

# Interdisciplinary Doctoral Student Socialization

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## Abstract

Interdisciplinary research and education are a growing emphasis in United States institutions of higher education but relatively little is known about the doctoral students engaged in these atypical programs. The purpose of this study was to understand the socialization process of 18 students involved in a large-scale, federally funded, interdisciplinary research project focused on sustainability at one university. Using Weidman, Twale, and Stein's framework of graduate student socialization, themes emerged related to (a) their distinctive characteristics and cultures, (b) the learning process, (c) balance, (d) uncertainty, and (d) support. Recommendations for policy and practice are included.

**Keywords:** interdisciplinary, socialization, qualitative

## Introduction

Interdisciplinary research, teaching, and collaboration have gained increasing popularity in institutions of higher education in the United States (U.S.) in recent years. For example, the National Science Foundation (NSF) has played a vital role in encouraging interdisciplinary scholarship in the U.S. through multiple funded projects, like the Integrative Graduate Education and Research Traineeship (IGERT) program (Carney, Chawla, Wiley, & Young, 2006). The Association for Integrative Studies (2008) compiles a listing of many such interdisciplinary programs throughout the U.S., which currently number in the hundreds. Despite this growth in interdisciplinary doctoral programs, relatively little is known about these students and how their experiences differ from doctoral students in traditional, single discipline programs.

Research on traditional doctoral programs demonstrates that socialization is a central component of students' success (Mendoza & Gardner, 2010); however, it is a largely unexplored factor in research on interdisciplinary doctoral education. In this paper, we forward a conceptual understanding of interdisciplinary doctoral student socialization through the analysis of interview data from 18 doctoral students involved in one such interdisciplinary experience as a case study. We

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begin with an overview of interdisciplinary doctoral education and its relationship to the literature on doctoral student socialization, focusing specifically on the model of Weidman, Twale, and Stein (2001). We then discuss our findings and the implications for policy, practice, and future research.

## Interdisciplinary Doctoral Education

Interdisciplinarity can be defined as:

“The interaction among two or more different disciplines. This interaction may range from simple communication of ideas to the mutual integration of organizing concepts, methodology, procedures, epistemology, terminology, data, and organization of research and education in a fairly large field... a common effort on a common problem with continuous intercommunication among the participants from the different disciplines.”  
(Organization for Economic Cooperation and Development, 1972, pp. 25-26)

In regard to doctoral education, then, “the interdisciplinary perspective presents a radical departure from the traditional structure of the Ph.D. in American higher education” (Holley, 2009a, p. 241). A traditional doctoral program imbues the student with a disciplinary culture and socialization to this culture that prepares him or her for success in the larger disciplinary field (Bragg, 1976; Golde, 1998; Weidman et al., 2001). The socialization process to a traditional doctoral program is one that has been called a “perilous passage” due to its complexity (Weidman et al., 2001). Interdisciplinary programs combining two or more disciplines are, therefore, by definition even more complex for the student, requiring a straddling of two or more worlds’ norms, values, beliefs, and understandings.

The complexity of conducting interdisciplinary research cannot be understated. Scholars studying these efforts have found that few true interdisciplinary collaborations are actually successful given the myriad obstacles facing them (Amey & Brown, 2004; Creamer, 2005), including language barriers among disciplines, epistemological differences, and structural issues that permeate traditional universities such as reward systems and even the physical boundaries of buildings (Holley, 2009b; Huutoniemi, Klein, Bruun, & Hukkinen, 2010; Lattuca, 2001). The literature related to interdisciplinary graduate education has pointed to these obstacles as owing also to the difficult nature of learning about multiple disciplines in the doctoral program. These difficulties can be structural (i.e., navigating two or more disciplinary/departmental cultures and expectations) as well as cognitive as students work to merge or even create new understandings from traditionally separate bodies of knowledge (Boden, Borrego, & Newswander, 2011; Borrego & Newswander, 2010). Moreover, students in interdisciplinary doctorate programs can face obstacles in professional preparation. Boden et al. (2011) remarked, “Student socialization is significant within traditional academic disciplinary settings; however, in interdisciplinary research areas with less clearly defined career paths, knowledge of potential employers’ expectations are particularly important for students to find appropriate post-graduation employment” (p. 750).

Recognizing the structural and cognitive complexities faced by interdisciplinary graduate students, scholars have pointed to particular attributes of those most likely to succeed in these endeavors. For example, a high tolerance for ambiguity is often needed to navigate the complexities inherent in such work (Bromme, 2000; Klein, 1990; Newell, 1994), as well as flexibility, resilience, and risk-taking (Klein, 1990). Indeed, Boden et al. (2011) argued that it takes a “unique type of student to succeed and flourish in these circumstances” (p. 752). While these attributes are important for interdisciplinary student success, research on traditional programs shows that doctoral student socialization is often the factor that determines who succeeds and fails in doctoral programs (Mendoza & Gardner, 2010).

## Doctoral Student Socialization

Socialization is the process through which an individual learns the knowledge, skills, values, attitudes, habits of mind, and modes of thinking that are required to gain admission and acceptance into a particular organization or culture (Bragg, 1976; Tierney, 1997; Van Maanen & Schein,

1979). Doctoral student socialization is even more complex, however, as it requires that the student is dually socialized to the role of graduate student as well as to the professional role that the student seeks once graduate school is completed (Golde, 1998). Given this complexity, it is perhaps not surprising that this socialization process has been described as “a perilous passage” for graduate students (Weidman et al., 2001). Indeed, unsuccessful socialization has been connected to graduate student departure (Council of Graduate Schools, 2004).

The socialization process, as discussed as occurring in “traditional” doctoral programs wherein the student is enrolled in one disciplinary program, occurs in four stages. The first stage is the anticipatory stage, wherein students enter the program and learn new roles. The second stage of socialization is the formal stage, where students observe more advanced students and faculty and learn about their role expectations. These lessons occur through both formal methods, such as in coursework and research experiences, but also in informal settings such as in peer and faculty interactions. The informal stage is third, wherein the student continues to receive informal and formal cues for behavior but begins to transition from a less “student-like” role to one that is more professional. The final stage is the personal stage in which the student fuses the personal and professional identities and is able to successfully emerge from the graduate program into the professional realm (Weidman et al., 2001).

Taken together, Weidman et al. (2001) provide a framework for better understanding the socialization experience of doctoral students. When viewed in concert with the complexities of interdisciplinary graduate education, one can more fully appreciate the challenges of interdisciplinary doctoral student socialization.

## Methods

The research question guiding this study was, “What are the socialization experiences of doctoral students involved in one large interdisciplinary project?” The findings presented in this paper result from in-depth interviews with 18 doctoral students involved in a larger ongoing case study (Yin, 2009) of a \$20 million, five-year, federally funded interdisciplinary research project at one mid-sized, public, land-grant institution. This interdisciplinary project is focused on studying environmental sustainability and includes participation from faculty in over 20 distinct academic disciplines ranging from the biophysical sciences to the humanities. The majority of the funding for the project was focused on graduate students who largely applied to work with specific interdisciplinary project teams under the grant’s umbrella. Students were expected, however, to be co-advised by faculty from two distinct disciplines. In other words, students were not admitted into a specific interdisciplinary degree program but rather were admitted to one or two graduate degree-granting department(s) to work with two faculty members in different academic departments. The expectation was that interdisciplinary coursework and an interdisciplinary emphasis in their dissertation would ensue. In many cases, students were explicitly expected to choose departments from both social science and natural science disciplines, thereby creating an even more complex interdisciplinary program.

Given that the interdisciplinary project under examination is characterized as a “particular context within which the participants act,” and that we were interested in better understanding the influence of this context on the participants’ actions, as well as “the meaning of the events, situations, and actions they are involved with” (Maxwell, 1996, p. 17), qualitative methods were best suited for this study. We conducted open-ended interviews with the doctoral students involved in this interdisciplinary endeavor in order to better understand how the students were experiencing the socialization process in this interdisciplinary environment.

The data presented in this paper result from these open-ended interviews with the 18 students admitted in Years 2 and 3 of the project. They were interviewed twice over a two-year period.

Due to the multiple years of data collection, these interviews also represent ongoing understandings of the students' socialization as a developmental process (Gardner, 2009b); in particular, the focus on their early socialization to interdisciplinarity was purposeful in understanding how these early understandings and identities are formed. While we did not examine demographic characteristics in our study, gender representation of the students included four males and 14 females. The mean age of the participants was 32 years at the time of the interviews. Students were all full-time in their respective programs at the time of the study. Racial representation among the population was all White with one exception, who was also an international student. In Table 1 we present an overview of the participants, masking some of the identifiable information to protect students' confidentiality.

Table 1 – Participants by Pseudonym, Disciplinary Backgrounds, and Age

<b>PSEUDONYM</b>	<b>DISCIPLINES REPRESENTED</b>	<b>AGE IN YEAR 1</b>
Hope	Wildlife Ecology Marine Policy	39
Julie	Communications Policy	31
Andrea	Anthropology Forestry	29
Jody	Forestry Ecology	35
Barbara	Communications Environmental Resources	24
Dan	Forestry Conservation Biology	30
Sarah	Engineering Ecology	27
Amy	Land Resource Mgt Policy	43
James	Conservation Planning Forestry	32
Nicholas	Forestry Ecology	29
Mary	Economics Psychology	29
Gina	Wildlife Ecology Environmental Studies	31
Melissa	Economics Wildlife Ecology	37
Angela	Communications Policy	29
Emily	Natural Resources Economics	27
Kate	Economics Ecology	35
Ellen	Geology Earth Sciences	33
Jeff	Engineering Economics	31

After receiving informed consent, we conducted the interviews using an open-ended protocol (see Appendix) that asked students about their experiences in the project and their thoughts about interdisciplinarity in both their first and second years. We audio-recorded the interviews and transcribed them verbatim. We then utilized Glaser's (1978) constant comparative method for data analysis. The steps of the constant comparative method, include (1) Begin collecting data; (2) Find key issues, events, or activities in the data that become main categories for focus; (3) Collect data that provide many incidents of the categories of focus; (4) Write about the categories explored, keeping in mind past incidents while searching for new ones; (5) Work with the data and emerging model to discover relationships; and (6) Sample, code, and write with the core categories in mind. The steps of the constant comparative method occur simultaneously during data collection until categories are saturated and writing begins. We utilized Glaser's steps in data analysis, along with the framework of socialization (Weidman et al., 2001).

## Findings

The 18 interdisciplinary doctoral students interviewed in this study discussed their socialization experiences as occurring across several major themes: (a) their distinctive characteristics and cultures that required navigating (b) the learning process, as well as learning to (c) balance their multiple roles and expectations, often resulting in much (d) uncertainty for both their present situations and future ones, but tempered by (e) support they received through the process. We now discuss each of these themes in turn.

### ***Distinctive Characteristics and Cultures***

The students in the study were well aware of how distinctive their experiences were in this interdisciplinary research endeavor. Not only was the project distinctive – a \$20 million, federally funded project focusing on solutions-centered research to create change related to sustainability issues – but the doctoral experience was also distinct. Students discussed the project as something that Julie described as “a once in a lifetime opportunity,” and what Dan described as “groundbreaking.” Students also were attracted to the interdisciplinary experiment that was an inherent part of the project. Gina described her undergraduate experience as one that attempted to incorporate multiple disciplines without success. When she saw the interdisciplinary focus of the project and its emphasis on coming to understand interdisciplinarity as part of the process she was intrigued. She said, “I had witnessed the continual struggle for people to speak the same language and figure out what needed to be done and struggling with this and not finding necessarily ways to make it work. [This project], the structure of it, and just thinking it would be an opportunity to explore those themes was an appealing thing.” On the other hand, other students were drawn to the project because of their undergraduate experiences in the liberal arts, which had prepared them for this synthesis of disciplinary understandings. Nevertheless, some of the students saw the entire project as one big experiment and recognized that they were sometimes the focus of the research. Sarah laughed nervously and remarked, “I guess so far I've been getting the feeling that it's sort of like an experiment and so my role is to just kind of like participate as best I can in a positive way.”

Another unusual aspect of the students' experiences was their own backgrounds. First of all, the average age of these students in their first year of the doctoral program was 32 years. Given the fact that most doctoral students in STEM (science, technology, engineering, or mathematics) disciplines will graduate by their early 30s (National Science Foundation, 2010), this age is noteworthy. Additionally, a large number of the students had worked before entering the doctoral program, including – interestingly enough – at least three students who had been involved in the Peace Corps. The applied focus of the interdisciplinary project, with its emphasis on creating solutions to environmental sustainability problems in the “real world,” was often what drew the stu-

dents to the interdisciplinary project in the first place. Gina said, “I really liked the applied nature of what was going on in [the project], that’s what attracted me.”

All of this distinctiveness, however, was both boon and hindrance for the students. From a positive perspective, the students saw themselves as forging trails in new territory. Often, the students used phrases like “pushing boundaries,” “getting out of the comfort zone,” and “being on the edge.” From this perspective, the students’ appreciated the ambiguity involved in the project. Certainly, the ground-breaking nature of the project was exciting but they also realized that breaking new ground tends to mean that it’s someone’s job to do the digging.

## **Learning Process**

As such, the learning that the students discussed, even in the first year of their programs, was monumental. Students discussed the intense learning process involved in such an endeavor that required incorporating learning about two or more disciplines, learning about two or more sets of expectations from different departments about how to be a graduate student, learning new languages and research methods in these different disciplines, and fusing and integrating these understandings and meanings in a true interdisciplinary fashion. It was common to hear the students remark plainly, “Interdisciplinary research is hard.” Dan further explained, “I think interdisciplinarity is a learning process. Essentially, the faculty doesn’t have all the answers. There are a lot of schools across the country that do interdisciplinary research, and they don’t have all the answers. It’s really difficult to do.”

In addition to Dan, students commented on the learning involved in this work and how they saw the faculty learning to do it along with them. Jody expressed,

“Yeah, I don’t know that they even know; I don’t know that the faculty members know. I think this is iterative, and they’re learning with us. They don’t have all the solutions and it’s refreshing, you know, that they don’t because interdisciplinarity is such a tangled beast. It’s a tough thing to wrap your head around.”

Therefore, many of the students realized that they would play central roles in breaking the ground on this work, rather than only following the faculty. The students saw the constraints the faculty were under, including time and expectations from the funding sources, not to mention being mired in the tradition of their disciplines. Jody explained,

“I think that we’re going to be the ones that figure it out, more than the faculty. I think that we’re going to drive the questions a little more. We’re not committed to certain funding source or a certain way of doing things yet because we’ve come in under somebody else’s funding.”

Students, like Andrea, also discussed the organizational and structural challenges that were inherent in any interdisciplinary project.

“Administratively, it’s a total nightmare. But I guess I had that sense before I signed up for it, but that has definitely proved to be true since I’ve been here. I mean, not like there’s anything anyone can do about it, I think it’s just a fundamental problem of trying to do it. Because you have to have some way that everyone communicates with each other and knows what’s going on - I mean, besides forcing everyone to be in same building, which I think would actually be really valuable. There’s no other way to make sure everyone’s on the same page.”

Indeed, communication was a looming issue for the students in their socialization process as they learned to communicate across disciplines and to understand new languages and methods in-

volved in these disciplines. More to the point, students discussed issues of time, including the extensive time required for interdisciplinary communication, learning, and research. Gina stated,

“I’m amazed at how much time it takes to try to speak each other’s language and jargon and get a sense of what methods are involved in that other discipline. It seems like it’s really costly in terms of time and energy, you know, how do we make this happen?”

Hope further explained,

“I think that the biggest barrier is time. I think that we’re all intelligent enough individuals, we can all sit down and learn from different perspectives. We may think different. But I find that when I sat down with somebody, I found we had the same interests, but way different literature, and then I get bogged down in this. Do I need to read all that literature and try to figure it out? And it just becomes, every time you try and narrow your question, it blows up again. It just kind of sets you back and it makes you go back and re-think your original question over and over.”

In his first semester, Dan shared,

“I think give me another semester just to kind of hit up some of my home department courses and learn my language first. Then, bring me back together consecutively every semester with these other students to try to continue to learn from them and learn their languages, and learn different methods to go about it. Yeah, I’d love to take other classes but I’m not able to, and even if I was, I guess it’s not totally needed right now.”

These comments not only reveal the complexity of learning deeply and broadly as interdisciplinary students, but also the paradoxical quality of the learning experience for students balancing on the tightrope of interdisciplinary research.

## **Balance**

Students described the challenge of balancing interdisciplinary learning experiences, including the demands for breadth and depth of research in multiple fields and the programmatic aspects of their assistantships, including meetings, department versus assistantship expectations, and teaching-research requirements.

Students in interdisciplinary programs are often required to balance many expectations of their time and learning (Newswander & Borrego, 2009). One such balancing act required in interdisciplinary doctoral work is that of depth versus breadth. The Council of Graduate Schools (2005) forwarded, “The Doctor of Philosophy degree is awarded by faculty stewards of the discipline to those who have demonstrated the highest level of mastery of the intellectual principles of their chosen field” (p. v). Students involved in the interdisciplinary project under examination, however, were expected to have one home discipline but to have two advisors from two different disciplines, resulting in an interdisciplinary dissertation that incorporated concepts and methods from both fields. From the Council of Graduate Schools’ perspective, a Ph.D. implies mastery of one discipline. The students involved in this study struggled to identify the line between mastery of one discipline and multiple disciplines. Angela, echoing this concern of balance in disciplinary focus, said, “I think that kind of balance is really hard. There are so many things available to you, so kind of deciding what is my focus when there are all of these really interesting and fascinating things going on.” James also wondered about the balance of learning new things without getting “sidetracked.”

“I’m interested to learn. I’m interested enough to understand it, but without doing it, you know what I mean? Without getting sidetracked because I have a tendency to sort of get

sidetracked into other interesting things, so I want to learn enough about it so I understand, but not so much that I feel like I'll get sidetracked."

Nicholas echoed this concern,

"I don't have a lot of time to be pulled this way and that by other disciplines while I'm getting a Ph.D. I've got four years to do it, and if I let myself get pulled every which way by everything that sounds interesting – which is apt to happen with me – I may end up not getting anything done."

Students also expressed that balancing the programmatic components of their different doctoral programs was demanding. Because of the interdisciplinary nature of the program, students were expected to participate in their home department's events and activities as well as those related specifically to the interdisciplinary project. The time involved in participating in these myriad meetings, events, and activities required a constant balancing act on the part of the students. Hope remarked, "I think the time is going to be really hard, both the physical time, the meetings, the places you need to be, and, then, more the academic side where you're constantly being bombarded with these new ideas." Sarah expressed her concern thus:

"I am a little bit worried about the amount of meetings I'll have to go to because I'm housed in the engineering department, part of the ecology program, and [a project] team member, so you know the idea of balancing all those...and appeasing everybody is a challenge."

The time involved in learning not just one discipline, but multiple, also required balance for the students. James explained,

"In the case [of the project], there are expectations within your own department - we have the same expectations as all other graduate students have, but on top of that, there's other things. That includes an extra class maybe once a semester, a bunch of extra meetings - none of which are inherently bad, it just means you have to spread yourself a little thinner, or you have to give less. One of the challenges starting out has been when to get involved and when not to get involved, and knowing when your priorities should be your departmental work and classes versus [project] stuff."

James learned one strategy for dealing with this challenge: "I'm trying hard to be better at saying 'no' sometimes."

Importantly, Angela highlighted inclusiveness as a motivator for the meetings, while at the same time arguing the need for balance, "It's important that we're not overloading students with great initiatives and ideas because each project has their own things going on and then there are department kinds of requirements. I think there's a balance between involvement and overburdening."

Not all the students' assistantships were structured similarly and some discussed the need to balance teaching demands with their research. Barbara was one of a few students who had teaching assistant expectations in addition to project research, and she discussed her concern about balancing teaching with research, on top of the other project meetings and responsibilities.

"It's hard, too, I think, as doctoral students to focus so much on research when we have so many other responsibilities as well. I mean class, teaching, all these things, and to fully dedicate so much time to [the project]. I think we have to find a way to balance the external pressures of what we're all doing in our home departments and our assistantships, because it's hard when you have classroom responsibilities and those you really can't fudge on, you just have to do it. So, something's got to give."

Finally, the majority of students in this interdisciplinary initiative have co-advisors, creating another need for “balancing.” Many students wondered about how they might eventually balance their co-advisors’ feedback. One student explained, “The involvement of more people and more disciplines might be harder [in interdisciplinary research]. People might be eyeing your research a little more, making sure it’s well-rounded.”

## ***Uncertainty***

The combination of the unusual nature of the interdisciplinary project, with the learning involved, and the balance it necessitated resulted in a general feeling of uncertainty for the students. This uncertainty surrounded both the present program in which they were involved as well as uncertainty about their futures.

Many uncertainties for the students stemmed from the lack of structure for the interdisciplinary program and a resulting lack of clear expectations. Barbara explained,

“I feel like so much of this is exploratory territory, which I understand, but at the same point, we’re all doctoral students and we’re all here to conduct a line of research to get to an end product to be employed somewhere. We need that kind of traditional doctoral student support to get there.”

Mary summarized many of the uncertainties that the students discussed in this experience.

“I’m concerned with the uncertainty of where the program is going. It’s really exciting to be on the innovative edge, right, and kind of being part of something that’s new, and cutting across disciplines, and it feels very exciting. But, on the flip side, it’s not well established. It’s in the process of forming and I wonder sometimes what happens if our funding gets pulled. Where then do I go? Am I absorbed into economics? What would happen? And, then, also thinking about my job search when I’m done. I think interdisciplinary studies are becoming more and more respected, but sometimes I just wonder if that’s going to look less respected than if I were to get a Ph.D. from the school of economics, for example. I don’t know. I’ve never gotten a Ph.D. and tried to find a job so I don’t have personal experience. So, I do think that’s a challenge for people coming out with an interdisciplinary Ph.D. If we think back the last 20 years of academics, people have gotten degrees in specific disciplines, so it’s kind of interesting to see how [an interdisciplinary Ph.D.] will be interpreted.”

Hope expressed a similar concern,

“I think it’s a little scary, because I have no idea, in terms of [the job market]. It’s exciting in a way because I think it will open up a lot of opportunities - I could be in a million different departments. You know, I’ve talked to people who are like, yeah, you could fit in communications, you could fit in wildlife, you can fit in economics. So, that is exciting. But then, in another respect, there is a lot of tradition in these departments and it worries me that people will look at my degree and not even take that step to ask me what it means or where I would go with it.”

Interestingly, however, the majority of the students were unlike Hope in their job prospects. For example, most of the students expressed that they would not choose the academic track upon graduation but rather careers in non-profit, non-government organizations (NGOs), or in agencies straddling policy and government arenas. Indeed, most students expressed their future prospects as Nicholas did,

“I see two potential paths, well, three. One is do something for the federal government at some higher level in the EPA or USDA or other agencies concerned with land resource

management - director of a lab, I don't know, something with an impressive title. Another one is get into NGOs somehow, you know, director of this or that, director of water research, director of aquatic sciences for the Nature Conservancy. I don't even know if the position exists, but you know something along those lines. And the third one, which is probably the least preferred option, but far more competitive and perhaps even the nasty option, is academia. It's a bit cutthroat and I'm not sure I'm cutthroat."

However, there were just as many students, like Sarah, that when asked what she was considering doing after completing her degree, responded, "I have no idea."

Despite this uncertainty, the students involved in this interdisciplinary project were able to see how they possessed the ability to overcome some of this uncertainty, often through their own dispositions of open-mindedness and intellectual curiosity. Julie shared her ability to ask what she described as "stupid questions": "This is not a background I have so I have to be comfortable asking stupid questions, you know, and putting myself out there and being like, 'I don't understand what you're talking about,' and 'That word doesn't make sense to me.' It's hard to know what you don't know; it requires being comfortable with a level of discomfort."

### **Support**

To navigate these challenges the students discussed the sources of support they regarded as most helpful in this interdisciplinary experience. Interestingly enough, it was more often the students' peers who provided the support rather than faculty members. For example, Sarah shared, "I'm probably going to lean more on my fellow students for moral support," which Amy echoed. Hope also expressed, "For me, it's a lot of the grad students who have been going through it with me along the way." Julie further delineated this support, "I think the fellow students are really a key resource, just for commiserating and sharing ideas and kind of recognizing that you're not alone in this and that everybody is experiencing, maybe different challenges, but similar challenges as well."

Students also expressed how important this peer interaction was to their success, mostly in both formal and informal settings. Julie discussed the import of "building community" among students and James emphasized how much he valued the project's cohort approach to building the student community.

"I like the cohort approach. I think that's going to strengthen it. We have a couple of different sort of venues - the readings course and just some more general social events. I think going through it as a cohort makes a lot of sense in that there's a lot to be gained from other fellow students - even if they're working in other disciplines - just about the Ph.D. student experience factor more than anything else. So, I've really enjoyed that part of it."

Only secondarily were advisors and faculty mentioned, and usually only after peers were mentioned. Mary was one of the few exceptions to mention her faculty support first, however,

"My two main advisors will be the best support system, I guess, and just making sure that, I'm meeting their goals and expectations, and making sure that I'm on track as a new student. And, then, as I get my grounding, reaching out with the greater committee that I'm working with. I guess it's hard for me to separate my research from being a student too. So, I'm talking about my advisor and my committee."

The third group most mentioned by the students ended up falling into the category of family and friends outside of the graduate experience. Like Amy, who mentioned her husband's support as being crucial to her success in the program.

## Discussion

In this study, the 18 students described their socialization experiences in one federally funded, large-scale, interdisciplinary project. If one considers socialization in graduate school to be “the processes through which individuals gain the knowledge, skills, and values necessary for successful entry into a professional career requiring an advanced level of specialized knowledge and skills” (Weidman et al., 2001, p. 56), then several issues arising from the students’ experiences merit discussion.

If one views socialization as a four stage process (anticipatory stage, the formal stage, the informal stage, and the personal stage, Weidman et al., 2001), the students described several interesting elements related to their anticipatory socialization. First, it was fascinating to see not only the age of the students but also that the majority of them had worked in professional settings prior to enrolling in their doctoral program. This delayed entrance after employment could account for both the students’ attraction to the program as well as the faculty members’ interest in these particular students, particularly given the applied emphasis of this interdisciplinary work. Students relished the real-world focus of the project and said they came because of it. At the same time, this advertised focus meant that many of them arrived to the project with preconceived notions of their roles in the teams. These role expectations seem important to recognize when examining the anticipatory stage of socialization. In this way, these students represent something other than the “typical” graduate student in the sciences, which may be a requisite for interdisciplinary graduate student success (Boden et al., 2011). Second, most of the students also discussed their liberal arts undergraduate experiences as owing to their interest and openness to interdisciplinarity. From this perspective, we speculate that the cognitive development that is fostered in a liberal arts setting as well as the professional experiences of the students may have allowed for a higher tolerance of ambiguity, high cognitive complexity, humility, and resiliency – all traits of those successfully engaged in interdisciplinary work (Klein, 1990; Newell, 1994; Rhoten, O’Connor, & Hackett, 2009). These background characteristics and program expectations inevitably may be important antecedents to successful socialization in interdisciplinary programs. As such, early exposure to interdisciplinary experiences and cognitive development to foster interdisciplinarity may be important. Indeed, Amey and Brown (2004) pointed out this “critical juncture” in the cognitive development of students and Strober (n.d.) remarked, “It is in the institution’s interest to expose junior faculty, post-docs, and doctoral students to multidisciplinary and interdisciplinary projects early in their careers, before they become set in their intellectual ways” (p. 21). Perhaps it is this timing and openness early in the students’ formative years that allows for more successful socialization to interdisciplinarity or the interdisciplinary experiences offered to them in their undergraduate years.

The second stage of socialization is the formal stage. In this study, students began to discuss a more keen sense of the interdisciplinary project itself as well as their place in it. Particularly, it was interesting to note the students’ awareness of their own understandings of interdisciplinarity and how they were, in many cases, more advanced in their thinking about interdisciplinarity than their faculty members. This too is perhaps not surprising when the majority of the faculty members involved in the project were socialized to a particular discipline and department. Strober (n.d.) explained:

“For most scholars, the longer one has been in a discipline, the more one’s habits of mind become fixed. Moreover, the longer one has been in a discipline, the more investment one has made in these habits of mind so that seeking new intellectual territory has increasing opportunity costs.” (p. 17)

From this perspective, graduate students have not yet made the intellectual investment in one particular discipline that their faculty members have made. At the same time, students recognized

and were concerned about finding the balance between depth and breadth. Students expressed some hesitation at being pulled in too many directions and wanting to have focus. Amey and Brown (2004) remarked on this point, stating that graduate school may be too early for young scholars to make the cognitive leap to interdisciplinarity primarily due to their inability to critically examine one particular frame of reference until it is deeply understood, much less several. In this way, one might see the inherent conflict between scholars' perceptions on the appropriate timing for interdisciplinary socialization. The students also seemed to experience uncertainty about their interdisciplinary socialization, evident in comments about feeling "sidetracked" by interdisciplinary ideas that may or may not be directly related to their field of study and program goals. Further, they expressed concern about how they would fit not only into their own "home" departments but also into any future careers within academe.

The formal stage of socialization is also a time focused heavily on communication (Weidman et al., 2001). Given the complexities of interdisciplinary communication, wherein individuals must learn not only the language of one particular discipline but several (Thompson, 2009), the students face a daunting task at this stage. In fact, the students discussed language barriers being some of the most prevalent in their interdisciplinary experiences thus far. Due to the time it takes to master multiple languages, methods, and ways of knowing, the students found themselves more deeply entrenched in this socialization process than students in a single-discipline doctoral program.

The third stage of socialization is the informal stage, wherein "the novice learns of the informal role expectations transmitted by interactions with others who are current role incumbents" (Weidman et al., 2001, p. 14), leading to the final stage, or the personal stage, where students fuse the student and professional role and begin to separate from the graduate school setting (Weidman et al., 2001). Viewing the students' experiences through these stages of the socialization process, several concerns are noteworthy. First, the majority of the students expressed a strong desire to find positions outside of academia, if they were able to express any particular professional path whatsoever. At the level of the Ph.D. it is expected that the training and education that occurs will prepare students for a specific professional path (Golde, 1998); indeed, this is ultimately the purpose of the socialization experience in graduate school (Gardner, 2007). Therefore, the students' lack of clear professional goals in light of the degree program may be worrisome. Moreover, the few students who had academic career aspirations were concerned about their prospects in this arena, given their "non-traditional" focus. Perhaps none of these points are surprising when the students themselves did not remark upon any mentors or role models who encapsulated their chosen career paths. Instead, students worked closely only with faculty who were housed firmly in one discipline or another. Second, it was disconcerting to see the students' own admissions of self-direction through the interdisciplinary socialization process. They were quick to point out that their faculty were not as attuned to interdisciplinarity as they were, thereby requiring their own direction through the experience. Faculty are expected to play a pivotal role in successful graduate student socialization (Gardner, 2009a; Gardner, 2010; Weidman et al., 2001). Instead, students more often discussed their reliance on their peers for support, guidance, and direction. This emphasis on peer support could be due to several causes, including the students' age or non-traditional status (Gardner, 2007; 2008), but it could also be due to the faculty members' lack of expertise in interdisciplinary endeavors. Regardless, without faculty guidance in these important stages of socialization some concern exists for these students' future prospects. Moreover, as unsuccessful socialization has been connected to a lack of doctoral completion (Council of Graduate Schools, 2004), this guidance may be deemed even more critical.

## Implications

In light of the students' socialization to interdisciplinarity in this study, we offer several recommendations for practice, policy, and future research. While this study only encompassed the experiences of students at one institution and in one interdisciplinary project, it is our hope that faculty, administrators, and students engaging in similar interdisciplinary endeavors can be equally informed.

Interdisciplinary programs are growing in popularity in U.S. colleges and universities because of the promise they offer in solving the world's complex problems (National Science Foundation, 2009; The National Academies, 2004) but also because of the institutional benefits that they hold, wherein fewer individuals have the potential to provide expertise in multiple areas and program flexibility can be realized (Klein, 2010). As such, it is often difficult to resist the siren's call of interdisciplinarity on campuses today. Nevertheless, previous studies have demonstrated repeatedly that true interdisciplinarity rarely exists and that the organizational and structural barriers are formidable in traditional university settings (Klein, 2010). From the perspective of graduate education, an organizational entity steeped in tradition and disciplinarity (Boden et al., 2011; Council of Graduate Schools, 2005), change can be even more formidable.

The students in this study pointed to several organizational and structural challenges they faced in their own interdisciplinary experience. First, the lack of cohesion and clear expectations were obstacles discussed widely by the students. Each student was admitted into one distinct department – meaning, more often than not, one discipline – for their graduate programs but was required to have an additional advisor from outside this home department. While the interdisciplinary project expected them to attend a readings course offered by the project faculty in their first year, beyond that, no other cohesive coursework was offered. Borrego and colleagues have found similar structures in NSF IGERT programs to be less than optimal in providing cohesion and clarity for students (Boden et al., 2011; Borrego & Cutler, 2009, 2010; Newswander & Borrego, 2009). Given the evolving nature of this initiative, structures for promoting long-term interdisciplinary collaborations were lacking, requiring students to forge new paths in their graduate experience, prompting feelings of uncertainty.

Given the importance of a solid curriculum in the socialization experience (Weidman et al., 2001), faculty and administrators involved in planning interdisciplinary graduate programs should consider developing clear expectations and a cohesive graduate curriculum prior to admitting students. If it is necessary to admit students into distinct departments, guidelines for integrating coursework, advising, and expectations for involvement should be developed. For example, how do students navigate what could potentially be conflicting feedback on dissertation drafts from co-advisors? What are the expectations for student time when they are required to be in attendance at both departmental meetings and events as well as those for the interdisciplinary program? How does the curriculum allow students to gain the depth in a particular area or areas while allowing for flexibility in relation to learning about new disciplines and perspectives? How can departmental guidelines be made more flexible to allow for these experiences and others? These are critical questions that need to be addressed in order to enhance the learning process and reduce student feelings of uncertainty and struggling alone to find balance.

The concept of space is also noteworthy in interdisciplinary socialization at the graduate level. Indeed, space permeates much discussion on interdisciplinarity since it is often the physical buildings and walls of a campus that separate scholars from working together (Klein, 2010; The National Academies, 2004). If students are admitted into different graduate programs but expected to come together with each other and their faculty to collaborate across disciplinary lines, then physical and intellectual space must be created. Is there a shared space for faculty and students involved in this program? How is time carved out for the faculty and students who require it to

learn new disciplinary languages, methodologies, and habits of mind? It was clear that students relied more strongly on one another for some of the support and mentoring that they were experiencing. If programs seek to foster this peer mentoring and support, then structures and time should be created to encourage it in both formal and informal venues. These structures can include shared coursework but also shared office space for students to congregate can be ripe environments for collaboration and connection.

An additional question to consider in the formation of interdisciplinary graduate programs is the professional preparation and mentoring required for successful socialization. The question ultimately is this: To what or for what are students being socialized? If students are being socialized to become academics, where are their role models for such positions? Are there interdisciplinary faculty on campus who mentor them and can speak to the unusual challenges they will encounter? If students are being socialized to positions in NGOs or government, where are their examples of such individuals? Providing panels of these individuals or even requiring external committee members for their research might prove fruitful in this light.

Future research should continue to examine contexts and concepts related to interdisciplinary graduate student socialization. For example, how do students experience the co-advising process or the cohort experience? How do different institutional contexts influence students' socialization – do students fare better in interdisciplinary centers, for example, versus departments? What perspectives do faculty hold and what techniques can they use to conduct successful socialization processes? What are the differences in experiences and perspectives of faculty who have been trained interdisciplinarily versus those trained in specific disciplines? Do particular interdisciplinary combinations (i.e., STEM with humanities, social sciences with STEM, etc.) have more success in this socialization experience? How do individual demographic differences in students play out in these socialization experiences? And, are certain students more apt to gravitate toward these programs and who tends to succeed? Careful consideration of these programs, collaborations, and initiatives will continue to strengthen their success in the future.

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## Appendix

### **First Year Student Protocol**

Can you tell me a little about your academic background? (e.g., degrees, disciplines, areas of expertise/thesis topic, etc.)

From which academic institutions did you receive your degrees and in what years?

What about work experience? (e.g., type of work; positions; responsibilities)

What motivated you to apply for the position?

What are you planning to do when you graduate?

What do you perceive as your role in the project?

What is *research* to you and how does one go about conducting it?

What is your definition of *interdisciplinary* research?

Follow up: Do you think this is what [the project] is doing?

What have been your previous experiences with interdisciplinary research?

What are some of the challenges you see in conducting interdisciplinary research?

How do you see these other disciplines influencing your own work?

As a student coming into [the project], what do you see as some of the challenges you will face?

What do you think will be the most helpful sources of support to you in this experience?

If you were to offer the [project] faculty and administration advice about getting new graduate students started, what advice would you give?

Is there anything I didn't ask you about that you think would be helpful for me to know about your experience thus far as a graduate student [involved in the project]?

### ***Second Year Student Protocol***

In what ways has your involvement in [the project] changed how you think about research?

What are some of the particular challenges you have encountered as an SSI student in the past year?

What have been the greatest sources of support you've had in the past year?

Do you know of people who have left [the project] in the past year? What is your understanding of this? Are you concerned about others leaving?

What are you planning to do when you graduate? What concerns do you have about this?

Is there anything I didn't ask you about that you think would be helpful for me to know about your experience thus far as a graduate student [in the project]?

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