous in nature, is transdisciplinary, is reviewed through external channels, is often conducted in groups and the results are disseminated through the process of production and application of new knowledge (Jacob, 2000). Since Mode 2 knowledge production is more applied, it has a greater reliance on social accountability and scientists are therefore more aware of the impact of their work. This inter-reliance of the university (for funding) and industry (for knowledge) has shifted knowledge production away from the centrally located and powerful disciplines into a more interdisciplinary process of research (Hellstrom & Jacob, 2000).

In his essay, “The Autonomy of Knowledge and the Decline of the Subject,” Tierney (2001) explodes the assumptions that knowledge building is politically neutral. Instead of acting as critical agents of national interests, the university knowledge producers have perpetuated them. By comparing modernist and postmodernist approaches to knowledge building within the university, Tierney (2001) exposes the inter-relation of the two. Modernism holds that university faculty set the tasks of discovering knowledge through the scientific methods and that such knowledge is value free. Therefore, knowledge production becomes the basis for the organization of the university into departments based on disciplinary content and thus follows the reward structure of the university based on the development of such research. Post-modernist
perspectives, however, view knowledge as a social construction and posit that as a result knowledge carries with it power structures (Tierney, 2001). Knowledge production, then, becomes the by-product of social and political contexts and has both social and political consequences. Therefore, knowledge is not neutral nor value free.

Tierney (2001) suggests three main tenets for improving the understanding of knowledge production in academic institutions. First, universities must seek for more heterogeneity in definition of who they are and what their mission is. A one size fits all approach to knowledge production and education simply does not make sense when there are varying ways of knowing and understanding the world. Second, Tierney (2001) recommends engagement with the other roles of the universities (applied research, civic engagement, student development). Only by becoming aware of and embracing the multiple roles demanded of universities, can universities seek to transmit knowledge to multiple audiences. Finally, Tierney (2001) recommends shattering the myth that there is one method and one truth. Methods and knowing are multiple and value-laden; therefore, they must be approached with a solid understanding of their political power and import.

Conclusion

The organizational structure of academic institutions is set up to promote disciplinary research and teaching. The organizational culture, and the social learning that goes on within that culture, create norms and values which the members of the organization internalize and follow. Thus the organizational structure of a university contains more power than simply dividing duties among the members, but it also imparts a value system on what knowledge is valued, how much and to what extent the structure
of the system is changeable. The organizational structure of a university strongly influences the work of knowledge production that goes on within it.

Disciplinarity and Interdisciplinarity

Lattuca (2001) uses both structuralist and post-structuralist theories to understand the concept of “discipline.” Both perspectives give insight into the changing definitions of disciplinarity throughout the history of the academy. They both focus on the use of disciplines as an organizational tool for knowledge. Post-structuralists point out that changing cultural environments allow for changes in definitions of disciplines.

Toulmin’s (1972) definition of discipline is highly structured. He defined discipline based on concepts, methods and aims while also acknowledging the role of the academy in conceiving the epistemological dimensions of disciplines. One of the most defining characteristics of a discipline is its language. Lattuca (2001) argues that it is important to think of disciplines as cultures because doing so helps researchers to understand why interdisciplinarity is difficult to perform. When a faculty member decides to pursue an interdisciplinary research course, he/she must leave the boundaries of his/her discipline and risk losing professional identity. The risks, social and professional, can be great.

Foucault (1995) furthered the concept of discipline by pointing out the inherent power structures that are embedded in the term and the organization of disciplines into departments in higher education. Foucault (1995) uses the term “discipline” with the adhering concepts of social regulation through developing norms of social conduct and behavior. When faculty members become “members” of a discipline, they take on the social norms and expectations that members of their discipline demand. In doing so, they
self-regulate and become imprisoned to the organization—in the case of faculty this means that they become disciples of their discipline.

Klein (1996) begins her treatise on interdisciplinarity by quoting Burton Clark on the fact that disciplines are the primary organizational structure in higher education:

The discipline rather than the institution tends to become the dominant force in the working lives of academics. To stress the primacy of discipline is to change our perception of enterprises and systems: we see the university or college as a collection of local chapters of national and international disciplines, chapters that import and implant the orientations of knowledge, the norms, and the customs of the larger fields. The control of work shifts toward the internal controls of the disciplines, whatever their nature. (pp. 5-6)

She posits that interdisciplinarity, by its very nature, is disruptive to this stolid construction of higher education organization. Because interdisciplinarity is about bridge building instead of wall building, it exposes the “inadequacies of the existing organization of knowledge to accomplish given tasks” (Klein, 1996, p. 14) and creates a new way of knowing. In order for interdisciplinarity to gain recognition as a viable force in academic knowledge production, it must gain critical mass through economic capital, social capital, cultural capital and symbolic capital.

Lattuca (2001) furthers Klein’s argument by pointing out that the structure of academia has discouraged interdisciplinary research while repeatedly demonstrating that disciplinary conventions do not ask the right questions and have other significant drawbacks. She defines two approaches to interdisciplinary research:
• Instrumental or utilitarian interdisciplinarity is exercised by early interdisciplinary researchers and hard scientists and

• Deconstructionist interdisciplinarity is practiced by the humanities and social scientists.

In tracing the history of interdisciplinarity, Lattuca (2001) points out that experimental multidisciplinary programs began in the 1920s through the 1940s focusing on themed issues such as regional specialties. After World War II, federal funds were set aside for the building of interdisciplinary teams to focus on areas of research to improve America’s political and scientific standing in the world.

Lattuca (2001) argues that defining interdisciplinary research is difficult and needs to focus on methodological approaches, theoretical approaches, operational definitions, instrumental definitions and integration of disciplinary knowledge. She cites Birnbaum’s criteria for interdisciplinary research as the following:

• Different disciplines are represented,
• Different problem solving approaches are used,
• Different roles in problem solving are encouraged,
• Researchers seek answers to a common problem,
• A group is responsible for the final product,
• The group shares common facilities,
• The problem drives selection of group members, and
• Group members are influenced by how others perform tasks.

As Lattuca (2001) acknowledges, Birnbaum’s perspective of interdisciplinary research involves only group endeavors and does not admit that interdisciplinary research can
happen at the individual level. Poststructuralist theories challenge the notion that interdisciplinarity requires collaboration of many individuals to happen. By dismantling the inherent power structures created by disciplinary boundaries and definitions, interdisciplinarity becomes “an end as well as a means to an end” (p. 15).

Lattuca (2001) instead poses the Center for Educational Research and Innovation’s definition of interdisciplinarity as the one that best works in a poststructuralist academy because it offers a continuum of interdisciplinary possibilities based on the following premises:

- Interdisciplinary research requires the interaction of two or more disciplines in one or more of the following ways;
  - Communication of ideas and organization of knowledge,
  - Borrowing of methods and procedures,
  - Borrowing of theories, and
  - Using terminology and data;
- The interactions can be between members of a group or by an individual; and
- The interdisciplinary effort is focused on a single problem.

Lattuca points out that the processes, contexts and outcomes of interdisciplinary research must be considered fully and in relation to one another.

Lattuca (2001) further defined four different types of interdisciplinary research. Informed disciplinarity uses concepts, theories or methods from one discipline to help understand another. She claims that this approach is not truly interdisciplinary because the organizing question is discipline focused. The second type is synthetic disciplinarity. In this type of research the questions are formed at the intersection or gap of two or more
disciplines and the research’s purpose is to bridge that span. In this type of research, the contributing discipline is still recognizable. The third type of research is transdisciplinarity which uses concepts, methods and theories across disciplines with the intent of developing an overarching synthesis. Finally, Lattuca defines conceptual interdisciplinarity approaches topics without a disciplinary lens and uses the best methods, theories and content necessary for the topic.

Klein (1996) points out that the boundaries erected in academia are permeable to interdisciplinary efforts, some more so than others. It is important to understand that the permeations are usually more focused on methodology, theory and conceptual frameworks rather than actual intellectual content. She claims that the only truly interdisciplinary theory is one that acknowledges that it is impossible to create a theory that is not in some way founded in disciplinary practice. In order to understand the concept interdisciplinarity one must understand its definitional reliance on the very term that it is attempting to disrupt—disciplinarity. She states: “interdisciplinary work is in the disciplines as much as it is outside them” (p. 56, emphasis in original).

It is also important to distinguish multi/cross disciplinary work from interdisciplinary work. Golde and Gallagher (1999) point out that in multidisciplinary research, separate people attack a common problem from several perspectives, whereas in interdisciplinary research people jointly come together to frame a problem and identify methodological and analytical approaches. Interdisciplinary research is, therefore, about synthesis or integration of different disciplinary methods or knowledge to solve a common, real-world problem.
Early efforts at interdisciplinary research were problem based research initiatives, often funded by the government (Klein, 1996). These projects scaled up during World War II to create such weapons as the atom bomb, among other things. These collaborations later led to industry-university partnerships, increased the visibility of interdisciplinarity and increased the prestige of interdisciplinary research in the non-academic world. Over time, government funding of research grants furthered interdisciplinary research by giving more money to create large-scale research projects; however, disciplinary boundaries are still prevalent in peer review and funding of these projects. Many interdisciplinary research proposals now face dismissal because they are scrutinized by academics who are discipline based and have difficulty understanding or seeing the merit of interdisciplinary research. Mattila (2006) asserts that these academics often look down upon interdisciplinary research because it is highly applied; whereas, the applicability of university research is exactly the reason that business has attached itself to interdisciplinary researchers.

In response to the need of businesses and the government for better trained interdisciplinary workers, The National Academy of Sciences’ Committee on Science, Engineering and Public Policy (COSEPUP) argues that graduate training needs to include engagement in interdisciplinary research, not only to prepare faculty to do interdisciplinary research, but also to prepare those students for other types of work where interdisciplinary skills are expected (Golde & Gallagher, 1999).

Salter and Hearn (1996) examine the interdisciplinary research activities of Canadian faculty members in their book, *Outside the Lines: Issues in Interdisciplinary Research*. They claim that there are two camps in interdisciplinary research: Those that
look at interdisciplinary research as an applied problem and those that focus on interdisciplinary research as a way of synthesizing and producing new knowledge. They examine interdisciplinary first by pointing out that knowledge of disciplines is essential to understanding interdisciplines because these two concepts are tightly related to each other and to the power and organizational structures within the academy. Because interdisciplinarity dismantles the structure of knowledge, it is an empowering force that challenges “the limitations of premises of the prevailing organization of knowledge or its representation in an institutionally recognized form” (Salter & Hearn, 1996, p. 43). As such, interdisciplinarity is not simply a new way of knowing or examining problems, but is a political force through which researchers challenge long-held beliefs about the primacy of the discipline as the organizational unit of knowledge.

Interdisciplinary Struggles

Hansson (1999) argues that interdisciplinary research suffers from many different stigma. First and foremost, it is fraught with difficulties in maintaining good, solid research teams that are able to approach creatively a problem from the multiple perspectives required, perhaps because university administrators approach the team-building as a managerial issue rather than as a problem-based issue. Hansson (1999) points out that many have become overly enthusiastic about interdisciplinary research, often at the expense of disciplinary work. For interdisciplinarity to work well, cross-fertilization and cooperation are paramount.

Lattuca’s (2001) interviews with faculty members about their experiences pursuing interdisciplinary research identify faculty who are at odds with their identity as interdisciplinary researchers. They feel they lack the expertise necessary to do rigorous
work. They fear making mistakes. Collaborations are often put together by proximity and convenience rather than expertise and need. Faculty also point out that there are significant time constraints or stress because of collaborative efforts, and time management is a serious impediment to doing quality interdisciplinary research. They struggle to learn the language of the new disciplines and to understand the methods and theories used. Interdisciplinary researchers must also learn the difference in publication conventions across disciplines. Spanner (2001) also found that interdisciplinary researchers work under considerably more stress than their disciplinary counterparts, particularly when it comes to time management, feelings of insecurity and inadequate interdisciplinary library collections.

Another significant concern for interdisciplinary researchers is the tenure and promotion process in academia. Because publications are the primary means of evaluating faculty work over their tenure bid (Lattuca, 2001), faculty are often reluctant to pursue interdisciplinary research until tenure has been awarded. This action is often in conflict with the university administration’s desire for more interdisciplinary research; however, Lattuca (2001) claims that the systems of evaluation are still heavily bound to disciplinary convention and until these have changed the call for more interdisciplinarity will not be heeded by faculty members.

According to Kezar (2005), if an administrator wants to promote more collaborative, interdisciplinary research, he/she should move away from a structure and culture that supports only individual work. Among the key components of a successful collaborative institution are a mission focused on collaboration and interdisciplinarity, networks of researchers and structures of support (Kezar, 2005). Importantly, reward
structures within the institution should change so that faculty feel encouraged and rewarded for doing collaborative work. Kezar (2005) asserts that senior level faculty should conduct collaborative work and encourage younger faculty to do so as well.

*Doing Interdisciplinary Research*

In her study interviewing faculty members who participate in interdisciplinary research, Lattuca (2001) discovered that there are many different approaches to “becoming interdisciplinary.” Some individuals in her study always thought interdisciplinarily while others were interested in pursuing interdisciplinary research in their graduate training but were strictly forbidden to do so by their advisors. The majority of her participants, however, followed a model of conceptual change. They came to interdisciplinary approaches to research when the traditional disciplinary approaches no longer answered their questions adequately. She found that when doing interdisciplinary research, faculty tend to let the research questions drive the interdisciplinary nature of their work. In other words, interdisciplinary researchers seek the best methods, theories and content areas to answer the questions posed.

Lattuca (2001) also found that faculty members use whatever interdisciplinary approach makes the most sense to answer the research question they have posed (see the previous section for Lattuca’s four types of interdisciplinary research). She claims that interdisciplinary research begins with the questions asked and is not measured simply by the process or outcome. Because of this, faculty often are in tension about their participation in interdisciplinary research. They may feel that they do not hold themselves up to the rigorous standards that they would in strict disciplinary work. Lattuca (2001) points out two reasons why faculty may feel this way: they feel that
interdisciplinary research is trendy and they have a persistence in disciplinary ways of thinking. For these reasons, faculty worry that their interdisciplinary work is not taken seriously. Therefore, Lattuca (2001) argues that it is important that professional development opportunities for faculty to learn about interdisciplinary research be made available and encouraged.

Klein (1996) points out several characteristics of people who are interested in doing interdisciplinary research. They have access to funding, they develop answers to public concerns, they have access to journals who are willing to publish their research and they have a significant social interest in merging town and gown. Interdisciplinary programs that manage to find the four forms of capital mentioned earlier (economic, social, cultural and symbolic) are perceived by the university administration as being successful and having importance to the institution. Those that do not are perceived as a liability (Klein, 1996).

Lattuca (2002) further examines the culture of conducting interdisciplinary research. She claims that higher education administrations need to be cognizant of the fact that interdisciplinary researchers must first be interdisciplinary learners. The act of having to learn something new, especially outside of one’s major discipline, is disempowering and can create anxiety in faculty members who are attempting to answer research questions in the best method they see. In addition to being content learners, interdisciplinary researchers are cultural learners. They learn about the cultural expectations and trappings of other disciplines in addition to the content. They have to step outside of the boundaries of their original discipline into the “no man’s land” of the new discipline, acquiring appropriate meditational tools along the way (Lattuca, 2002).
is very important to understand that the context in which interdisciplinary research takes place and the faculty learning within that culture are inseparable.

**Interdisciplinary Teams and Collaboration**

Both within the academy and without, interdisciplinary work is often done in teams. Because about half of the doctoral students enter faculty positions with the other half entering industry and government jobs (where employees are expected to work in teams) (Fagen & Suedkamp Wells, 2004), team-work can be a critical component of interdisciplinary work and training. Burke, Wilson and Salas (2005) comment that team-work in organizations is often seen as a proactive step in creating change; however, they emphasize that team-work must also focus on resilience in order to create an environment where the change is welcome and reliable. However, doing interdisciplinary work in teams is not easy. According to Klein (1996), blending of disciplines in teams often results in a hierarchy of importance with contributions by different disciplinary faculty members carrying different weights of importance.

Lélé and Norgaard (2005) point out that bridges between the disciplines are not built simply by putting an interdisciplinary team together and charging them with solving a problem. Individual members bring to the group preexisting beliefs and prejudices that affect how they perceive the knowledge, theories and methods of other group members. These preconceived notions can create turmoil and conflict within the group because individuals may not think that their conceptions are wrong. It is, therefore, important in developing interdisciplinary groups to create a concept of scientific communities and look for commonalities between them during the team-building phase. Lélé and Norgaard (2005) challenge the scientific community to find similarities and negotiate
differences in the following areas: subject focus, assumptions about factors under study, larger world-view assumptions, models used, methods used and the intended audience.

*Disciplinary Organizational Structure in Higher Education*

One issue with interdisciplinarity that often arises at academic institutions is one of structure (Klein, 1996). It is often perceived that if the interdisciplinary program does not fit, then it does not belong and is marginalized because interdisciplinarity calls to attention the lack of absolute power of the structure to identify and organize all units. Klein asserts that interdisciplinarity is disruptive to the university structure because there erupts out of it conflict over values, symbols and power relations.

Bogg and Geyer (2005) explore the reasons why true interdisciplinary research in higher education is rare. They find that the 18th century Newtonian model of science and knowledge reduces knowledge into definable disciplines and departments, separates them by organizational culture and keeps them separated by tradition (see also Lattuca, 2001). When disciplines do cross-breed, instead of creating a new interdisciplinary model, the academy simply creates a new discipline and department (see also Becher & Trowler, 2001; Blau, 1973). Such an organizational structure creates a difficult world in which to do interdisciplinary research. Bogg and Geyer (2005) point out that it is important to keep in mind when changing the university model to be more interdisciplinary that outcomes matter; however, interactions are far more important and groundbreaking. The new interdisciplinary institution must be structured so that interactions between faculty are open and adaptable.

Golde and Gallagher (1999) examine the organizational structure of higher education and how it inhibits graduate students from adequately learning how to
approach research from an interdisciplinary perspective. Because graduate training is focused on highly specialized disciplinary research, graduate students are socialized to think in disciplinary ways. They highlight three features that come together to encourage graduate students to specialize:

- Academic departments are the locus of control and power over graduate education,
- Individual faculty members have power over graduate students and their choice of curriculum and research, and
- Research funding that expects specialization in disciplinary research.

In order for graduate students who wish to participate in interdisciplinary research to succeed, they must find an advisor who will support their interdisciplinary work, master knowledge in multiple disciplines, find an intellectual community and, finally, overcome their fears of rejection in the academy (Golde & Gallager, 1999).

Austin and McDaniels (2006) explore the effects of graduate socialization on preparation of faculty to actually do what they are expected. They point out multiple times that new faculty are expected to participate in interdisciplinary activities, if for no other reason than to be able to critique the work of colleagues. They need to understand the concepts of team building and the skills and management of conflict that is necessary to make successful team projects. At present, however, graduate training does not provide the needed skills in interdisciplinary understanding or research and must be changed so that new faculty are prepared for the myriad interdisciplinary expectations on their new job.
Conclusion

The literature reveals a complex relationship between disciplinarity and interdisciplinarity. The concepts rely on each other for existence yet struggle for power and recognition. Outside of academia, employees are expected to be able to approach problems interdisciplinarily and in teams; yet, the academy does not, by and large, provide an interdisciplinary learning environment. The barriers that faculty come up against in attempting to do interdisciplinary research are strong and real and create an organizational culture in which success through interdisciplinary research is difficult.

Model for Success

Knowing all the struggles of interdisciplinary researchers, one is tempted to ask, “why would faculty pursue interdisciplinary research agendas?” If faculty members risk not being awarded tenure, or losing the respect of their colleagues, why would they do what seems impossible and continue with an interdisciplinary research agenda? Why do universities encourage interdisciplinary research by expecting faculty members to seek external funding for research yet not implement structures and evaluation procedures that enable such research to take place? In a basic sense, how do faculty become interdisciplinary thinkers when the graduate system appears set up to train them to be specialized only as disciplinary researchers? How do individual faculty members become viable group members creating exciting interdisciplinary discoveries?

Interdisciplinary research does happen on university campuses and is meeting with much success. It is encouraged by businesses who want to hire employees who understand the world interdisciplinarily. It is encouraged by the government who funds research to answer a whole problem, not just a part of it. It is encouraged by a society
which expects accountability for the research that takes place within universities that are funded by state dollars. Yet, interdisciplinary researchers struggle to maintain a research agenda, gain respect from their peers and disseminate promising and applicable research.

For this reason it is important that researchers develop a model for success—one that could be followed and implemented through policies at institutions varying in size and mission. Discovering the factors that motivate faculty to pursue interdisciplinary research (research question 1) will provide university administrators with the necessary tools to encourage and seek out the most promising interdisciplinary research faculty and graduate students and create teams that will seek answers to a variety of questions. Knowing what differentiates successful from unsuccessful interdisciplinary researchers (research question 2) will provide answers to the keys to success so that university administrators can implement policies and change evaluation tools to create more success on their campuses.
CHAPTER III

METHOD

This chapter will detail the method for the dissertation study. The final product of this study was a validated survey instrument to examine the research behaviors of academic researchers. Instrument development helped to determine the distinguishing characteristics of interdisciplinary researchers as compared to disciplinary researchers. Likewise, the instrument will assist the researcher in understanding the motivational characteristics that lead faculty to pursue interdisciplinary research as well as the characteristics associated with successful interdisciplinary research. In order to accomplish the task of developing a survey instrument, the researcher carefully undertook a multi-phase project in order to ensure that the instrument was reliable and valid. In this chapter the steps in instrument development are described. Chapter IV illuminates the results of each step. In order to avoid confusion and unnecessary repetition, the researcher has limited discussion of the results of each step to Chapter IV.

Steps for Instrument Development

In order to clarify the multiple steps undertaken in the instrument development, each step is listed below and described briefly. A flow chart is also provided after the descriptions in Figure 1.

- Step 1: The researcher began instrument development by conducting an extensive literature review which is detailed in Chapter II. The literature review helped establish an understanding of common methods and practice in analyzing interdisciplinary research efforts. As a result of the literature review, the researcher identified factors to be analyzed (see section titled “Factors to be
Analyzed” below) as well as determined that the subjects of the research study needed to include both interdisciplinary researchers as well as disciplinary researchers.

- Step 2: The second step was to conduct a focus group to determine if there were attitudes and behaviors in practice by interdisciplinary researchers that were not present in the literature. The purpose of the focus group was to align real-world practices with those found in the literatures as well as determine if interdisciplinary researchers helped to identify factors that had not been detailed in the body of literature examined in Step 1. A detailed description of the focus group and its findings can be found in Chapter IV. For the purpose of identifying factors to analyze, focus group findings are discussed within the following survey development section and aligned with factors found in the literature.

- Step 3: An initial survey instrument was developed based on the factors identified in the literature review and the focus group.

- Step 4: A human sort was conducted on the initial survey instrument in order to determine construct logic. Forty individuals were administered the survey via Survey Monkey and asked to identify the factor in which each statement most logically fit. Items that met a 60% agreement rate were retained for the final survey instrument. A detailed discussion of the human sort results can be found in Chapter IV.

- Step 5: The initial survey instrument was administered in a small-scale pilot to 20 faculty at a mid-sized regional institution. The purpose of this step was to identify any factors that did not have a reliability score >.70. A detailed
discussion of the statistical analysis and decisions made as a result can be found in Chapter IV.

• Step 6: The final survey instrument was administered in a large-scale pilot at institutions nationally via Survey Monkey to 179 individuals. The instrument was delivered using Survey Monkey to individuals identified at institutions nationally. The individuals were asked to forward the survey instrument to colleagues resulting in a national sample.

• Step 7: The data from the survey were analyzed. The factors identified in Steps 1-5 above were tested using exploratory factor analysis as well as an alpha coefficient test. The factors that scored >.70 on the alpha coefficient tests were further examined using MANOVA. Demographic characteristics were tested using cross tabs with chi square. Detailed discussion of the steps and results can be found in Chapter IV and Appendix C.

Figure 1

*Flow Chart of the Multi-Step Method for Survey Instrument Development*
Factors to be Analyzed

The ten factors outlined below were originally included on the faculty survey instrument (Step 3). For each factor the researcher provides a brief description, a brief statement of why this factor is included in the survey instrument and where appropriate, a sample question or statement to be included on the survey instrument.

Demographics

Demographic data included gender, age range, when the faculty member completed his/her Ph.D. or other terminal degree, ethnicity, tenure status and rank status. These questions were asked in a nominal response format.

Graduate Training

Both the literature (Austin & McDaniels, 2006; Austin & Wulff, 2006; Fagen & Suedkamp Wells, 2004; Golde & Dore, 2004; Golde & Gallagher, 1999) and the focus group identified graduate training as a crucial factor in whether or not faculty are interested in or able to conduct interdisciplinary research. Faculty were asked to indicate their level of agreement with five statements about their graduate training to determine if they were encouraged to study interdisciplinarily, if they were trained on how to publish and do independent research, and if they received training on what it was like to be a faculty member (work load, expectations, tenure process). Statements included, for example, the following utilizing a Likert scale:

- During my graduate training I conducted interdisciplinary research.
- Independent research was encouraged during my graduate training.
- I developed a strong understanding of the tenure process during graduate school.
• During my graduate training I was discouraged from working with faculty in different departments.

• During my graduate training I learned the work requirements of faculty.

**Disciplinary Affinity**

The purpose of statements about disciplinary affinity was to determine how likely a faculty member will be to engage in interdisciplinary research. Literature (Metzger, 1987; Finkelstein, 2006; Becher & Trowler, 2001) identifies that faculty tend to be more aligned with their disciplines than with their institution, thus examining the degree of affinity a faculty member has may indicate his/her interest in conducting interdisciplinary research. Sample Likert scale statements included:

- I identify strongly with my discipline.

- I identify more strongly with faculty at my institution than I do with my discipline.

- I do not read research from another disciplinary perspective.

**Administrative Support**

The focus group in particular, but the literature as well (Tierney, 2008; Lattuca, 2001; Lattuca, 2002; Salter & Hearn, 1996), identified administrative support as a key factor in the success of faculty to conduct interdisciplinary research. In order to explore administrative support for interdisciplinary research, the researcher engaged the faculty participant in a series of statements that identify how strongly the institution’s administration supports interdisciplinary research activities—either through communicative acts, rewards or punishments. Examples of statements using a Likert scale included the following:
• If I pursue an interdisciplinary research project, my administration will provide me with the necessary tools (such as graduate students, course release) to conduct it in a timely manner.

• My institution provides funds to bring interdisciplinary research colleagues to campus.

• My institution will provide me with graduate assistants if I do quality research.

Faculty Networks

Faculty networks were identified in the focus group as an important component to conducting interdisciplinary research. In this study, the researcher identified whether the faculty participants establish research networks and whether their institutional administration provides policies, fiscal support or organizational support for establishing networks. Examples of the Likert scale items included the following:

• I discuss my research endeavors with a network of colleagues from outside of my university/college.

• My administration supports (financially) travel to meetings so that I can engage in interdisciplinary research with colleagues from outside of my university/college.

Outside Funding

The expressed need for access to funding agencies appears in the literature (Salter & Hearn, 1996; Klein1996) as a motivator for individuals to begin interdisciplinary research. The researcher examined to what extent faculty have attempted to gain funding from federal and private agencies and if so if they have been successful in doing so.
Publication Venues

The literature (Becher, 1987; Dunn, Rouse, & Seff, 1995; Finkelstein, 2006; Lattuca, 2001; Lattuca, 2002; National Academies, 2005; Salter & Hearn, 1996) has identified lack of access for publication for interdisciplinary research as a major barrier for faculty—who must publish in order to obtain tenure and promotion—who wish to conduct interdisciplinary research. Originally statements were included in the faculty survey that would identify whether faculty have avoided interdisciplinary research because of the fear of not obtaining tenure; however, these statements were not included on the final survey because they did not stand up to the human sort method of identifying constructs.

Rewards and Punishments for Doing Research

The tenure and promotion process is seen as the reward for faculty research. Rewards could also include such institutional support as extra graduate assistants or access to travel funds to attend conferences to present research. Punishments for doing research not approved by the institution might include withdrawal of the rewards mentioned or denial of tenure or promotion. Punishments may also include, for faculty at research institutions, a higher teaching load than their colleagues. For researchers conducting interdisciplinary research, punishments and rewards may motivate their research interests. The literature (Becher, 1987; Dunn, Rouse, & Seff, 1995; Finkelstein, 2006; Lattuca, 2001; Lattuca, 2002; National Academies, 2005; Salter & Hearn, 1996) and focus group identified this issue as important in faculty decisions regarding research choices. However, statements intended to be included in this construct did not withstand
the human sort method because they were confused with administrative support or tenure and rewards and were, therefore, not included on the final survey instrument.

Non-Academic Work Experience

The focus group identified that working outside of academia before becoming a faculty member encourages one to see the research context differently, and therefore, engage in interdisciplinary research more readily. Faculty were asked whether they have worked outside of the academy in a professional sense (for example, after they finished their Ph.D. or before coming back to obtain a Ph.D.).

Applied Compared to Basic Research

Much of the literature (Boyer, 1990; Finkelstein, 2006; Hansson, 1999; Hellstrom & Jacob, 2000; Jacob, 2000; Klein, 1996; Lattuca, 2001; Lattuca, 2002; National Academies, 2005; Salter & Hearn 1996; Weisbuch, 2004) defines interdisciplinary research as applied rather than basic. For that reason, faculty were asked to what degree they engage in applied research.

Affinity for Working Alone or in Teams

The survey instrument was used to assess faculty’s preference to work in teams or whether they would rather work alone to conduct research. Much of the literature (Finkelstein, 2006; Hellstrom & Jacob, 2000; Klein, 1996; Lattuca, 2001; Lattuca, 2002; National Academies, 2005; Salter & Hearn 1996) states that interdisciplinary research occurs in teams, sometimes established by the administration or sometimes developing from within a network of faculty. Even if one prefers to work alone, he/she may have the perception that interdisciplinary research requires a team to conduct and, therefore, are
less willing to engage in this type of research as a result. Statements to evaluate this construct included the following examples:

- I prefer to work alone when conducting research.
- Interdisciplinary research can be conducted only in teams.
- Faculty networks are important to conducting interdisciplinary research.

General Methodology for the Study

Using the factors from the previous section, a survey instrument was developed (Step 3) to pilot test with faculty (Step 5) at universities in the United States. The faculty survey was a self-administered survey made available via Survey Monkey. A total of 199 respondents were obtained for the pilot testing of this survey instrument.

In order to gain access to the faculty at the various universities, the researcher contacted faculty, the Vice President for Research and/or other administrative officials at twenty-five different institutions for support in conducting the research on his/her campus. Each of these individuals forwarded the survey to other colleagues both at their institution and others. Research participants represented a national sample and were drawn from a variety of types of academic institutions that require research for tenure and promotion consideration. IRB approval was obtained from the researcher’s host institution before conducting surveys with faculty.

The survey instrument was distributed via Survey Monkey and validated for reliability and accuracy using Exploratory Factor Analysis (Step 6) and a human sort method (Step 4). Once the factors were determined, scores for each factor were calculated using summation or averages. Statistical tests were conducted on the large-scale pilot data to illuminate which factors influenced motivation to conduct
interdisciplinary research as well as those which influenced their success. All data are reported in Chapter IV, and the implications of the development of the survey instrument are discussed in Chapter V.
CHAPTER IV
ANALYSIS

In this chapter, the researcher provides the results of the different steps in the development of the Faculty Interdisciplinary Research Instrument. The first topic discussed is the focus group, included in order to compare actual interdisciplinary faculty experiences with those set out in the literature. After the discussion of the focus group, the researcher presents the steps taken to fine-tune the final administered questionnaire which included a small scale pilot conducted at a regional research institution. Data from this initial survey were analyzed using a human sort method and initial exploratory factor analysis. From this small scale pilot, the researcher created the final questionnaire that was administered to faculty at institutions nationally as described in Chapter III. Finally, the researcher presents the final questionnaire and the results obtained from data analysis.

The Focus Group

The focus group (Step 2) was conducted on April 25, 2007. In order to obtain participants, invitations were sent out to nine faculty members at a mid-sized southern university who represented all five colleges at the university. Selection criteria also included those who do interdisciplinary research and those who do not as well as those who are successful and those who are not. Five faculty agreed to participate, and four attended the focus group. (It is interesting to note that one of the invitees was unable to attend because she was hosting a scholar in a multi-disciplinary lecture series). The facilitator was selected for his expertise in leading focus group research and conducting qualitative research. The researcher tape recorded the session and took notes during the
Since the focus group was held over the lunch hour, food was provided. After the participants ate, the researcher provided them with a brief description of her project and a working definition of interdisciplinary research, as provided by the National Academies (2005):

A mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice. (p. 2)

The two-fold purpose of the focus group was provided to the participants:

- What are the factors that are necessary for successful interdisciplinary research? (enablers)
- What are the factors that hinder interdisciplinary research? (barriers)

The first half-hour of the focus group focused on the first question, and the second half-hour focused on the second question. Participants were allowed to brain-storm ideas, discuss the validity of the concept, decide whether to keep it as an “enabler” or “barrier”
and then move onto other concepts and ideas. When the participants’ ideas seemed to be slowing down, they were prompted with enablers or barriers from the literature and asked to discuss whether these were, in their opinion, valid enablers or barriers. A concept was allowed on the list by the consensus of all participants.

*Findings of the Focus Group*

Discussion among the participants was very lively during the first half of the focus group. They were able to brainstorm many enablers to interdisciplinary research and provide examples of how and when it “should” take place, were willing to provide reasons for doing interdisciplinary research and what administration should do in order to allow its success in academia. They provided the following list of enablers:

**Table 2**

*List of Enablers Provided by the Focus Group*

<table>
<thead>
<tr>
<th>Enabler</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common interest—subject/method</td>
</tr>
<tr>
<td>Natural fit—reinforce topic</td>
</tr>
<tr>
<td>Need expertise outside of area</td>
</tr>
<tr>
<td>Social network—formal and informal</td>
</tr>
<tr>
<td>Non-academic work experience</td>
</tr>
<tr>
<td>Theoretical framework development</td>
</tr>
<tr>
<td>External funding—money</td>
</tr>
<tr>
<td>Value the outcome of the research</td>
</tr>
<tr>
<td>Mutual respect</td>
</tr>
<tr>
<td>Common language</td>
</tr>
<tr>
<td>Institutional support—faculty social networks, legislating, fiscal and organizational structure</td>
</tr>
<tr>
<td>Mixed methods research</td>
</tr>
</tbody>
</table>

The focus group iterated many of the common enablers provided by the literature (social network, need for expertise outside of area, common interest); however, interesting to this group was the need for mutual respect and a natural fit for the research. The need
for mutual respect is interesting because it iterates that prejudices exist in academia depending on the department or college where a researcher is housed. In addition, the researchers felt it was important for a natural fit of research interests to be present in interdisciplinary research projects because the interdisciplinary research projects needed to have a clear focus and direction in order to be successful. These researchers were adamant that the research team is built in a way that fits all the needs of the group members. They expressed that interdisciplinary research should happen to answer questions and solve problems, not because someone outside of their group is dictating that they perform interdisciplinary research. This is an interesting difference between what happens in the business world in which most interdisciplinary research groups are developed to solve a problem for the industry and are designed from the top to solve the problem, and then often dissolved once the research purpose has been met (National Academies, 2005).

Secondly, one participant mentioned that mutual respect between participants is essential for successful interdisciplinary research. She articulated respect in all senses of the word: for example, respect for the field of study, respect for the person, respect for the type of research conducted (hard versus soft). The male participants worded this same concept in terms of value of the research outcome.

A final note about the enablers is the concept suggested by a couple of the participants that mixed methods research is essential to conducting good interdisciplinary research. At first, this was rejected by the other two participants, but as they discussed, they eventually agreed that a respect for qualitative and quantitative methods is essential
for conducting truly interdisciplinary research since it provides a more complete look at
the topic.

The discussion then turned to barriers to interdisciplinary research. Surprising to
the researcher, the participants had a difficult time generating ideas for barriers to
interdisciplinary research. They had to be prompted with concepts from the literature, and
then were able to get started brainstorming ideas. Even so, they would start talking about
a barrier, and then argue whether it was truly a barrier or not. They were agreed upon the
following list of barriers to interdisciplinary research:

Table 3

<table>
<thead>
<tr>
<th>List of Barriers Provided by the Focus Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ignorance</td>
</tr>
<tr>
<td>Entrenchment in departmental model</td>
</tr>
<tr>
<td>Don’t value outcome</td>
</tr>
<tr>
<td>Applied compared to basic research</td>
</tr>
<tr>
<td>Forced from top down (funding agencies/administration requiring)</td>
</tr>
<tr>
<td>Professions define value of research, not institution</td>
</tr>
<tr>
<td>Faculty want to research what they are interested in</td>
</tr>
<tr>
<td>Personality of faculty is anti-group work</td>
</tr>
<tr>
<td>Politics—institutional and personal</td>
</tr>
<tr>
<td>Time frame for completion is longer for teams than individuals</td>
</tr>
<tr>
<td>Team members have to add value/contribute to team</td>
</tr>
<tr>
<td>Training in disciplinary framework</td>
</tr>
</tbody>
</table>

Academic entrenchment in a disciplinary/departmental model was the most
discussed topic. Focus group participants listed many reasons that this model made
interdisciplinary research difficult. First the structure imposed on research at a university
or within the professional field provides little opportunity for reward outside of the
departmental model—meaning that if a faculty member (untenured especially) wishes to
pursue interdisciplinary research, they must do so in addition to regular disciplinary
research in order to receive tenure, promotion and other rewards. They also cited strict graduate training in a disciplinary model as a serious hindrance to pursuing interdisciplinary research because researchers are then required to learn whole new content areas and research methodologies in order to pursue interdisciplinary research successfully.

Graduate training further complicates matters for interdisciplinary research because by the nature of being a disciplinary specialist, interdisciplinary research relies heavily on teams to perform successful or competitive research projects. As all members of the focus group agreed, faculty members typically do not like to work in teams, nor do they like to research something that is slightly outside of their interests. They cited that often interdisciplinary research fails because of lack of team unity or unequal contributions by team members, and by lack of respect for team members’ fields of study, methodology or disciplines. This point further complicates the finding in the enabler list that mutual respect is essential for successful interdisciplinary research. Though the participants were not unanimous in saying that mutual respect was essential for successful interdisciplinary research, all agreed that lack of mutual respect was a death-knell for successful interdisciplinary research.

Implications of the Focus Group

The purpose of the focus group was to help elucidate the findings from the literature regarding interdisciplinary research and how it works in academia. The focus group helped to establish that practitioners feel what the theorists have said: That interdisciplinary research is necessary in the academic setting, and that it is on-going because of some very important factors that enable it to be successful. However, there
are also significant barriers in academia that must be overcome either through policy or practice that will enable interdisciplinary research to be more successful and natural in the academic setting.

This focus group enabled the researcher to further the research started in the National Academies study. Their survey of faculty, while thorough, does not allow for an easily quantified factor study of what is working or not working in academic interdisciplinary research. The focus group illuminated the conversations and attitudes regarding interdisciplinary research by faculty at an academic institution and informed a refinement of the National Academies Survey into a survey instrument.

The Survey Instrument

The final survey instrument is presented in Appendix A. Demographic data were collected to determine gender, age, highest degree earned, when the highest degree was completed, ethnicity, tenure track and rank. These data were used in analyzing constructs using MANOVA tests as will be described below.

The twenty-four items used in the survey are shown in Table 10. These items were analyzed using coefficient alpha (Cronbach alpha) and exploratory factor analysis to determine the reliability and validity of the survey instrument.

Finally, survey participants were asked to explain different components of their research production. The researcher was interested in whether participants had received external funding or published their interdisciplinary or non-interdisciplinary research. These items were used to determine whether a participant would be considered “successful” in their research endeavors. These items allow for a matrix of possibilities: successful interdisciplinary researcher, unsuccessful interdisciplinary researcher,
successful non-interdisciplinary researcher and unsuccessful non-interdisciplinary researcher. Faculty participants were also asked whether they had worked outside of the academic environment because the research (Fagen & Suedkamp, 2004; Golde & Dore, 2004; Hellstrom & Jacob, 2000; Jacob, 2000; National Academies, 2005) indicates that faculty who worked outside of academia were more interested in applied and interdisciplinary research. The final two items on the survey instrument asked faculty participants to rank their research productivity on a scale from 100% applied to 100% basic/theoretical and 100% disciplinary to 100% interdisciplinary.

The Small-Scale Pilot

An initial draft of the survey instrument was developed (Step 3), and survey items were analyzed using a human sort method (Step 4) to identify items that did not fit into the constructs that the researcher intended. The statements were administered using Survey Monkey, and respondents categorized them according to the construct they deemed the best fit. From this analysis 11 of the original 35 items were eliminated, and 7 constructs were reduced to the following 4, using a 60% agreement rate:

- Graduate Training,
- Disciplinary Affinity,
- Administrative Support and Rewards, and
- Faculty Networks and Teams.

The final list of items with the factors identified is in Appendix B.

After completing the human sort, the survey instrument was administered to a small group of faculty at a regional research institution (Step 5). This group of faculty were selected purposefully to include individuals who conducted interdisciplinary
research as well as disciplinary research. Individuals were asked to complete the survey who had been identified by colleagues and administrators as successful as well as unsuccessful researchers. Attempts at diversity in demographic characteristics were also made in order to be able to assess the demographic traits in the initial small-scale pilot. The items were analyzed for reliability using a Cronbach Alpha test. Items 2, 3, 4, 9, 11, 12, 16, 17, 23 and 24 were reverse coded before conducting the analysis. The factor of “publication” was weak in all of the initial exploratory analyses; therefore, it was removed from the study. Also, “teams” was combined with “faculty networks,” and “rewards” was combined with “administrative support” because of the results of the sort. Items were placed into the four categories as identified in the sort step with the following results shown in Table 4:

Table 4

<table>
<thead>
<tr>
<th>Factor</th>
<th>N</th>
<th>Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graduate Training</td>
<td>5</td>
<td>.785</td>
</tr>
<tr>
<td>Disciplinary Affinity</td>
<td>3</td>
<td>.678</td>
</tr>
<tr>
<td>Administrative Support and Rewards</td>
<td>9</td>
<td>.890</td>
</tr>
<tr>
<td>Faculty Networks</td>
<td>7</td>
<td>.421</td>
</tr>
</tbody>
</table>

N=Number of items per factor

As can be seen in the data table the first three factors have a strong reliability coefficient, while the fourth factor did not. The researcher decided to keep the fourth factor in the survey with the assumption that it could be removed from the final data if the reliability still was not at the desired level. Since the literature places (Dunn & Seff, 1995; Gillespie, et al, 2005; Kezar, 1996; Klein, 1996; Lattuca, 2001, 2002; Lélé & Norgaard, 2005; Weisbuch, 2004) such an importance on creating faculty networks and working in
teams for the success of interdisciplinary research, it was decided that this factor should be examined in the national survey.

Large-Scale Pilot Descriptive Data

After the initial small scale pilot steps, the researcher conducted a national pilot test of the instrument (Step 6). The survey of faculty researchers resulted in an \( n \) value of 199 (20 from Step 4 and 179 from Step 5). Selection of faculty was purposeful to represent small, medium and large research institutions (in terms of student body). Faculty were also sought to represent campuses that had large and small research funding amounts. An attempt was also made to include faculty from privately and publicly funded institutions as well as those with focus on teaching as well as research as the main agenda. Faculty who completed the survey work in all areas of the country, representing both rural and urban areas. Faculty were also selected to ensure a variety of disciplinary affiliations. Descriptive data from the survey is described below according to the different sections of the survey beginning with demographics, then the research experiences and finally research production.

Demographic Data

Of the 199 respondents, two did not answer the gender item. There were 96 males who completed the survey and 101 females. Three respondents did not answer the ethnicity item, 177 responded that they were White, non-Hispanic while 19 respondents chose another category including African-American, White-Hispanic, Asian or Mixed. The age range of respondents covered all options and is shown in Table 5 below (1 participant did not respond):
Table 5

*Age Range of Survey Participants*

<table>
<thead>
<tr>
<th>Age Range</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>26-30 years</td>
<td>8</td>
</tr>
<tr>
<td>31-35 years</td>
<td>23</td>
</tr>
<tr>
<td>36-40 years</td>
<td>29</td>
</tr>
<tr>
<td>41-45 years</td>
<td>36</td>
</tr>
<tr>
<td>46-50 years</td>
<td>27</td>
</tr>
<tr>
<td>51-55 years</td>
<td>23</td>
</tr>
<tr>
<td>56-60 years</td>
<td>21</td>
</tr>
<tr>
<td>61-65 years</td>
<td>17</td>
</tr>
<tr>
<td>66-70 years</td>
<td>11</td>
</tr>
<tr>
<td>Over 70 years</td>
<td>3</td>
</tr>
</tbody>
</table>

The largest number of participants were in the age range of 41-45 with the least amount in the Over 70 group. With the exception of the 26-30 and 66-70 groups, the remaining groups were similar in group size.

The highest degree attained by participants is shown in Table 6.

Table 6

*Highest Degree Attained by Survey Participants*

<table>
<thead>
<tr>
<th>Highest Degree</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D.</td>
<td>171</td>
</tr>
<tr>
<td>Ed.D.</td>
<td>6</td>
</tr>
<tr>
<td>Ed.S.</td>
<td>1</td>
</tr>
<tr>
<td>MFA</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>17</td>
</tr>
<tr>
<td>Missing</td>
<td>2</td>
</tr>
</tbody>
</table>

The vast majority of participants had attained the Ph.D. with only 26 reporting a degree other than the Ph.D. This shows that the survey reached mostly faculty who are working at research institutions and have the qualifications of being research faculty. Other degrees reported were J.D., Doctor of Science, M.D., M.A., M.S., M.B.A. and M.Ed.
The year that faculty respondents reported having completed their highest degree ranged between 1956-2011. Table 7 shows the responses by decade:

Table 7

Decade that Respondents Completed Highest Degree

<table>
<thead>
<tr>
<th>Decade Completed Highest Degree</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before 1980</td>
<td>17</td>
</tr>
<tr>
<td>1980-1989</td>
<td>20</td>
</tr>
<tr>
<td>1990-1999</td>
<td>48</td>
</tr>
<tr>
<td>2000-2009</td>
<td>83</td>
</tr>
<tr>
<td>2010-2011</td>
<td>10</td>
</tr>
<tr>
<td>Missing</td>
<td>21</td>
</tr>
</tbody>
</table>

Almost half of the respondents have completed their highest degree since 2000 with a large number of respondents also completing their highest degree in the 1990s. The faculty participants were also asked what their tenure status is. Table 8 summarizes their responses:

Table 8

Tenure Status of Survey Participants

<table>
<thead>
<tr>
<th>Tenure Status</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tenured</td>
<td>105</td>
</tr>
<tr>
<td>Not tenured</td>
<td>58</td>
</tr>
<tr>
<td>Not tenure track</td>
<td>35</td>
</tr>
<tr>
<td>Missing</td>
<td>1</td>
</tr>
</tbody>
</table>

Over half of the respondents reported that they had attained tenure, about one-fourth were not tenured and the remaining were not tenure track. Considering the time since completion of degree it is not surprising to see that most of the respondents had attained tenure. Faculty researchers were asked what rank they had attained. Those data are reported in Table 9.
Table 9

*Rank of Survey Participants*

<table>
<thead>
<tr>
<th>Rank</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assistant Professor</td>
<td>62</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>61</td>
</tr>
<tr>
<td>Full Professor</td>
<td>43</td>
</tr>
<tr>
<td>Instructor</td>
<td>9</td>
</tr>
<tr>
<td>Lecturer</td>
<td>8</td>
</tr>
<tr>
<td>Professor Emeritus</td>
<td>7</td>
</tr>
<tr>
<td>Other</td>
<td>16</td>
</tr>
</tbody>
</table>

The total number for this item is 206 because participants were allowed to choose “all that applied” and a few participants chose more than one option. Data from this item indicate that most of the respondents to the survey fit into the “traditional” categories of faculty: assistant, associate or full professor.

*Self-Reported Research Experiences of Respondents*

The survey items that were presented in a Likert type scale assessed the research experiences of the survey participants. Table 10 summarizes the mean responses to the items that focused on research experiences. The items that were asked in a negative format (2, 4, 9, 11, 12, 16, 17, 23, 24) have not been recoded so that faculty responses are displayed in their original format. These means will be reported as recoded later when reporting reliability and validity tests. Responses have been organized from the lowest mean to the highest mean. The item with the lowest mean was “I avoid interdisciplinary research because I don’t like to work in teams,” while the item with the highest mean was “Faculty networks are important to conducting interdisciplinary research.” Any mean of 2.0 or lower indicates that the respondents in general “disagreed” with that statement. Four items fit into this category. It is interesting that three of these items are negative...
statements about specific interdisciplinary research habits. Any mean higher than 2.0 indicates that the respondents in general “agreed” with that statement. The faculty respondents in general “agreed” with all but the first four items and “strongly agreed” (mean higher than 3.0) with the last three.

Table 10

*Mean Responses to Research Experiences Items*

<table>
<thead>
<tr>
<th>Number</th>
<th>Item</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>I avoid interdisciplinary research because I don’t like to work in teams.</td>
<td>1.71</td>
</tr>
<tr>
<td>23</td>
<td>I do not read research from another disciplinary perspective.</td>
<td>1.77</td>
</tr>
<tr>
<td>15</td>
<td>My institution will provide me with graduate assistants if I do quality research.</td>
<td>1.96</td>
</tr>
<tr>
<td>9</td>
<td>During my graduate training I was discouraged from working with faculty in different departments.</td>
<td>1.98</td>
</tr>
<tr>
<td>21</td>
<td>Interdisciplinary research can be conducted only in teams.</td>
<td>2.02</td>
</tr>
<tr>
<td>5</td>
<td>If I pursue an interdisciplinary research project, my administration will provide me with the necessary tools (such as graduate students, course release) to conduct it in a timely manner.</td>
<td>2.15</td>
</tr>
<tr>
<td>11</td>
<td>The tenure system does not reward individuals who conduct interdisciplinary research.</td>
<td>2.20</td>
</tr>
<tr>
<td>17</td>
<td>My university is less likely to pay for travel to a professional conference if it is outside my discipline.</td>
<td>2.23</td>
</tr>
<tr>
<td>20</td>
<td>I identify more strongly with faculty at my institution than I do with my discipline.</td>
<td>2.24</td>
</tr>
<tr>
<td>16</td>
<td>Faculty are less likely to get tenure if they do only interdisciplinary research.</td>
<td>2.27</td>
</tr>
<tr>
<td>6</td>
<td>My institution provides funds to bring interdisciplinary research colleagues to campus.</td>
<td>2.31</td>
</tr>
<tr>
<td>8</td>
<td>I developed a strong understanding of the tenure process during graduate school.</td>
<td>2.34</td>
</tr>
<tr>
<td>24</td>
<td>I prefer to work alone when conducting research.</td>
<td>2.34</td>
</tr>
<tr>
<td>13</td>
<td>During my graduate training I learned the work requirements of faculty.</td>
<td>2.45</td>
</tr>
<tr>
<td>14</td>
<td>The administration at my institution has implemented programs to encourage interdisciplinary work among the faculty.</td>
<td>2.51</td>
</tr>
<tr>
<td>1</td>
<td>During my graduate training I conducted interdisciplinary research.</td>
<td>2.53</td>
</tr>
<tr>
<td>12</td>
<td>Team work is difficult for faculty to do because of the amount of time required.</td>
<td>2.53</td>
</tr>
<tr>
<td>22</td>
<td>My administration supports (financially) travel to meetings so that I can engage in interdisciplinary research with colleagues from outside of my university/college.</td>
<td>2.68</td>
</tr>
</tbody>
</table>
Table 10 (continued).

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>My institution will provide me with travel funds to attend an interdisciplinary conference.</td>
<td>2.90</td>
</tr>
<tr>
<td>7</td>
<td>I have established networks among faculty who are interested in doing interdisciplinary research.</td>
<td>2.93</td>
</tr>
<tr>
<td>19</td>
<td>I discuss my research with a network of colleagues from outside of my university/college.</td>
<td>2.97</td>
</tr>
<tr>
<td>2</td>
<td>I identify strongly with my discipline.</td>
<td>3.17</td>
</tr>
<tr>
<td>3</td>
<td>Independent research was encouraged during my graduate training.</td>
<td>3.32</td>
</tr>
<tr>
<td>18</td>
<td>Faculty networks are important to conducting interdisciplinary research.</td>
<td>3.33</td>
</tr>
</tbody>
</table>

**Self-Report of Research Production**

The final set of items focused on research productivity and were used to determine how successful a researcher is and whether he/she considers him/her-self an interdisciplinary researcher. Faculty participants were asked whether they had received external funding. In response, 120 chose “yes,” whereas 76 chose “no” and three did not respond. This indicates that the faculty in general are successful at securing external funding for their research. The researcher probed more deeply to see if researchers had received external funding for interdisciplinary research. To this item, 64 respondents chose “yes,” whereas 130 chose “no,” and five did not respond. Faculty were asked to identify which agencies had funded their research in an open-ended question. Of all the responses only 6 were not funded by national or state agencies.

The next set of items focused on publication habits of the researchers. When asked if they had published interdisciplinary research, 134 respondents chose “yes,” while 39 chose “no” and 22 chose “have not conducted interdisciplinary research.” Four did not respond to this question. Those who responded yes to the above question were asked to describe where they had published their research. The responses are summarized in Table 11:
Table 11

*Where Faculty Researchers Have Published Interdisciplinary Research*

<table>
<thead>
<tr>
<th>Publication Venue</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journal in your own discipline</td>
<td>77</td>
</tr>
<tr>
<td>Another disciplinary journal</td>
<td>58</td>
</tr>
<tr>
<td>Interdisciplinary journal</td>
<td>62</td>
</tr>
<tr>
<td>Other</td>
<td>13</td>
</tr>
</tbody>
</table>

The total number of responses is higher than the $n$ value of 199 because respondents could choose all that apply. Approximately one-third of the published interdisciplinary research has been published in interdisciplinary journals while the remaining two-thirds has been published in disciplinary journals.

Respondents were also asked whether they had worked professionally outside of academia. Of the 195 who responded to this question, 107 had worked outside of academia and 88 had not. Faculty were also asked to rank their research on an interdisciplinary continuum with 0 indicating that they conducted 0% interdisciplinary research and 10 indicating that they conducted 100% interdisciplinary research. Table 12 shows the responses:

Table 12

*Interdisciplinary Research Continuum*

<table>
<thead>
<tr>
<th>Level of Interdisciplinary Research</th>
<th>Number</th>
<th>Valid Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 (0% Interdisciplinary)</td>
<td>11</td>
<td>5.7</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>21</td>
<td>10.9</td>
</tr>
<tr>
<td>3</td>
<td>35</td>
<td>18.1</td>
</tr>
<tr>
<td>4</td>
<td>28</td>
<td>14.5</td>
</tr>
<tr>
<td>5</td>
<td>21</td>
<td>10.9</td>
</tr>
<tr>
<td>6</td>
<td>14</td>
<td>7.3</td>
</tr>
<tr>
<td>7</td>
<td>24</td>
<td>12.4</td>
</tr>
<tr>
<td>8</td>
<td>17</td>
<td>8.8</td>
</tr>
<tr>
<td>9</td>
<td>13</td>
<td>6.7</td>
</tr>
</tbody>
</table>
Table 12 (continued).

<table>
<thead>
<tr>
<th>Level</th>
<th>Number</th>
<th>Valid Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 (100% Interdisciplinary)</td>
<td>9</td>
<td>4.7</td>
</tr>
<tr>
<td>Missing</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

Half of the respondents reported that they conducted interdisciplinary research up to a ranking of 4. Only 5.7% indicated that they conducted no interdisciplinary research while 4.5% indicated that they conducted all interdisciplinary research.

The final item of the survey instrument focused on the applied versus basic research continuum. Faculty were asked to rank their research as 1: 100% Applied to 10: 100% Basic. Table 13 provides a summary of faculty participant responses:

Table 13

*Applied versus Basic Research Continuum*

<table>
<thead>
<tr>
<th>Level of Applied vs. Basic Research</th>
<th>Number</th>
<th>Valid Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (100% Applied)</td>
<td>9</td>
<td>4.7</td>
</tr>
<tr>
<td>2</td>
<td>15</td>
<td>7.8</td>
</tr>
<tr>
<td>3</td>
<td>24</td>
<td>12.5</td>
</tr>
<tr>
<td>4</td>
<td>26</td>
<td>13.5</td>
</tr>
<tr>
<td>5</td>
<td>33</td>
<td>17.2</td>
</tr>
<tr>
<td>6</td>
<td>27</td>
<td>14.1</td>
</tr>
<tr>
<td>7</td>
<td>28</td>
<td>14.6</td>
</tr>
<tr>
<td>8</td>
<td>14</td>
<td>7.3</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
<td>4.7</td>
</tr>
<tr>
<td>10 (100% Basic/Theoretical)</td>
<td>7</td>
<td>3.6</td>
</tr>
<tr>
<td>Missing</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

Again the faculty respondents ranked themselves on average in the middle ranges. Only 4.7% ranked themselves as purely an applied researcher and only 3.5% ranked themselves as purely basic/applied.
Large-Scale Pilot Reliability and Validity

In order to determine the reliability and validity of the survey instrument coefficient alpha tests and an Exploratory Factor Analysis were conducted (Step 7). Using the factors determined in the small-scale pilot and the sort testing reported in Table 4, the coefficient alpha scores for the large-scale pilot are reported in Table 14. As in the previous analysis item numbers 2, 4, 9, 11, 12, 16, 17, 23, 24 were reverse coded.

Table 14

Cronbach Alpha with Large-Scale Pilot Data

<table>
<thead>
<tr>
<th>Factor</th>
<th>N</th>
<th>Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graduate Training</td>
<td>5</td>
<td>.600</td>
</tr>
<tr>
<td>Disciplinary Affinity</td>
<td>3</td>
<td>.177</td>
</tr>
<tr>
<td>Administrative Support and Rewards</td>
<td>9</td>
<td>.787</td>
</tr>
<tr>
<td>Faculty Networks</td>
<td>7</td>
<td>.583</td>
</tr>
</tbody>
</table>

N=Number of items per factor

The only factor that shows strong reliability is the Administrative Support and Rewards, the remaining factors do not have a high enough reliability coefficient to be considered strong enough to use in analysis. The entire survey, however, has a strong reliability coefficient and could indicate that the instrument is measuring only one construct.

Factor Analysis

Factor analyses were run using principal axis factoring. Initially, a parallel extraction analysis was run which indicated nine factors (O’Conner, 2000). This finding was neither supported by theory, practice nor logic. Next, an exploratory factor analysis was conducted using all items from the survey instrument. The next factor analysis forced seven factors. See Appendix C for a further discussion and presentation of data from these two factor analyses. Based on a comparison of the two exploratory factor analyses, it was determined that the first analysis using Eigenvalue greater than 1 would
be further explored by eliminating any double loaded or negatively loaded items (items 23, 19, 2). The results from this final factor analysis are described below in Table 15.

Table 15

_Eight Factor Solution with Items Eliminated_

<table>
<thead>
<tr>
<th>Component</th>
<th>Eigenvalue</th>
<th>% Variance</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.08</td>
<td>24.01</td>
<td>24.01</td>
</tr>
<tr>
<td>2</td>
<td>1.82</td>
<td>10.71</td>
<td>34.72</td>
</tr>
<tr>
<td>3</td>
<td>1.56</td>
<td>9.16</td>
<td>43.89</td>
</tr>
<tr>
<td>4</td>
<td>1.42</td>
<td>8.35</td>
<td>52.24</td>
</tr>
<tr>
<td>5</td>
<td>1.25</td>
<td>7.32</td>
<td>59.56</td>
</tr>
<tr>
<td>6</td>
<td>1.08</td>
<td>6.40</td>
<td>65.96</td>
</tr>
</tbody>
</table>

Six components explain 65.96% of the variation in the data. The data were then assessed using the oblique rotated component matrix and factor loadings >.40. Visual inspection of the scree plot (Figure 2) confirmed a 6 component factor analysis.

Figure 2

_Scree Plot of the Six Component Factor Analysis_
The rotated component matrix is shown in Table 16:

Table 16

*Rotated Component Matrix for Six Component Exploratory Factor Analysis*

<table>
<thead>
<tr>
<th>Item #</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>.705</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>.599</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>.563</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>.775</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>.621</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td>.769</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td></td>
<td></td>
<td></td>
<td>.546</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.681</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.710</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.794</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.726</td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.671</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.469</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.668</td>
</tr>
</tbody>
</table>

Looking at the items to see if there were any logical connection between the items loaded into each component results in the following breakdown of factors (Table 17):

Table 17

*Factors Derived from Exploratory Factor Analysis*

<table>
<thead>
<tr>
<th>Factor</th>
<th>Items</th>
<th>Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrative Financial Support</td>
<td>22, 17, 10</td>
<td>.778</td>
</tr>
<tr>
<td>Administrative Support</td>
<td>15, 5, 6</td>
<td>.703</td>
</tr>
<tr>
<td>Tenure System</td>
<td>16, 11</td>
<td>.657</td>
</tr>
<tr>
<td>Networks</td>
<td>7, 19</td>
<td>.541</td>
</tr>
<tr>
<td>Graduate Understanding</td>
<td>13, 8</td>
<td>.730</td>
</tr>
<tr>
<td>Graduate Training</td>
<td>3, 1</td>
<td>.549</td>
</tr>
</tbody>
</table>

Items 12, 14 and 18 did not load into any component at >.40 so were removed from analysis. Using the factor loadings from the exploratory factor analysis and eliminating items that did not logically fit in the loadings, the researcher conducted a coefficient
alpha analysis on the factors and reported those coefficients in Table 17. The components for administrative support, financial support and graduate understanding of faculty requirements were all >.70 indicating a strong reliability of those components. These components were used in further statistical analysis after computing a mean score. These components are slightly different from what was identified in the human sort step. The Administrative Rewards and Rewards separated into two different components during the factor analysis: Administrative Financial Support and Administrative General Support. Disciplinary Affinity did not load into the factor analysis. Faculty Networks and Teams did not have a high enough correlation after the data were analyzed. Graduate Training was the only factor that remained the same as in the human sort analysis.

Large-Scale Pilot Data Analysis

The data were analyzed to determine the characteristics of interdisciplinary versus non-interdisciplinary researchers. Because ethnicity and highest degree attained did not have enough variation, they were not included in this analysis. However, age range, gender, rank, year since completing highest degree and tenure status had enough variation to conduct analyses looking at the qualities of researchers and whether they conduct interdisciplinary research or not.

Applied/Basic versus Interdisciplinary Continuum

The literature suggests (Anderson & Louis, 1991; Lattuca, 2001, 2002; National Academies, 2005; Salter & Hearn, 1996) that interdisciplinary researchers are more likely to conduct applied research. In order to determine whether the participant sample met the expectations from literature, the interdisciplinary continuum was compared to the applied versus basic continuum using a correlation test. It would be expected that the two
continua would be negatively correlated since the more interdisciplinary a researcher (higher score on IDR continuum) would conduct more applied research (lower score on the applied/basic continuum). The Pearson Correlation coefficient was computed: 
\[ r(n=190) = -0.063, \ p = .390. \] 
with a 2-tailed significance level of .390. This finding does not support the assumptions in the literature with very little correlation between the continua.

**Interdisciplinary Self-Identification**

In order to determine whether a researcher was “interdisciplinary” or not, the researcher used the self-identified scale from 0%-100% interdisciplinary research to create a scale to classify a researcher as interdisciplinary or not. If a researcher ranked him/herself as 0-3 he/she was classified as “non-interdisciplinary,” and anyone who ranked him/herself 4-10 was classified as “interdisciplinary.” There were 67 participants who scored themselves 0-3 and 126 who scored themselves 4-10.

Cross tabs with Chi Square were run on the following demographic characteristics: gender, tenure status, rank, age range and year completed highest degree. Chi Square tests run on these cross tabs did not show any significant relationships. Table 18 shows all Chi Square results for the demographic characteristics tested along with the significance level.

**Table 18**

*Results of Chi Square Tests on IDR Rank and Demographic Characteristics*

<table>
<thead>
<tr>
<th>Demographic Characteristic</th>
<th>( \chi^2 )</th>
<th>df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>.120</td>
<td>1</td>
<td>.729</td>
</tr>
<tr>
<td>Tenure Status</td>
<td>1.971</td>
<td>2</td>
<td>.373</td>
</tr>
<tr>
<td>Rank</td>
<td>1.420</td>
<td>6</td>
<td>.965</td>
</tr>
<tr>
<td>Age Range</td>
<td>.580</td>
<td>3</td>
<td>.901</td>
</tr>
<tr>
<td>Year Completed Degree</td>
<td>1.007</td>
<td>3</td>
<td>.799</td>
</tr>
</tbody>
</table>
While the Chi Square test on age range was not significant, the researcher finds the data interesting. The cross tab of the variable age range is shown in Table 19.

**Table 19**

*Cross Tab of Age Range and Interdisciplinary Ranking*

<table>
<thead>
<tr>
<th>IDR Ranking</th>
<th>40 and younger</th>
<th>41-50</th>
<th>51-60</th>
<th>61-older</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non Interdisciplinary</td>
<td>10</td>
<td>25</td>
<td>16</td>
<td>15</td>
</tr>
<tr>
<td>Interdisciplinary</td>
<td>19</td>
<td>40</td>
<td>33</td>
<td>31</td>
</tr>
</tbody>
</table>

The data in Table 19 show that the two older categories have a high number of individuals conducting interdisciplinary research compared to the younger categories of faculty. This is consistent with the claims of Blackburn and Lawrence (1995) and Becher and Trowler (2001). They claim older faculty become more interested in conducting research outside of their initial main emphasis area as they mature in their careers.

*Applied versus Basic Self-Identification*

In order to determine whether a researcher was an applied, mixed or basic/theoretical researcher, the researcher used the self-identified scale from 1-10 with 1 being 100% applied and 10 being 100% basic/theoretical to create a scale to classify a researcher as applied, mixed or basic. If a researcher ranked him/herself as 1-3 he/she was classified as “applied,” anyone who ranked him/herself 4-7 was classified as “mixed” and anyone who ranked him/herself 8-10 was classified as “basic.”

Cross tabs with Chi Square were run on the following demographic characteristics to determine if there were any differences in the likelihood of conducting interdisciplinary research or not: gender, highest degree earned, tenure status, rank, age range, whether the participant had worked outside of academia and year completed.
highest degree. None of these characteristics was significantly related to type of research. Results from the Chi Square tests are summarized in Table 20.

Table 20

Results of Chi Square Tests on Applied/Basic Research and Demographic Characteristics

<table>
<thead>
<tr>
<th>Demographic Characteristic</th>
<th>$X^2$</th>
<th>df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>1.235</td>
<td>2</td>
<td>.539</td>
</tr>
<tr>
<td>Tenure Status</td>
<td>3.838</td>
<td>4</td>
<td>.428</td>
</tr>
<tr>
<td>Rank</td>
<td>8.865</td>
<td>12</td>
<td>.714</td>
</tr>
<tr>
<td>Age Range</td>
<td>4.674</td>
<td>6</td>
<td>.586</td>
</tr>
<tr>
<td>Year Completed Degree</td>
<td>8.098</td>
<td>6</td>
<td>.231</td>
</tr>
</tbody>
</table>

Successful and Unsuccessful Researchers

The two statements that had participants identify whether they had received funding for their research were used to determine whether researchers were successful researchers or not. If the participant identified that they had received funding for interdisciplinary research, they were categorized as a successful interdisciplinary researcher. The self-identified ranking was used to determine whether a researcher was interdisciplinary or not. For those researchers who ranked themselves in the non-interdisciplinary category the question asking whether they had received funding for research was used to determine whether they were successful researchers or not.

Researchers were given a value to assign them in one of the following four categories shown in Table 21:

Table 21

Categories of Successful and Unsuccessful Researchers

<table>
<thead>
<tr>
<th>Categories</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Successful Interdisciplinary</td>
<td>53</td>
</tr>
<tr>
<td>Unsuccessful Interdisciplinary</td>
<td>73</td>
</tr>
<tr>
<td>Successful non-Interdisciplinary</td>
<td>36</td>
</tr>
</tbody>
</table>
The largest category are researchers who identify themselves as interdisciplinary researchers yet have not been able to secure external funding for their interdisciplinary research.

**MANOVA Tests**

The first research question of the study focused on what motivates faculty to conduct interdisciplinary research. The second research question focused on what leads to faculty success in interdisciplinary research. The researcher used the self-identified interdisciplinary research ranking as one independent variable and the success score as the second independent variable in a two-way MANOVA and the three components identified in the exploratory factor analysis as the dependent variables. Interdisciplinary research ranking was scored so that there were three levels as indicated in Table 22.

**Table 22**

Interdisciplinary Research Score

<table>
<thead>
<tr>
<th>Interdisciplinary Rank</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low level of interdisciplinary research</td>
<td>65</td>
</tr>
<tr>
<td>Medium level of interdisciplinary research</td>
<td>62</td>
</tr>
<tr>
<td>High level of interdisciplinary research</td>
<td>63</td>
</tr>
</tbody>
</table>

MANOVA results did not reveal significant differences among the research motivation categories: $F(3, 182) = .890, p = .448$.

**Conclusion**

Survey instrument development included several steps. First, the researcher conducted a thorough literature review. Next, she conducted a focus group to both
confirm and add to the factors that affect researchers’ decisions to conduct interdisciplinary research. A draft of the survey instrument was then developed and constructs were tested for reliability using a human sort method. From that method, four factors were identified to be strong enough to test using a pilot study.

The survey instrument was then piloted with a 199 participant responses using exploratory factor analysis and coefficient alpha tests. Three factors had a high enough alpha coefficient to justify further data analysis: administrative financial support, graduate training and administrative support. Of these factors none were significantly different in both motivating interdisciplinary researchers and leading to their success.

Demographic data from the survey instrument were analyzed using CrossTabs and Chi Square tests. No item from the demographic data demonstrated any relationship. This is contrary to what has been suggested in the literature and could indicate that demographic data do not play a role in whether one decides to conduct interdisciplinary research or not. Finally, also contrary to suggestions from the literature, applied versus basic research and the interdisciplinary continuum were not correlated.
CHAPTER V
DISCUSSION AND CONCLUSION

In this chapter, the researcher provides an overview of the initial findings from the survey, provides implications and recommendations for higher education, discusses the limitations of the survey and concludes with future research opportunities.

Initial Findings

Survey instrument development to focus on comparing interdisciplinary and disciplinary researchers is needed because previous interdisciplinary research that focuses on the attributes and activities of interdisciplinary researchers only examines interdisciplinary researchers (Latouca, 2002; Spanner, 2001; Klein, 1996). As a result, any comparisons made are not actually comparisons but simply descriptions of one group of researchers. The primary focus of this dissertation was to develop a survey instrument that would allow researchers to compare interdisciplinary and disciplinary researchers so that policies could be made. The data analyses resulting from this pilot study provide potentially interesting evidence from which administrators can begin to make policy decisions at their institutions. An aim of this research study was to provide comparisons by examining data derived from individuals who identified themselves as disciplinary researchers as well as interdisciplinary researchers. As discussed in Chapter IV and later in this chapter, there are few discernable differences between interdisciplinary researchers and disciplinary researchers based on demographic characteristics or motivational characteristics. Thus, the need for a comparative survey may be warranted.

Another aim of survey instrument development was to provide analysis that will assist administrators in making policy decisions regarding how to support
interdisciplinary researchers at their institution. Faculty work cycles (Blackburn & Lawrence, 1995) indicate that non-tenured faculty produce the heaviest amount of research but are unlikely to produce interdisciplinary research because of fear of not getting tenure (Spanner, 2001; Robinson, 1996). The initial findings from this study suggest that there are not any statistically significant differences in the interest and success rates of faculty despite age, time since completing highest degree, and rank. There was a slightly higher interest and production in the higher age range of faculty (not statistically significant) to conduct interdisciplinary research suggesting the need for further studies to determine if this difference is indeed statistically different or just an anomaly in this group of participants. Again, the research from this survey suggests that administrators should examine the research interests at their institution and support those faculty who are interested in interdisciplinary research despite age, tenure status, demographic characteristics and time since completing degree.

Survey Instrument Development: The Literature Review

Survey instrument development is a multi-faceted process that requires several steps and involves an understanding of the literature as well as carefully designed research protocol. Development of the survey instrument began with a thorough literature review (Chapter 2). The theoretical bases for researching interdisciplinary research behaviors are social exchange theory and social constructionism.

Social exchange theory provides the foundation upon which to understand motivational attributes of groups of people. If, as the literature suggests, interdisciplinary research is difficult to do because of the barriers erected throughout the higher education structure, then the researcher needs to have an understanding of why researchers would
conduct research in such a difficult way. Social exchange theorists (Muthasamy & White, 2005; Stolte, Fine, & Cook, 2001; Molm, 2003) would suggest that interdisciplinary researchers seek some sort of reward (intrinsic or extrinsic) to continue working interdisciplinarily. That reward could be the satisfaction of knowing they have conducted good work or it could be obtaining tenure because of their work. They may see themselves as gaining in power and influence because of their work in groups. Social exchange theory helps explain how interdisciplinary researchers choose to conduct research despite apparent barriers throughout academe. The findings from the study do not indicate that extrinsic motivational factors such as administrative financial support or general administrative support encourage faculty to conduct interdisciplinary research. Further research is needed to determine what intrinsic motivators are motivating faculty to conduct interdisciplinary research as well as to understand their willingness to work in teams.

Social constructionism theory helps to explain how truth becomes defined and how power can be embedded in knowledge. As such it can be applied to deepening an understanding of interdisciplinarity through opening the lens to disciplinary development, higher education organizational structure and privilege that is invested in certain types of research. Truth and Science as concepts are undermined by social constructionism because if it is accepted that Truth and Science are systems that are defined by certain groups of people, it would follow that different definitions could eventually be proposed and accepted. Thus, the belief that there is one Truth or one Science is vulnerable, and new approaches to scientific inquiry and multiple truths could become an acceptable way of knowing, creating a paradigm shift. The exploratory factor analysis did not identify a
factor focusing on disciplinary affinity or academic organization; therefore, this concept could not be tested in the study.

Using social constructionism theory, Tierney (2008) explains how institutions of higher education can be understood in a different way to allow for multiple types of research, teaching and ways of knowing to exist. Through different acts of communication, individuals within the organization influence and change the organizational culture of that institution. Therefore, Tierney (2008) argues, all individuals have to be aware of how their communication actions will be understood and acted upon by others within that organization to bring about change. Klein (1996), Salter and Hearn (1996), and Becher and Trowler (2001) all posit similar administrative influence on researchers decisions to conduct interdisciplinary research. That the factor of general administrative support and graduate educational training were not significant in either comparison that examined motivational factors or success factors could indicate that academic institutions are doing a good job of communicating the validity of conducting interdisciplinary research. In addition, only 5.7% of the respondents indicated that they conducted strictly disciplinary research further supporting the concept that interdisciplinarity has a higher level of acceptance than the literature had claimed.

Important to the development of the survey instrument was also a thorough understanding of the different components present in interdisciplinary research at academic research institutions. Thus, the researcher examined the literature pertaining to faculty scholarship, motivation and work productivity as well as organizational theory. Graduate education is the training ground for Ph. D.-holding faculty members. The tradition in independent basic, disciplinary research has created faculty who are deeply
embedded and trained in a single disciplinary model who then perpetuate that training in their graduate students (Haworth, 1996). Innovations in graduate education have helped to move along the interdisciplinary opportunities of newly trained faculty (Fagen & Suedkamp Wells, 2004; Nerad, Aanerud, & Cerny, 2004; Golde & Dore, 2004), and many institutions are seeing faculty members who are very interested in pursuing an interdisciplinary research career. The construct of graduate training was not statistically different for either motivational reasons to conduct interdisciplinary research or success in obtaining funding for interdisciplinary research. This finding suggests that even though graduate students are highly “disciplined” during their graduate training, they seek out opportunities to conduct interdisciplinary research and are successful when they do.

It is important to understand graduate training because it is the preparation for faculty members to conduct their future research (Wulff, Austin & Associates, 2004; Austin & Wulff, 2004; Fagen & Suedkamp Wells, 2004; Pruitt-Logan & Gaff, 2004; Austin & McDaniels, 2006). Faculty are expected to contribute scholarship and generate new knowledge, provide service to their institution and community and teach (Boyer, 1990; Bieber, 1999; Blackburn & Lawrence, 1995; Dunn, Rouse, & Seff, 1995; Fox, 1985; Metzger, 1987). The findings from the survey did not support this claim as there were no relationships between the demographic data characteristics of gender, time since completing the highest degree, age, tenure status or rank.

According to Lattuca (2001), interdisciplinarity by its very existence is disruptive to the higher educational organizational structure. Interdisciplinarity has long been understood to be the result of pressure from outside of the academic environment (Klein,
1996), and meeting the demands of outside constituents a primary focus of early interdisciplinary efforts (Mattila, 2006). Academic research focused on interdisciplinary research has focused primarily on the struggles of interdisciplinary researchers (Hansson, 1999; Lattuca, 2001; Spanner, 2001). This research has examined interdisciplinary researchers in great detail and made claims that interdisciplinary researchers struggle with issues such as fear of not being able to attain tenure and promotion, difficulties of conducting collaborative research and barriers constructed by the academic organization. However, these researchers have not also examined disciplinary researchers to determine if they experience similar difficulties in conducting their research. One of the purposes of developing the survey instrument, therefore, was to provide a mechanism for comparing the attitudes, behaviors, motivations and success factors of both interdisciplinary and disciplinary researchers. No differences were found in this study between disciplinary and interdisciplinary researchers on motivational factors, success factors or demographic characteristics. This finding suggests one of three options: much more is present that encourages faculty to conduct interdisciplinary research than the literature suggests, disciplinary researchers experience the same struggles to be motivated and successful researchers as interdisciplinary researchers do, or the way this researcher categorized interdisciplinary research was not fine-tuned enough to identify differences between the two groups.

Survey Instrument Development: The Focus Group

The next step was to conduct a focus group (Chapter IV). In the focus group, the researcher was able to tease out ideas for survey development that the literature had touched upon but that faculty researchers reported were very important: academic
departmental structure by discipline is a barrier to interdisciplinary research; social networks and teamwork are vital for interdisciplinary research; non-academic work experience is helpful for understanding the importance of interdisciplinary research; having external funding for interdisciplinary research; administrative support through graduate assistants, financial incentives and other such monetary support for research, are also important for conducting interdisciplinary research; and training in disciplinary framework does not encourage interdisciplinary research.

The literature supports several of these ideas. Specifically, administrative support (Becher & Trowler, 2001; Blackburn & Lawrence, 1995; Tierney, 2008), graduate training (Fagan & Suedkamp Wells, 2004; Golde & Dore, 2004; Golde & Gallagher, 1999), tenure process (Blackburn & Lawrence, 1995; Tierney, 2008) and time to complete interdisciplinary projects (National Academies, 2005; Lattuca, 2001, 2002; Klein, 1996; Salter & Hearn, 1996) are in the forefront of the literature regarding interdisciplinary research habits of faculty in academic institutions. The literature also posits that interdisciplinary researchers tend to be more applied in their approach to research (Anderson & Louis, 1991; Lattuca, 2001, 2002; National Academies, 2005; Salter & Hearn, 1996), have worked professionally outside of academia (Fagen & Suedkamp, 2004; Golde & Dore, 2004; Hellstrom & Jacob, 2000; Jacob, 2000; National Academies, 2005) and will forego interdisciplinary research until they have achieved tenured status.

The Survey Instrument

Keeping in mind all of the factors that the literature review and the focus group highlighted, the researcher created a survey instrument (see Appendix A) that focused on
gathering the data to analyze different factors from this initial research. The survey instrument was subjected to a “human sort” method to determine which questions fit into different factors, with the resulting factors being chosen as remaining in the survey instrument:

- Graduate training,
- Disciplinary affinity,
- Administrative support and rewards, and
- Faculty networks and teams.

After administering the survey (n=199), the participants were given a score on successful/unsuccessful researcher, both interdisciplinary and non-interdisciplinary so that research question #2 could be answered. Exploratory factor analysis using principal components analysis was conducted to validate the survey, and coefficient alpha tests were run to determine reliability of the factors identified in the exploratory factor analysis. Using an Eigenvalue greater than 1 explained 67.5% of the variation. Three of the factors that were identified in the exploratory factor analysis were used in further analysis of the data: administrative financial support, administrative support and graduate understanding of faculty work requirements.

The researcher will continue working with the survey instrument to develop items that will examine several constructs that the literature claims is important to conducting interdisciplinary research: disciplinary affinity, graduate training, affinity for working in teams, rewards and punishments for conducting interdisciplinary research and faculty networks. These constructs could provide a deeper understanding of the factors that contribute to the motivation and success of interdisciplinary researchers.
Interdisciplinary versus Non-Interdisciplinary Researchers

Analysis was conducted using cross-tabs and Chi Square tests to determine if there were relationships between interdisciplinary and non-interdisciplinary researchers. None of the demographic characteristics were significant. Gender, tenure status, rank, age, whether the participant had worked outside of academia, and year since completing Ph.D. did not show any significance. That the other demographic characteristics did not show any level of statistical significance indicates that they are not good indicators of the type of individual who will conduct interdisciplinary research. This is an important finding, because, contrary to the literature (Berbrier, 2002; Blackburn & Lawrence, 1995; Crowley, 1999; Lattuca, 2002, 2002; Klein, 1996; Lélé and Norgaard, 2005; O’Shea, 1998; Salter & Hearne, 1996), demographic characteristics did not show a difference in the interdisciplinary and non-interdisciplinary researchers. Much of the research published about the characteristics of interdisciplinary researchers has not compared them to non-interdisciplinary researchers, therefore, the researcher wanted to examine whether these characteristics did make a difference in whether someone pursued interdisciplinary research. Using a research instrument and design that looks at both types of researchers allows for an examination of the actual differences between these two groups of researchers. That there were no differences indicates that individuals choose interdisciplinary research for reasons other than their demographic categories. As stated before, the lack of significant differences and relationships may be a function of the way in which interdisciplinarity was defined.
**Applied versus Basic Researchers**

A cross tab with Chi Square analysis was run using the “applied versus basic” continuum. Three categories were created for this continuum—those who did more applied, those who were mixed and those who did more basic research. Gender, tenure status, rank, age, whether the participant had worked outside of academia, highest degree attained and year since completing Ph.D. did not show any significant relationship to type of research conducted. While the literature (Anderson & Louis, 1991; Lattuca, 2001, 2002; National Academies, 2005; Salter & Hearn, 1996) suggests that similar demographic characteristics can be found in applied researchers as interdisciplinary researchers, the findings from the survey did not indicate differences among any category, once again not supporting the suggestions from literature not based on comparative studies.

**Correlation between Applied and Interdisciplinary Research**

The literature (Anderson & Louis, 1991; Lattuca, 2001, 2002; National Academies, 2005; Salter & Hearn, 1996) claims that interdisciplinary researchers tend to be more applied in their research focus. In order to test this assumption, a correlation was run between the two continua. There was no significant correlation between the continua suggesting that there is not a relationship between interdisciplinary and degree of applied research. On the other hand, research indicates that there would be a relationship between interdisciplinary and applied research. That there is not, indicates that individuals who conduct basic research are just as likely as those who conduct applied research to be interdisciplinary researchers.
Motivation to Conduct Interdisciplinary Research

Analysis was conducted using the factors identified during survey development and the self-identified interdisciplinary research score. There were no significant differences found. The lack of significance on this research question suggests that it is important for administration to keep in mind that interdisciplinary researchers do not differ from disciplinary researchers in what motivates them to conduct research. Because of this, administrators should use the same methods of encouragement for all faculty researchers.

Successful Interdisciplinary Research

Analysis was conducted using the constructs identified during survey development, the applied/basic continuum, the interdisciplinary continuum and the successful interdisciplinary matrix score. There were no significant differences found in this research study regarding constructs that lead to faculty success.

Implications of Research Study

The implications of the research study will be discussed in two parts. First, the implications of developing the survey instrument will be highlighted. Second, the researcher will examine the implications of the data gleaned from the initial pilot test of the survey instrument.

Implication of the Research Instrument

Developing a research instrument that examines attitudes and behaviors regarding interdisciplinary research by researchers who identify themselves on a continuum of interdisciplinary research habits is a necessary step for identifying research habits that are specific to interdisciplinary researchers. More interdisciplinary researchers completed
the survey than non-interdisciplinary researchers; however, a number of non-interdisciplinary researchers did complete the survey allowing for comparisons to be made.

Analysis of demographic characteristics of faculty did not show any differences in their tendency to conduct interdisciplinary research or to conduct applied versus basic research. These findings suggest that interdisciplinary researchers are not demographically different from their non-interdisciplinary counterparts. If administrators at institutions of higher education are interested in supporting and encouraging interdisciplinary research, they will need to encourage all faculty regardless of gender, age or tenured status.

While the difference was not significant, more researchers who had completed their degrees before 1980 expressed a higher interest in conducting interdisciplinary research. Therefore, administrators could use this older group’s experience and interest to lead programs to encourage younger, untenured, less experienced faculty to conduct interdisciplinary research. Administrators should also realize that the work-cycle of faculty tend to take them towards a higher interest in conducting interdisciplinary research as their career matures. As such, it would be wise to put in place encouragements and recognition for those faculty who wish to take on a more interdisciplinary role in their research. Further examination of the age-related demographic is worthy of study since the implications to higher educational institutions and research fields in general could be greatly impacted by recognizing and encouraging the research interests of this group of faculty.
Implications of the Data

Findings from the statistical analyses suggest there are no significant differences in motivation or factors that lead to success of interdisciplinary researchers when compared to disciplinary researchers. Because of this, administrators need to remember that if they desire to encourage interdisciplinary research on their campus and help put support systems in place that will lead to success, they can do the same types of support that they have put in place for disciplinary researchers: reward structures such as tenure and promotion, financial backing for meetings and research trips, encouragement to present at conferences and graduate training in good research practices. All of these methods of encouraging research will motivate all types of researchers on a university campus.

Recommendations for Higher Education

It is important for the field of higher education to recognize and examine the activities that occur to create a successful interdisciplinary research program. More research needs to be done in this area looking at both interdisciplinary and non-interdisciplinary researchers in order to examine those specific traits that differentiate the two groups, if there are any. This research study suggests that more mature faculty gain an interest in interdisciplinary research; therefore, it is recommended that higher education administrators recognize this trend and put in place programs and opportunities for interdisciplinary research.

This research study also implies that financial backing by higher education administrators is necessary to encourage both motivation and success of interdisciplinary researchers. Therefore, it is recommended that higher education administrators create
seed accounts and projects to encourage start-up interdisciplinary research as well as provide travel funds and other monetary support to ensure that interdisciplinary research teams can meet in person and discuss research projects and results.

Limitations

Research studies have limitations brought upon by decisions made by the researcher as well as occurrences beyond her control. In this research study the following limitations apply.

Ethnicity could not be studied because almost all of the participants were white. Since the literature suggests (Berbrier, 2002; Blackburn & Lawrence, 1995; Crowley, 1999; Lattuca, 2002, 2002; Klein, 1996; Lélé & Norgaard, 2005; O’Shea, 1998; Salter & Hearne, 1996) that non-white academicians are likely to conduct interdisciplinary research because of their interest in special populations and projects, it would be interesting to have enough data to examine this position to see if it holds with the practices of researchers.

Sample size is another limitation. In order for a factor analysis to have good reliability an \( n \) value of 300 or greater is desired (Mertler & Vannatta, 2009). The researcher was able to obtain an \( n=199 \) for this survey which has an estimated reliability ranking of “fair.”

Conducting the survey on-line creates another limitation of the study. Participants were recruited nationally in order to provide a more robust sampling of the faculty population, and in order to accomplish this in a timely and financially reasonable manner, the survey was administered on-line. Participants, therefore, were limited to those who feel comfortable completing an on-line form. This could have affected the age of the
participants who completed the survey instrument as most of the participants who completed the survey were close to her age. It is also impossible to calculate a response rate because distribution was through many different avenues resulting in a situation where there is no way to know how many individuals had the opportunity to complete the survey.

Finally, an initial intent of the research study was to determine if types of higher education institutions affected the motivation or success of interdisciplinary researchers. However, a decision was made upon developing the survey instrument not to pursue that information at this time because the research project was becoming unfocused and unwieldy. It was determined that that particular research focus could be addressed in future research.

Future Research Possibilities

Several research possibilities arise from the findings of this research study. First, the researcher intends to continue with the survey instrument development in order to create items that address some of the initially intended factors that did not work out with this instrument: disciplinary affinity, graduate training, faculty networks and attitudes about team work.

A second interesting research possibility is to examine the types of research institutions to determine whether faculty are more motivated or have more success as interdisciplinary researchers at different types of institutions.

More research needs to be conducted comparing the different traits, characteristics and motivating factors of interdisciplinary and non interdisciplinary researchers. If, as suggested in this study, there are not significant differences
demographically or by supposed characteristics, then administrators and funding agencies can drop certain assumptions about interdisciplinary researchers and adopt practices and policies that will be more reflective of what actually motivates and leads to the success of interdisciplinary researchers.

Finally, if the demographic that older faculty are more interested in conducting interdisciplinary research holds, then a research project studying different programs to encourage and lead to the transition of these researchers into interdisciplinary researchers needs to be conducted.
APPENDIX A

FACULTY RESEARCH SURVEY

Demographics

Please select the information that describes you from the options below:

1. Gender
   ___ Male
   ___ Female

2. Age Range
   ___ 20-25
   ___ 26-30
   ___ 31-35
   ___ 36-40
   ___ 41-45
   ___ 46-50
   ___ 51-55
   ___ 56-60
   ___ 61-65
   ___ 66-70
   ___ over 70

3. Highest degree earned:
   ___ Ph.D.
   ___ Ed.D.
   ___ Ed.S.
   ___ MFA
   ___ Other (please specify)____________________

4. Year completed highest degree: __________

5. Ethnicity:
   ___ White, non Hispanic
   ___ White, Hispanic
   ___ African American, Black
   ___ American Indian
   ___ Asian, Pacific Islander
   ___ Mixed
   ___ Other (please specify)____________________

6. Tenure status: ___ tenured
   ___ not tenured
   ___ not tenure track

7. Rank (check all that apply):
   ___ assistant professor
   ___ associate professor
   ___ full professor
   ___ instructor
   ___ lecturer
   ___ professor emeritus
   ___ other (please specify)____________________
Complete the following statements by selecting the number that most closely reflects your experience.

1=strongly disagree, 2=disagree, 3=agree, 4=strongly agree

<table>
<thead>
<tr>
<th>Statement</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>During my graduate training I was encouraged to conduct interdisciplinary</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>research.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I identify strongly with my discipline.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Independent research was encouraged during my graduate training.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>I avoid interdisciplinary research because I don’t like to work in teams.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>If I pursue an interdisciplinary research project, my administration will</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>provide me with the necessary tools (such as graduate students, course</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>release) to conduct it in a timely manner.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My institution provides funds to bring interdisciplinary research colleagues to campus.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>I have established networks among faculty who are interested in doing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>interdisciplinary research.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I developed a strong understanding of the tenure process during graduate</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>school.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>During my graduate training I was discouraged from working with faculty</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>in different departments.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My institution will provide me with travel funds to attend an interdisciplinary conference.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>The tenure system does not reward individuals who conduct interdisciplinary research.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Team work is difficult for faculty to do because of the amount of time</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>required.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>During my graduate training I learned the work requirements of faculty.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>The administration at my institution has implemented programs to encourage interdisciplinary work among the faculty.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>My institution will provide me with graduate assistants if I do quality research.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Faculty are less likely to get tenure if they do only interdisciplinary research.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>My university is less likely to pay for travel to a professional conference if it is outside my discipline.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Faculty networks are important to conducting interdisciplinary research.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>I discuss my research with a network of colleagues from outside of my university/college.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>I identify more strongly with faculty at my institution than I do with my discipline.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Interdisciplinary research can be conducted only in teams.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>My administration supports (financially) travel to meetings so that I can engage in interdisciplinary research with colleagues from outside of my university/college.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>I do not enjoy reading research from another disciplinary perspective.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>I prefer to work alone when conducting research.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
Please select the most appropriate response to the following questions and statements.

1. I have received external funding for my research projects. ___Yes ___No

2. I have received external funding for interdisciplinary research projects.
   ___Yes ___No
   a. If yes, which agencies have funded your research?

3. I have published my interdisciplinary research. ___Yes ___No ___Have not conducted IDR
   a. If yes, please select the venue: (select all that apply)
      ___journal in your own discipline,
      ___another disciplinary journal,
      ___interdisciplinary journal,
      ___other.

4. Have you worked professionally outside of the academic environment?
   ___Yes ___No

5. Where would you place your research on the following applied to basic continuum?

   100% Applied 1 2 3 4 5 6 7 8 9 10 100% Basic/Theoretical

6. How much of your research time do you devote to interdisciplinary research?

   0% interdisciplinary 1 2 3 4 5 6 7 8 9 10 100% interdisciplinary
## APPENDIX B

### REMAINING SURVEY ITEMS WITH FACULTY, AND POSITIVE OR NEGATIVE ATTRIBUTE

<table>
<thead>
<tr>
<th></th>
<th>Question</th>
<th>Factor</th>
<th>+/-</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>During my graduate training I conducted interdisciplinary research.</td>
<td>1</td>
<td>+</td>
</tr>
<tr>
<td>2</td>
<td>I identify strongly with my discipline.</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Independent research was encouraged during my graduate training.</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>I avoid interdisciplinary research because I don’t like to work in teams.</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>If I pursue an interdisciplinary research project, my administration will provide me with the necessary tools (such as graduate students, course release) to conduct it in a timely manner.</td>
<td>3</td>
<td>+</td>
</tr>
<tr>
<td>6</td>
<td>My institution provides funds to bring interdisciplinary research colleagues to campus.</td>
<td>3</td>
<td>+</td>
</tr>
<tr>
<td>7</td>
<td>I have established networks among faculty who are interested in doing interdisciplinary research.</td>
<td>4</td>
<td>+</td>
</tr>
<tr>
<td>8</td>
<td>I developed a strong understanding of the tenure process during graduate school.</td>
<td>1</td>
<td>+</td>
</tr>
<tr>
<td>9</td>
<td>During my graduate training I was discouraged from working with faculty in different departments.</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>My institution will provide me with travel funds to attend an interdisciplinary conference.</td>
<td>3</td>
<td>+</td>
</tr>
<tr>
<td>11</td>
<td>The tenure system does not reward individuals who conduct interdisciplinary research.</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>12</td>
<td>Team work is difficult for faculty to do because of the amount of time required.</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>13</td>
<td>During my graduate training I learned the work requirements of faculty.</td>
<td>1</td>
<td>+</td>
</tr>
<tr>
<td>14</td>
<td>The administration at my institution has implemented programs to encourage interdisciplinary work among the faculty.</td>
<td>3</td>
<td>+</td>
</tr>
<tr>
<td>15</td>
<td>My institution will provide me with graduate assistants if I do quality research.</td>
<td>3</td>
<td>+</td>
</tr>
<tr>
<td>16</td>
<td>Faculty are less likely to get tenure if they do only interdisciplinary research.</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>17</td>
<td>My university is less likely to pay for travel to a professional conference if it is outside my discipline.</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>18</td>
<td>Faculty networks are important to conducting interdisciplinary research.</td>
<td>4</td>
<td>+</td>
</tr>
<tr>
<td>19</td>
<td>I discuss my research with a network of colleagues from outside of my university/college.</td>
<td>4</td>
<td>+</td>
</tr>
<tr>
<td>20</td>
<td>I identify more strongly with faculty at my institution than I do with my discipline.</td>
<td>2</td>
<td>+</td>
</tr>
<tr>
<td>21</td>
<td>Interdisciplinary research can be conducted only in teams.</td>
<td>4</td>
<td>+</td>
</tr>
<tr>
<td>22</td>
<td>My administration supports (financially) travel to meetings so that I can engage in interdisciplinary research with colleagues from outside of my university/college.</td>
<td>3</td>
<td>+</td>
</tr>
<tr>
<td>23</td>
<td>I do not read research from another disciplinary perspective.</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>24</td>
<td>I prefer to work alone when conducting research.</td>
<td>4</td>
<td>-</td>
</tr>
</tbody>
</table>
APPENDIX C

PRELIMINARY EXPLORATORY FACTOR ANALYSIS

The exploratory factor analysis was run using a principal axis factor analysis.

Three separate exploratory factor analyses were run: one using a measure of an
Eigenvalue greater than 1, an analysis forcing 7 factors (as intended in the original
construction of the instrument) and a final exploratory factor analysis that again used a
measure of an Eigenvalue greater than one with the double loaded and negatively loaded
items removed from analysis (which was reported in Chapter 4). Analysis of an
Eigenvalue greater than 1 suggests 8 components and explains 63.5% of the variation.

Table C1 shows the Eigenvalues for the Exploratory Factor Analysis:

Table C1

*Eigenvalues and Total Variance Explained*

<table>
<thead>
<tr>
<th>Component</th>
<th>Eigenvalue</th>
<th>% Variance</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.36</td>
<td>18.18</td>
<td>18.18</td>
</tr>
<tr>
<td>2</td>
<td>2.07</td>
<td>8.64</td>
<td>26.82</td>
</tr>
<tr>
<td>3</td>
<td>2.01</td>
<td>8.38</td>
<td>35.20</td>
</tr>
<tr>
<td>4</td>
<td>1.77</td>
<td>7.37</td>
<td>42.57</td>
</tr>
<tr>
<td>5</td>
<td>1.45</td>
<td>6.06</td>
<td>48.63</td>
</tr>
<tr>
<td>6</td>
<td>1.34</td>
<td>5.60</td>
<td>54.23</td>
</tr>
<tr>
<td>7</td>
<td>1.17</td>
<td>4.87</td>
<td>59.10</td>
</tr>
<tr>
<td>8</td>
<td>1.05</td>
<td>4.39</td>
<td>63.49</td>
</tr>
</tbody>
</table>

The data were then assessed using the rotated component matrix and factor loadings >.40.

The rotated component matrix using oblique rotation is shown in Table C2:
Table C2

Rotated Component Matrix for Large-Scale Pilot Exploratory Factor Analysis

<table>
<thead>
<tr>
<th>Item #</th>
<th>Component 1</th>
<th>Component 2</th>
<th>Component 3</th>
<th>Component 4</th>
<th>Component 5</th>
<th>Component 6</th>
<th>Component 7</th>
<th>Component 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>.722</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>.672</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>.495</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>.436</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16r</td>
<td></td>
<td>.745</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11r</td>
<td></td>
<td></td>
<td>.669</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>.552</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>18</td>
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<td>.506</td>
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<tr>
<td>19</td>
<td></td>
<td></td>
<td>.490</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
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<td></td>
<td></td>
<td>.732</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td>.690</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.766</td>
<td></td>
<td></td>
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<tr>
<td>10</td>
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<td></td>
<td></td>
<td>.621</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>17r</td>
<td></td>
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<td></td>
<td></td>
<td>.592</td>
<td></td>
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<td></td>
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<tr>
<td>23r</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.420</td>
<td></td>
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<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.652</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.565</td>
</tr>
</tbody>
</table>

Items that did not load at a minimum of .40 were 2r, 4r, 9r, 12r, 21, 24r. Looking at the items to see if there are any logical connection between the items loaded into each component results in the following break down of factors (see Table C3):

Table C3

Factors Derived from Exploratory Factor Analysis

<table>
<thead>
<tr>
<th>Factor</th>
<th>Items</th>
<th>Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrative Support</td>
<td>5, 6, 15, 14</td>
<td>.732</td>
</tr>
<tr>
<td>Financial Support</td>
<td>17, 22, 10</td>
<td>.778</td>
</tr>
<tr>
<td>Tenure</td>
<td>16, 11</td>
<td>.657</td>
</tr>
<tr>
<td>Faculty Networks</td>
<td>7, 18, 19</td>
<td>.503</td>
</tr>
<tr>
<td>Graduate Understanding</td>
<td>8, 13</td>
<td>.730</td>
</tr>
<tr>
<td>Graduate Training</td>
<td>3, 1</td>
<td>.549</td>
</tr>
</tbody>
</table>
Item #23 did not fit logically into the Financial Support component so was eliminated from further analysis. Item #20 formed individual components and therefore was not analyzed further. Using the factor loadings from the exploratory factor analysis and eliminating items that did not logically fit in the loadings, the researcher conducted a coefficient alpha analysis on the factors and reported those coefficients in Table C3. The components for administrative support, financial support and graduate understanding of faculty requirements were all >.70 indicating a strong reliability of those components.

Next a principal axis factor analysis was run forcing 7 components. The variance explained is 59.1%. Forcing the principal components analysis to evaluate seven components results in the following rotated components matrix shown in Table C4.

Table C4

*Rotated Component Matrix for Large-Scale Pilot Exploratory Factor Analysis, Forcing 7 Factors*

<table>
<thead>
<tr>
<th>Item #</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
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<td>.697</td>
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</tr>
<tr>
<td>15</td>
<td>.519</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>.482</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>16</td>
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<td>.740</td>
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<tr>
<td>11</td>
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<td>.686</td>
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<tr>
<td>12</td>
<td></td>
<td>.401</td>
<td></td>
<td></td>
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<tr>
<td>7</td>
<td></td>
<td></td>
<td>.622</td>
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<tr>
<td>19</td>
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<tr>
<td>18</td>
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<td></td>
<td>.407</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td>.691</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
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<td>.656</td>
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<td>10</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>.554</td>
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<td></td>
<td></td>
<td>.519</td>
<td></td>
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<td>23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.514</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.751</td>
</tr>
</tbody>
</table>
Factor loadings >.4 are shown in the table. The factor loadings were analyzed to eliminate items that did not logically fit into the component where they were loaded, and items that did not load into any construct to create the following factors shown in Table C5.

Table C5

*Factor Loading and Coefficient Alpha for Factors Derived from Exploratory Factor Analysis with Seven Factors Forced*

<table>
<thead>
<tr>
<th>Factor</th>
<th>Items</th>
<th>Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrative Support</td>
<td>5, 6, 15, 14</td>
<td>.732</td>
</tr>
<tr>
<td>Tenure</td>
<td>16, 11, 12</td>
<td>.606</td>
</tr>
<tr>
<td>Travel Support</td>
<td>17, 10</td>
<td>.645</td>
</tr>
<tr>
<td>Faculty Networks</td>
<td>7, 19, 18</td>
<td>.503</td>
</tr>
<tr>
<td>Graduate Understanding</td>
<td>8, 13</td>
<td>.730</td>
</tr>
</tbody>
</table>

While the factor loadings make logical sense, most do not stand up to the reliability test. Only administrative support and graduate understanding have a coefficient alpha coefficient >.70. As in all previous analyses, the overall alpha coefficient is >.70.
APPENDIX D

IRB APPROVAL FORM

THE UNIVERSITY OF SOUTHERN MISSISSIPPI

Institutional Review Board

118 College Drive #5147
Hattiesburg, MS 39406-0001
Tel: 601.266.6820
Fax: 601.266.5509
www.usm.edu/irb

HUMAN SUBJECTS PROTECTION REVIEW COMMITTEE
NOTICE OF COMMITTEE ACTION

The project has been reviewed by The University of Southern Mississippi Human Subjects Protection Review Committee in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services (45 CFR Part 46), and university guidelines to ensure adherence to the following criteria:

- The risks to subjects are minimized.
- The risks to subjects are reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered regarding risks to subjects must be reported immediately, but not later than 10 days following the event. This should be reported to the IRB Office via the “Adverse Effect Report Form.”
- If approved, the maximum period of approval is limited to twelve months. Projects that exceed this period must submit an application for renewal or continuation.

PROTOCOL NUMBER: 10110104
PROJECT TITLE: Barriers and Enablers of Interdisciplinary Research at Academic Institutes
PROPOSED PROJECT DATES: 01/01/2010 to 12/31/2010
PROJECT TYPE: Dissertation
PRINCIPAL INVESTIGATORS: Leslie Butler
COLLEGE/DIVISION: College of Education & Psychology
DEPARTMENT: Educational Studies & Research
FUNDING AGENCY: N/A
HSPRC COMMITTEE ACTION: Expedited Review Approval
PERIOD OF APPROVAL: 11/01/2010 to 10/31/2011

[Signature]
Lawrence A. Hosman, Ph.D.
HSPRC Chair
References


Essays and bibliographic sources on research design and methods (pp. 143-157).

Thousand Oaks, CA; Sage.


