Inquiry Complete: Experiences and Positive Career Outcomes Among Creative Inquiry Participants

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INQUIRY COMPLETE: EXPERIENCES AND POSITIVE CAREER OUTCOMES AMONG CREATIVE INQUIRY PARTICIPANTS

A Dissertation
Presented to
the Graduate School of
Clemson University

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy
Industrial–Organizational Psychology

by
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Accepted by:
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ABSTRACT

Participation in undergraduate research has been shown to improve students’ abilities and increase their interest in pursuing post-graduate education. However, previous research has focused on differentiating between participants and non-participants, not necessarily within-program differences that can affect these outcomes. In Creative Inquiry at Clemson University, student participants can assist with projects in a wide variety of fields and experience team-based learning with close mentor supervision. This dissertation sought to expand the undergraduate research literature by showing how positive development students experienced as part of their time in undergraduate research led to beneficial psychological and career-related outcomes following graduation. The results suggested that the skill development and growth opportunities undergraduate research participants undergo led to improvements in work self-efficacy, graduate school attendance, and career choice satisfaction. This dissertation also showed that within-program differences, such as mentorship, participation length, and project productivity, did not affect the relationships between development and outcomes, suggesting these benefits may be program-wide rather than individually specific. Implications for the Undergraduate Research/Industrial-Organizational Psychology literatures as well suggestions for practice are also discussed.
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INTRODUCTION

Undergraduate research (UR) is a process through which undergraduates are able to participate in research directly with faculty mentoring them through the experience (Hunter, Laursen, & Seymour, 2007). This process has been shown to benefit students through increasing their intentions to pursue post-graduate education (Russell, Hancock, & McCullough, 2007), improving their technical and communication skills (Behar-Hornenstein, Roberts, & Dix, 2010), and familiarizing them with what a career in the sciences is like (Linn, Palmer, Baranger, Gerard, & Stone, 2015). The most common goals of UR are often to encourage student participants to pursue careers in the sciences and to pursue post-graduate education (Wilson et al., 2018). UR programs are generally successful at both of these goals, with participation increasing intentions to pursue both scientific careers and graduate school (Russell, Hancock, & McCullough, 2007). Given the current shortage of science, technology, engineering, and mathematics (STEM) PhDs the United States is currently experiencing, UR has been suggested as a key remedy to boost these flagging numbers and help drive economic growth as a result (Brewer & Smith, 2011). In addition, UR can be beneficial to the humanities by providing an internal funding opportunity for research that many researchers in these fields often lack (Kinkead, 2012).

Evidence suggests participating in UR is beneficial for undergraduates’ career development. Students who choose to participate due to genuine interest and immerse themselves in the “culture” of research (attending conferences, mentoring other students, writing journal papers, etc.) show the best outcomes (Russell, Hancock, & McCullough,
Lopatto (2003) uncovered similar results in a survey of science faculty involved in UR across three universities. The most popular responses to the survey included heavily involving undergraduates throughout the entire research process and both scientific and career-oriented skills. Evidence is clear that UR participation is beneficial (Wilson, et al., 2018) but understanding of exactly why UR works so well has not been studied as extensively (Gentile et al., 2017). The concrete benefits of UR, such as more frequent graduate school pursuit, have strong evidence behind them (Eagan, Hurtado, Chang, Garcia, Herrera, & Garibay, 2013), but less obvious improvements such as non-scientific skill development and the unique opportunities granted by UR participation are in need of further research (Linn, Palmer, Baranger, Gerard, & Stone, 2015). Another key benefit to UR participation is that students become more socialized to their future careers. Socialization includes acclimating to the day-to-day responsibilities and actions one takes on one’s job, (Wanberg & Kammeyer-Mueller, 2000). This socialization can take the form of being better socialized to STEM careers and what it means to be a scientist (Carpi, Ronan, Falconer, & Lents, 2017) as well as being socialized to graduate school—especially PhD programs (Bauer & Bennett, 2003). Finally, UR participation gives students access to opportunities they would not have in a normal undergraduate curriculum: one the of the foremost being exposure to authentic research experiences (Harsh, Maltese, & Tai, 2011). Overall, UR participation has been shown to benefit undergraduate participants, though the approach to doing so has changed over the years.  

A Brief History of Undergraduate Research
The history of undergraduate research (UR) in the United States is one of initial fragmentation but eventually leading to an overarching call to action and finally the establishment of a dedicated promotive organization. Kinkead (2012) considers UR to be German in origin, with American students attending German universities focused on “discovery” in the early 19th century. UR in the early-to-mid 20th century was generally institution-specific with land-grant institutions taking a lead role owing to their initial mission aligning well with UR objectives of serving students first and foremost. This changed when the Council on Undergraduate Research (CUR) was founded in 1978 with the goal of introducing research concepts to the undergraduate curriculum at a broader set of institutions. CUR initially focused on chemistry departments at private liberal arts colleges but grew to become multidisciplinary and inclusive with regard to higher education institutions (CUR, 2020). CUR continued to grow and absorb similar organizations such as the National Conference on Undergraduate Research (NCUR) and now serves as the largest promoter of UR programs in the United States.

At present, no overarching history of UR in the United States has been compiled, with much of the history being specific to institutional programs (Kinkead, 2012), such as Creative Inquiry at Clemson University, to be discussed later. Prior to the report from the Boyer Commission on Educating Undergraduates in the Research University, large research institutions generally did not include undergraduates in faculty research (Kenny et al., 1995). The commission sought to create a new blueprint for optimal undergraduate education in response to growing concern that students were not being properly trained in career-relevant skills despite attending prestigious research universities with vast
resources at their disposal. The primary recommendation from the report was to involve students in faculty research to provide them direct exposure to the research process and one-on-one mentorship with experienced advisors. This inquiry-based approach to education, rather than traditional lectures, was intended to better prepare undergraduates for their post-graduation career and/or graduate school. The response to the Boyer Commission recommendations from research universities was initially fairly slow. Institutional change tends to be inherently difficult (Seo & Creed, 2002), and the sweeping changes suggested require vast resources/investments and a sense of unity often not present in the siloed and complex cultures of large research universities (Katkin, 2003). However, in a survey of research universities 8 years later, 65% of respondents stated their institution supports UR and helped to develop faculty’s UR mentorship skills (Katkin, 2003).

**Mentorship in Undergraduate Research**

One of the key recommendations of the Boyer Commission was for research to involve one-on-one mentoring between faculty and students. The goal of this recommendation is for a supportive relationship to develop between mentor and student and to help form a collaborative research environment (Kenny et al., 1995). Shanahan, Ackley-Holbrook, Hall, Stewart, and Walkington (2015) identified the best practices of UR mentors from reviewing the existing literature. These include recommendations identical to the Boyer Report, such as supporting students as they deal with the additional demands of research participation and building a sense of community between students and mentors. However, other recommendations are novel, such as actively socializing
students through networking and explanation of norms. This socialization is a key benefit of UR participation and has been shown to ease transition into careers in the sciences (Hunter, Laursen, & Seymour, 2007). Shanahan et al. also recommend that mentors encourage students to present their findings and properly guide them in how to do so both in presentations and in writing. This can help develop students’ communication skills, which is beneficial both in scientific and non-scientific careers (Payne, 2005).

The benefits of mentorship for UR participants are many. Mentorship helps students develop their skills, socialize to the research community, and navigate the graduate school process (Gafney, 2005). The skill development students undergo is one of the key benefits to UR, as mentors help them learn both science-specific skills such as data analysis and literature review, as well as more general skills such as oral and written communication (Lopatto, 2003). Socialization to the culture of being a scientist can be equally important as mentors help students learn the norms and expectations for research, such as project ownership, proper communication of findings, and building relationships with peers and other mentors (Hunter, Laursen, & Seymour, 2006). Finally, mentors help students with both determining their career path and, once that has been decided, helping them achieve the goals they set for themselves (Seymour, 1997). Through these benefits, mentorship in UR helps provide students with opportunities they would not have in a normal undergraduate curriculum and helps them develop into both better scientists and to be better prepared for the workforce in general.

Unfortunately, one-on-one mentorship is not always a priority for faculty. The Boyer Report itself laments how much of mentorship and teaching is delegated to
graduate students and post-docs, leaving undergraduates with little time to interact with faculty directly (Kenny et al., 1995). The largest cause of this is due to ever-growing class sizes and fewer resources to devote to students. Many universities are looking to address these issues with adjunct professors rather than hiring additional tenure-track faculty (Katkin, 2003). Because of this, many faculty simply do not have the time to directly mentor undergraduate researchers. Another glaring issue is one of motivation. Kerr (1975, p. 1) puts it best: “Numerous examples exist of reward systems that are fouled up in that behavior which are rewarded are those which the rewarder is trying to discourage, while the behavior he desires is not being rewarded at all.” This problem of which behaviors are being rewarded applies to UR in that faculty are often not directly rewarded or can even be penalized for participating. Faculty are often judged based on their classroom teaching and their publication record from their research, neither of which incentivizes taking the time to develop individual students (O’Meara & Braskamp, 2005). UR in particular can be seen as a diversion away from career-critical activities, with faculty concerned over their time and whether undergraduates are ready for research participation (Ubbes, 2018). This concern can be two-directional: undergraduates may not be ready for the growth that comes with UR participation and/or may not have sufficient skills to actively assist with the mentor’s research.

Addressing concerns that mentors may have can be difficult, but the foremost approach is to directly incentivize participation. Clemson’s Creative Inquiry program incentivizes mentorship by directly funding projects so mentors will not have to expend any of their own financial resources mentoring undergraduates (Speziale, 2013). To
address the time issue, institutions should build UR mentoring into the faculty workload directly and make participation the standard rather than the exception (Morrison, Berner, Manske, Jones, Davis, & Garner, 2018). UR programs should also encourage faculty to meld the work they do with undergraduates into their main research program to minimize extra work. Creative Inquiry directly encourages this and also seeks to keep track of the presentations and publications faculty produce from their work undergraduates participate in (Speziale, 2013). By tracking these accomplishments, Creative Inquiry is able to show that mentoring undergraduates can be advantageous to participating faculty in addition to the students.

**Undergraduate Research in Clemson’s Creative Inquiry**

Creative Inquiry (CI) is the flagship undergraduate research program at Clemson University. The program is project-based, with faculty mentoring students in investigating topics that can be specific to their field or multidisciplinary. Creative Inquiry exhibits broad participation from across the university. One of the key differentiators of Creative Inquiry compared to programs at other institutions is this plurality of support, whereas many other programs tend to be STEM-specific (Wilson et al., 2018). Projects may produce a variety of outcomes once they conclude (or as they continue indefinitely). Some are purely scientific and focus on journal publications and conference presentations. Others are humanitarian in nature and could take the form of developing an ongoing water system in Haiti, for example (Speziale, 2013). Rather than simply preparing students for careers in the sciences, Creative Inquiry seeks to develop students’ universally career-relevant skills such as communication and prepare them for
the workforce (Epstein, 2007). This push for development includes the annual Focus on Creative Inquiry (FoCI) poster session where students become familiar with presenting their work to audiences. Following participation in Creative Inquiry, the majority of students report that they feel they have developed their skills as a result (Speziale, 2013).

Creative Inquiry projects follow a team-based learning approach consisting of research teams of undergraduates supervised by one or more mentors. These projects follow the essential elements for team-based learning put forward by Michaelsen and Sweet (2008). The teams have clear groupings as students must enroll in a CI course to participate in a project, so team sizes are clearly established. Students are held accountable for their work predominantly by their project mentor as the CI courses are graded. The close mentoring of students encourages frequent feedback, so students are able to quickly improve their skills. Finally, project functions encourage both learning and team development in that students form closer ties with each other as they work on the project. Overall, these guidelines for team-based learning keep CI project functioning efficiently and help ensure participating students learn appropriately.

Internal examinations of student data have created a profile of what the average Creative Inquiry student at Clemson looks like. Creative Inquiry enrolls students from all seven colleges at Clemson University. The majority of students participating are upperclassmen with most being in their senior year. For example, in the 2018-2019 school year, 55% of student enrollments came from seniors alone. Almost all participating students report they joined to add the experience to their resume, with many also agreeing that they joined for mentorship opportunities with faculty and to see if
graduate school would be something they would be interested in pursuing. For most
students, Creative Inquiry was the only research experience that had while at Clemson
University. Overwhelmingly, students reported they believed that having a research
experience while at Clemson was an important goal for them and that providing mentored
research opportunities should be a major goal for Clemson University. Overall, almost all
students reported being satisfied with their Creative Inquiry experience and the majority
of students returned to the program for at least one additional semester.

Mentors for Creative Inquiry projects also come from across all colleges and
backgrounds. Most are faculty (70% of mentors in 2018-2019), though lecturers, graduate
students, post-doctoral researchers, and university staff may also mentor projects. CI
projects often have multiple mentors, with most projects having tenure-track faculty as
the primary mentor. Creative Inquiry encourages interdisciplinary projects and these
projects often consist of mentors from multiple colleges and differing fields. For
example, a project investigating the engineering applications for the butterfly proboscis
consists of mentors from both engineering and biology backgrounds. Creative Inquiry
suggests faculty mentors structure their projects around their career goals and personal
research interests, using undergraduates as research assistants so they may pursue grants
and publications. This is to encourage active mentor participation so that mentoring CI
projects is beneficial to mentors and not simply additional work. Faculty tend to report
that mentoring Creative Inquiry projects can be challenging to juggle with their
classroom teaching and research responsibilities, but that the work is ultimately
rewarding both personally and professionally.
Summary and Contributions

The literature is already clear that UR participation benefits students through improving their self-efficacy, their ability to carry out scientific tasks, and their intentions to pursue post-graduate education (Carpi, Ronan, Falconer, & Lents, 2017; Gilmore, Vueyra, Timmerman, Feldon, & Maher, 2015; Russell, Hancock, & McCullough, 2007), but existing literature evidence on exactly what leads to these improvements is fairly light and this dissertation seeks to clarify these causes by framing UR development as a combination of skill development and taking advantage of growth opportunities. Another literature gap this dissertation fills is whether there are within-program but between-project differences that affect the process of how UR experiences lead to positive outcomes. One advantage of the sample I used for this dissertation is the diversity in projects that undergraduates assist with. By using this sample and by including potential moderators in the model, I examined potential project-specific attributes that affect the proposed relationships, specifically focusing on two between-project variables. The first was project productivity, which is the number of publications, presentations, grants, and awards associated with each project. The second was satisfaction with mentor, which is intended as an estimation of how involved the mentor is with their project. Considering these variables helps to inform the literature by highlighting areas UR programs may wish to focus on to maximize positive outcomes for their student participants.

Finally, this dissertation introduces a new concept to the UR literature by measuring career choice satisfaction as an outcome of interest. Undergraduate research traditionally focuses on skill improvements and graduate school, not as frequently on UR
a career-interest refinement process (Bauer & Bennett, 2003). Previous research has shown UR participation does increase interest in pursuing a career in the sciences (Lopatto, 2007), but not satisfaction with that career following graduation. By considering career choice satisfaction as an outcome of interest, this dissertation illuminates an additional positive effect of UR participation that has not yet been studied and shows the mechanism through which it occurs.

Overall, the aim of this dissertation was to show the benefits undergraduates gain from actively participating in Clemson’s Creative Inquiry, as well as how differences between student experiences can affect these relationships. Specifically, I predicted that the skill development undergraduates undergo and the opportunities afforded by Creative Inquiry will lead to higher graduate school attendance, higher work self-efficacy, and improved career satisfaction with their career choice following graduation. The results of this dissertation show that the positive benefits of UR participation last beyond graduation and can have effects regardless of career path. In addition, by shedding light on exactly how these benefits occur, this dissertation helps inform UR practitioners on how best to structure their program to maximize positive outcomes for their students.
HYPOTHESES

Model Summary

A visualization of the full model including hypotheses can be seen in Figure 1. Overall, the model ties responses students completed during their time in Clemson’s Creative Inquiry to outcomes collected in a survey distributed to these same students following their graduation from Clemson University and includes also moderators from the time respondents were participating in Creative Inquiry. The model takes a causal perspective that the predictors from the student survey ultimately lead to positive outcomes following graduation. For the two predictors, I used two variables from the student survey: skill development and growth opportunities. Skill development consists of items measuring “soft” skills that are related to career success (Majid, Liming, Tong, & Raihana, 2012) including time management, teamwork, leadership, and communication skills. Growth opportunities is a new construct proposed by this dissertation and consists of items measuring whether or not students took advantage of unique opportunities provided to them as part of their participation in Creative Inquiry. Examples include determining post-graduation plans, networking with faculty and professionals, and learning career-relevant information beyond the classroom setting.

In the alumni survey, I measured three variables: graduate school attendance, work self-efficacy, and career choice satisfaction. Graduate school attendance is straightforward: were students accepted into a post-graduate degree program following graduation? This is one of the key goals of UR participation (Wilson et al., 2018) and one of the key contributions of this dissertation was to show the process for how this occurs.
through skill development and growth opportunities. Work self-efficacy is how confident CI alumni feel in their ability to complete tasks at work. I hypothesized that work self-efficacy would be improved by the foundational skill development students undergo during their time participating in Creative Inquiry. Finally, career choice satisfaction is the degree to which alumni are satisfied with the career path they have chosen. I hypothesized that this would be improved through the growth opportunities students take advantage of through participation in Creative Inquiry. These opportunities should help guide them in their career decision process and lead to higher satisfaction with their choice later on. Overall, the relationships between these variables provide insight into exactly how UR leads to positive outcomes for participating students.

In addition, I predicted three variables would moderate the relationships between skill development and growth opportunities and the alumni outcomes. The first is participation length, which was measured by the number of semesters each student participated in a CI project. Spending more time on a project enables students to develop their skills further than they would if they were to stay a single semester. In many cases, it takes over a year for students to have developed enough in the project to be sufficiently productive (Linn, Palmer, Baranger, Gerard, & Stone, 2015). Because of this, I predicted participation length would moderate the relationship between skill development and work self-efficacy. In addition, students who stay on the project longer should have access to more growth opportunities, both by virtue of having more time and by being able to forge closer relationships with mentors and students. This helps develop their values and perceptions of their career path (Mavrenac, 2005) and subsequently helps them choose
their career following graduation (Newton, Grayson, & Whitley, 1998). As a result, I predicted that participation length would moderate the relationship between growth opportunities and career choice satisfaction following graduation.

The second moderating variable I tested was project productivity. Creative Inquiry requests all project mentors to report on anything they produce as part of the CI project, called “accomplishments.” These accomplishments can take the form of journal publications, conference presentations, or even something as simple as a photo of the students working. For the purposes of this dissertation, I only included conference presentations, journal publications, student and mentor awards, and grants. I predicted that the productivity of students’ projects, as defined by having a higher cumulative number of accomplishments, would moderate the effects of their skill development and growth opportunities on whether or not they attend graduate school. I theorized this is the case because higher accomplishments help enhance applicant resumes, making it more likely they will be accepted into graduate school (Cole, Rubin, Field, & Giles, 2007), as well as increasing students’ intentions to pursue graduate school via their self-efficacy with regard to whether or not they would be successful graduate students (Carpi, Ronan, Falconer, & Lents, 2017).

The final moderating variable I tested was satisfaction with mentor. This is an overarching question asked to Creative Inquiry participants of how satisfied they are with their level of involvement with the mentor of their CI project. Research has shown the best mentors are hands-on and provide one-on-one development time for students (Shanahan et al., 2015) and students with involved mentors tend to show the best
outcomes from their UR participation (Behar-Horenstein, Roberts, & Dix, 2010). Because of this, students who were closely mentored and satisfied with the experience should have the effects of their development enhanced on their post-graduation outcomes. Closely mentored students tend to show better soft skill development (Chopin, Danish, Seers, & Hook, 2013), which should lead to greater self-efficacy once they enter the workforce. Effective mentors should also be assisting students with their professional development and networking (Shanahan et al., 2015), which should help students feel confident in their choice in career following graduation. Finally, students with hands-on mentors should have both their skill development and growth opportunities’ effects on their graduate school enhanced. These effects can take the form of directly assisting them in the application process through providing them with resume-worthy opportunities as well as potentially writing them effective letters of recommendation (Keith-Spiegel & Wiederman, 2000; Shanahan, 2015), which highlight the skill development and growth opportunities the students have experienced. These effects may also be indirect as effective mentors encourage their students who may not have otherwise considered graduate school to do so as they build their skills and take advantage of opportunities. This mentoring can help both help students decide if graduate school is the right path for them while building their confidence in their ability to be accepted should they choose to apply. Overall, the effect a Creative Inquiry mentor has can be profound and the proposed model reflects this by considering its moderation effects on all proposed relationships between student skill development and growth opportunities and alumni outcomes.
To summarize, I predicted that the skill development Creative Inquiry participants undergo would lead to improved work self-efficacy as alumni, the growth opportunities they experience would lead to increased career choice satisfaction, and both student variables would lead to increased graduate school attendance. In addition, I predicted these relationships would be moderated by the students’ participation length, their project’s productivity, and their satisfaction with their CI mentor. Taken altogether, this model sheds light on exactly how participation in undergraduate research leads to positive outcomes and which factors in the UR experience are most crucial for these outcomes.

**Skill Development**

Undergraduates should develop their skills during their time participating in UR. Several studies focus on the skills specific to students’ disciplines as their outcome of interest (Whittinghall, Slovacek, Flenoury, & Miu, 2019) or skills specific to scientific pursuits in general (Hunter, Laursen, & Seymour, 2006). These skills tend to focus on direct application to graduate school activities and evidence suggests that development of these skills directly leads to improved performance as undergraduates transition into first-year graduate students (Hunter, Laursen, & Seymour, 2006). Less studied but equally important are so-called “soft” skills, which are not directly career relevant but critical for career success (Schulz, 2009). These can include skills like teamwork, ethical behavior, leadership ability, and communication (Robles, 2012). These skills are often harder to intentionally improve but may be more important than career-specific skills in determining career success (Wats & Wats, 2009). UR participation can help develop
these skills indirectly through mentorship and working together as part of a research team (Kumar & Hsiao, 2007). Creative Inquiry measures both the development of scientific skills as well as soft skills in their semesterly student surveys, though I focused on career-relevant skills for the purposes of this dissertation. For the purposes of this dissertation, I aggregated these various soft skills into a single construct titled skill development. Skill development should lead to improved work self-efficacy following graduation directly since research has shown improving these skills leads to improved self-efficacy (Direito, Pereira, & Duarte, 2012). However, previous research has looked at this relationship cross-sectionally and this dissertation will use multiple time points to strengthen the causal inferences concerning the relationship between the two. Similarly, because of this increased self-confidence, students should both intend to pursue graduate school and be accepted at higher rates (Carpi, Ronan, Falconer, & Lents, 2017).

**Growth Opportunities**

The growth opportunities undergraduates get to experience as they participate in UR are sometimes overlooked but may be crucial to students’ development. Previous research within Creative Inquiry suggests that the self-reported growth opportunities that students experience can be one of the most closely tied variables to the publication/presentation productivity of the CI project (Allard-Keese, Morgan, & Speziale, 2019). These opportunities include determining post-graduation plans, networking opportunities, participation in the research process, and providing opportunities to apply classroom knowledge. These facets have been separately considered as important considerations within UR (Bangera & Brownell, 2014) but have
not yet been considered holistically as a single construct in the UR literature. I name this construct “growth opportunities” as an amalgamation of the various opportunities UR participants get to experience that they would not otherwise gain in a normal undergraduate curriculum. An exploratory factor analysis of the various opportunities measured by the Creative Inquiry student survey supported the idea that these various opportunities do have a single underlying factor and that aggregating the growth opportunities into a single construct proved sufficiently reliable as measured by Cronbach’s alpha (Allard-Keese, Morgan, & Speziale, 2019).

Growth opportunities have been previously been considered from a purely scientific perspective, such as how UR participation helps students develop their own identity as scientists, but not necessarily how they grow in terms of overall experiences (Hunter, Laursen, & Seymour, 2006). This non-skill-related development will likely have the largest effect on graduate school attendance, as intention to attend graduate school is the best predictor of actual attendance (Eagan et al., 2013) and these intentions are a component of growth opportunities. Previous research has shown that students’ experiences while participating in UR help them clarify their career path (Lopatto, 2007) and this exposure to concepts they find engaging and worth pursuing should lead to enhanced satisfaction with their career choice following graduation due to their better understanding of their intended field (Kressel, 1990).

**Graduate School Attendance**

A key consistency across UR programs is that participation increases undergraduates’ interest in continuing on to graduate school as well as their success in
doing so (Hathaway, Nagda, & Gregerman, 2002; Russell, Hancock, & McCullough, 2007; Wilson, et al., 2018). This is due to the skill development offered by UR participation, as well as the ability to highlight the experience during the application process (Schmitz & Havholm, 2015). The Creative Inquiry student survey findings support the idea that students are considering the latter, as almost all CI participants agree that they joined in order to note the experience on their resume. In addition, students who participate in UR gain access to direct mentoring from faculty. This direct mentoring both helps them improve their skills (Shanahan et al., 2015) and leads to better letters of reference if they choose to pursue graduate school. The reference letters in particular are a concrete method through which UR participation leads to higher graduate school attendance through boosting acceptance probability (Landrum & Nelsen, 2002). Reference letters from faculty that students worked closely with are key considerations in the application process (Keith-Spreigel & Wiederman, 2000) and strong letters have been shown to relate to better academic performance (Kuncel, Kochevar, & Ones, 2014), so students who participate in UR and successfully build relationships with their faculty mentors should be more successful in their pursuit of graduate studies than non-participants.

UR participants may choose to pursue post-graduate studies for multiple reasons. Gates, Teller, Bernat, and Delgado (1998) found that students most often recognize that attending graduate school would give them the freedom to pursue their own interests and expand their knowledge of their field while improving their job security and marketability. Students may also choose to pursue graduate school for financial reasons:
according to the U.S. Bureau of Labor Statistics, individuals with master’s degrees earn over $10,000 more per year than those with only bachelor’s degrees and those with PhDs or professional degrees earn even more (Torpey, 2018). Ultimately, intentions to pursue graduate school depend on the degree to which undergraduates would value the experience and how career-oriented they are (Battle & Wigfield, 2003) and UR participation can help students make these determinations for themselves (Eagan et al., 2013).

A more theoretical way to look at students’ intentions to pursue graduate studies is through expectancy theory. In this theory, intentions can be broken down into expectancy, instrumentality, and valence (Vroom, 1964). Expectancy is the belief that effort will improve performance, instrumentality is the belief that good performance will lead to desired outcomes, and valence is the level of desirability of the outcome in question (Yourcoach, 2020). Expectancy theory can help explain student motivation and has been applied to concepts like goal setting, training, and turnover (Van Eerde & Thierry, 1996). When applied to UR and graduate school pursuit, the most important considerations are instrumentality and valence: will students’ performance lead to better chances of being accepted into a graduate program and do they want to attend graduate school? Participating in UR helps solidify both of these motivational questions, firstly by providing close mentorship that helps students build their self-efficacy and become more confident in pursuing graduate school as a result (Sams et al., 2015) and secondly by exposing students to concepts and research activities they would not normally experience in an undergraduate curriculum, helping them refine their career interests and goals and
thereby increasing their intention to pursue graduate studies (Lopatto, 2007). By improving students’ self-confidence and helping them learn whether post-graduate education is right for them, UR participants are more likely to desire to pursue graduate school as a result (Russell, Hancock and McCullough, 2007).

Graduate school admission comparisons are often between students who participated in UR and students who did not, not necessarily between students within a UR program. One of the key contributions of this dissertation is it will allow me to see how students who made good use of the opportunities and developed their skills compare to students who may have not actively participated to the same extent. This within-program comparison should illuminate some of the underlying mechanisms for how students go on to post-graduation success, namely their skill development and growth opportunities.

The skill development undergraduates undergo through UR participation should help them in their pursuit of graduate studies. The research skills they learn are most obviously applicable to the activities they perform while enrolled in graduate school and UR participants do tend to perform better as graduate students as a result (Gilmore, Vieyra, Timmerman, Feldon, & Maher, 2015). However, the soft skills they develop should help them gain acceptance into graduate school as well. These skills can be directly applicable if the application process requires an interview, as soft skills are closely tied to interview performance (Moss & Tilly, 1996). In fact, job interview training and soft skills training often significantly overlap, as both include recognition of social and communication skills (Hollandsworth Jr, Glazeski, & Dressel, 1978). This effect can
also be indirect, as skill development increases students’ self-confidence, which in turn increases their intention to pursue graduate studies (Carpi, Ronan, Falconer, Lents, 2017; Schunk & Gunn, 1986). Given that intention to pursue graduate school is the best predictor of acceptance (Russell, Hancock, & McCullough, 2007), students who self-report as having better developed their soft skills should attend graduate school at higher rates.

**H1: UR participants’ skill development will increase the likelihood of attending a post-graduate education program.**

In addition to skill development, the growth opportunities students experience through their participation in CI should increase their chances of pursuing post-graduate education. The most obvious facet of growth opportunities is helping to determine post-graduation plans and intention to pursue graduate school is the best predictor of eventually doing so (Eagan et al., 2013). Other facets of growth opportunities are less obvious but should be equally important. Wilson et al. (2018) concluded that opportunities such as access to diverse resources and support from fellow undergraduate researchers can be key benefits to participation in a UR program. These aspects are considered within the scale measuring growth opportunities through items discussing building relationships with other students and opportunities not gained through the regular undergraduate curriculum. These successes help develop students and socialize them to what the graduate school experience is like, increasing their intentions to pursue it through improving their beliefs they will both be accepted and ultimately succeed as a graduate student (Borrego, Knight, Gibbs Jr, & Crede, 2018).
H2: UR participants’ growth opportunities will increase the likelihood of attending a post-graduate education program.

Work Self-Efficacy

One UR mentor notes he mentors students because, “I want them to be capable and to believe that they are capable,” and to consider themselves “empowered agents” (Childress, 2015). This aligns well with Bandura’s (1986, p. 1) concept of self-efficacy, which he describes as “people’s judgments of their capabilities to organize and execute courses of action required to attain designated types of performances.” Essentially, one foundational goal for UR participation should be that students become more empowered and have a higher belief in their abilities. One program found that participation in UR increased undergraduates’ self-efficacy in their abilities to serve as research scientists and these gains served as a powerful “equalizer” for minority students who may otherwise not had the opportunity to develop their skills if not for UR participation (Carpi, Ronan, Falconer, & Lents, 2017). Some researchers have classified these self-efficacy gains as students “becoming scientists” as they gain more confidence in their own abilities (Hunter, Laursen, & Seymour, 2006). Regardless, improvements in undergraduates’ self-efficacy appear to be an important UR outcome; participation leads to both skill increases and a belief in one’s ability to apply them successfully.

Self-efficacy can be generalized or pared down to specific areas such as scientific skills and will be considered work-specific for the purposes of this dissertation. Spreitzer (1999) conceptualizes self-efficacy as a competence component of psychological empowerment in the workplace. Self-efficacy in the workplace is associated with other
positive outcomes, such as job satisfaction, organizational commitment, task performance, and leader-member exchange (Schyns & von Collani, 2002). Under this definition, workers’ self-efficacy helps them feel capable and skillful within their work context. Self-efficacy is closely tied to a worker’s self-appraisal of their job performance, though the self-appraisal and reality can differ (Sherf & Morrison, 2020). Bandura (1997) conceptualizes self-efficacy as having four sources: past performance, vicarious experience, verbal persuasion, and emotional cues. While all four could potentially be applicable to the UR participation experience, past performance is likely the most applicable. Past performance is the most important determinant of self-efficacy (Bandura, 1997) and can be defined as feeling more confident at performing specific tasks having successfully completed them previously (Lunenburg, 2011). Based on this definition, Creative Inquiry participants should feel more generally self-efficacious in the workplace because they should have developed and successfully demonstrated their more universally applicable soft skills during their time with Creative Inquiry. This development should carry forward into students’ future careers.

Research has already shown that the skill development associated with UR participation leads to improved self-efficacy (Sams et al., 2015), but gaps still remain. The first is that previous research has focused on student development directly following participation rather than post-graduation once former participants are deeper in their careers. By sampling from alumni, I can show the effects of CI participation last into participants’ college careers. The second is moving beyond science-specific skills measuring scientific self-efficacy, such as data analysis and properly writing results, and
showing how more general career-relevant skills such as soft skills improve career-specific self-efficacy. Creative Inquiry prides itself on improving these types of skills (Speziale, 2013) and these skills have been shown to relate to self-efficacy (Barron & Morin, 2010).

\[ H3: \text{UR participants’ skill development will lead to increased work self-efficacy}. \]

**Career Choice Satisfaction**

Career satisfaction is a more generalized form of job satisfaction and is less role-specific than job satisfaction. Specifically, job satisfaction can be conceptualized as an individual’s satisfaction with aspects of their current job whereas career satisfaction involves satisfaction with rate of career progress and overall work experiences (Erdogan, Kraimer, & Liden, 2004). Career satisfaction has been closely tied to other positive work variables, such as perceived organizational support (Armstrong-Stassen & Ursel, 2009), reduced turnover intentions (Joo & Park, 2009), and Leader-Member Exchange (Erdogan, Kraimer, & Liden, 2004). In addition, students who participate in UR have been shown to have higher career satisfaction versus students who did not participate (Yaffe, Bender, & Sechrest, 2014). However, career satisfaction includes several facets including pay and opportunities for advancement. For the purposes of this dissertation, I focused on one specific aspect that has not been as extensively studied: career choice satisfaction.

Career choice satisfaction is an individual’s satisfaction with the career path they have chosen for themselves (Eren, 2012). One way to look at career choice satisfaction is through the expectancy-value framework. In this motivational framework, choice is
determined by both the likelihood of success and the value attributed to the outcome (Crandall, 1969). Previous research has used this framework to attribute teachers’ career choice satisfaction to their task demands, self-perceptions, and how valuable they consider teachers to be, both personally and at a societal level (Watt & Richardson, 2007). From a UR perspective, participation can improve career choice satisfaction, as it can help develop students into believing they can succeed in their intended career path. In this perspective, UR participation can help students refine their career aspirations and ultimately be more satisfied as a result. This career choice satisfaction has been shown to lead to positive outcomes such as improved quality of life and psychological well-being (Eun, Sohn, & Lee, 2012).

Another way to look at career choice satisfaction is through career decision theory (Peterson, Sampson, Lenz, & Reardon, 2002). This theory consists of three questions that determine your attitudes towards your work environment, whether or not your interests and job match, whether or not you have sufficient self-efficacy regarding the job tasks, and do you believe in the mission, rules, and vision of the organization? (Perdue, Reardon, & Peterson, 2007; Reardon, Lenz, Sampson, & Peterson, 2000). The effects of UR participation on career choice are most profound on the first two questions, as UR can serve as a preview of scientific tasks and responsibilities to determine interest and helps students build their self-efficacy in conducting these tasks (Carpi, Ronan, Falconer, & Lents, 2017; Hathaway, Nagda, & Gregerman, 2002). As a result, students should exhibit higher satisfaction with their choice in career following graduation since they have both previewed the tasks to ensure they are enjoyable and built up their self-efficacy.
in their ability to perform job tasks (Betz & Hackett, 1986). In addition, previous research has shown there is significant overlap between students who report their UR experience was critical to their career choice and their overall career satisfaction down the road (Yaffe, Bender, & Sechrest, 2017).

The growth opportunities students experience, in particular, should lead to improved career choice satisfaction following graduation. The evidence already suggests participation refines career goals and higher degree aspirations (Russell, Hancock, & McCullough, 2007) both directly following participation and once students become alumni (Bauer & Bennett, 2003), but satisfaction with these choices has not yet been studied in a UR context. Because students gain exposure to concepts and opportunities they would not have otherwise had in a regular undergraduate curriculum, students who engage in these growth opportunities will further clarify their career goals and identify steps on how to achieve them, ultimately leading to improved satisfaction with their choice due to this additional time spent confirming whether or not they are on the right path (Gafney, 2005; Ishiyama, 2007; Yaffe, Bender, & Sechrest, 2014). I hypothesized that, ultimately, students who experience more growth opportunities as a student will exhibit higher career choice satisfaction as an alumni because of the additional career interest-refining experiences they undergo.

**H4: UR participants’ growth opportunities will lead to increased career choice satisfaction.**

**Moderating Variables**
One of the key tenets of Clemson’s Creative Inquiry program is that any undergraduate can participate. Unlike programs at some other universities where UR is STEM or department-specific, any student/faculty from any college can start a CI team and conduct research. Because of this diversity, students in different projects may have markedly different experiences from each other. For example one student may participate with a project for a single semester, meet with their mentor only once a month, and not participate in any career-relevant tasks while another student participates for two years straight, gets direct mentoring from a faculty member, and presents a poster on their work at a national conference. This dissertation considers these between-student differences by including them as moderators of the hypothesized student-alumni relationships within the model. The first moderating variable is participation length, as measured by the number of semesters a student enrolled in a CI project. The second is project productivity, measured by the number of cumulative accomplishments a project has reported. The last is satisfaction with mentor, measured by a question in the student survey. Together, including these moderators will help clarify which aspects of the UR experience may be most important and crucial for post-graduation success and well-being.

In addition, the proposed moderators may have direct effects on the predictors beyond the moderation effects on the proposed relationships. For example, students’ satisfaction with their mentors may directly impact their likelihood of attending graduate program due to their increased socialization to the sciences and the direct guidance on their decision-making process (Eagan et al., 2013). Any of the proposed moderators may have direct effects on the outcome variables and these direct effects will be assessed as
part of the hypothesis testing on moderation, as discussed in the analysis plan section. These potential direct effects are not included as hypotheses but are posed together as a research question in this dissertation.

Research Question 1: Will participation length, project productivity, or satisfaction with mentor exhibit direct effects on any of the outcome variables?

Participation Length

One factor that may influence the effect Creative Inquiry participation has on a student is their length of participation on the CI team. Creative Inquiry does not cap the number of semesters a student may be active on a CI project: it could range from a single semester up to eight or even ten if a student stays for their entire college career. Most participants tend to stay on the same project for two or three semesters as they often join CI teams in their junior or senior year when their classes become more major-specific. Research suggests that short periods of participation may not be enough to truly gain anything from UR participation and that it may take over a year for students to learn enough background knowledge and develop their skills enough to be sufficiently productive within their lab (Gates, Teller, Bernat, & Delgado, 1998; Linn, Palmer, Baranger, Gerard, & Stone, 2015). Because of this, it is possible that the number of semesters a student stayed involved with their CI project may affect the effect of the skill and opportunity predictors on the career outcomes.

Previous research already suggests that UR participation length is positively related to student performance. Fechheimer, Webber, and Kleiber (2011) found that students with higher UR participation length exhibited higher grade point averages and
Gilmore et al. (2015) found that UR participation length predicted first-year performance for students who went on to graduate studies. In addition, Zydney, Bennett, Shahid, and Bauer (2002) found that students who participate in UR for only one semester reported significantly lower benefits from their participation than students who participated for longer with the highest ratings coming from students who participated for four or more semesters.

According to Bandura’s (1997) conceptualization, one of the key determinants of self-efficacy is past performance. If students are able to successfully learn and apply their skills in the UR context, they should be able to carry it forward into their careers and have more self-efficacy in their ability to do so. However, there is high variability in participation length with regard to Creative Inquiry and because of this, some students may only participate for a single semester while others stay on the same CI project for multiple years of their undergraduate career. Previous research has shown that length of time spent developing skills can lead to improved self-efficacy following this development (Penrose, Perry, & Ball, 2007). I predicted that because students who participate for longer will have more time to develop their skills, they will ultimately be more self-efficacious following graduation.

*H5: Longer participation length will strengthen the positive relationship between skill development and work self-efficacy.*

Similarly, the additional time for students with higher participation length should allow them to take advantage of more opportunities that allow them to grow. One of the key takeaways students hope to achieve from their UR participation is to refine their
career interests and decide on a career path (Gafney, 2005) and the longer they spend participating in UR, the more time they should have to make their decision. This additional time should be spent engaging in growth opportunities such as having more time to network with peers and faculty and to learn more career-relevant information. Research already supports that students who have higher participation length report higher perceived benefit from their UR experience (Bauer & Bennett, 2003). I predicted that students who participate in Creative Inquiry longer will ultimately have higher career choice satisfaction since they had more time to take advantage of the unique opportunities and refine their career interests and goals.

\[ H6: \text{Longer participation length will strengthen the positive relationship between growth opportunities and career choice satisfaction.} \]

**Project Productivity**

A unique project attribute that has been relatively understudied (Morales, Grineski, & Collins, 2017) is project accomplishments. Creative Inquiry considers accomplishments to be anything the project produces as a result of undergraduate participation. The majority of reported accomplishments are presentations and posters at professional conferences, though accomplishments also include publications in peer-reviewed journals, grants, and awards won by either students or mentors. Creative Inquiry encourages students to be directly involved in accomplishments, such as having them present their results at conferences directly but does not require it. If a faculty mentor were to publish their results from a CI project without any students assisting with the manuscript, this would still count as an accomplishment since it is directly tied to the

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project. To date, over 7,000 accomplishments have been reported from Clemson CI projects since 2005. These high-accomplishing projects should ultimately produce better student outcomes than unproductive ones, especially with regard to graduate school attendance, as students who directly engage in graduate school activities such as presenting their work at conferences or applying for grants are more likely to be accepted (Wilson et al., 2018).

Morales, Grineski, and Collins (2017) investigated what best predicts whether or not faculty mentors publish results collaboratively with their undergraduate research team members. These collaborative publications help to advance the faculty mentor’s research while helping undergraduates to better develop their skills (Bozeman & Corley, 2004). Morales et al. found that mentors who were more experienced, had more resources available, exhibited higher research productivity in general, and who genuinely enjoyed mentoring undergraduates were most likely to publish with them. UR programs can best encourage these collaborative publications by ensuring students are paired with these kinds of mentors and ensuring mentors have the resources they need for their UR team. Harvey and Thompson (2009) look at what determines project productivity beyond only collaborative publications. They recommended that faculty mentors tie their UR project to their own personal research, seriously include students beyond giving them busywork, and to ensure faculty stay engaged with peers in their field to continue generating viable research ideas. Taken together, the literature suggests that project productivity depends more on the mentors than UR participants, but even participating in a productive project
without actually presenting or publishing themselves can help students gain valuable experience and further develop their skills (Harvey & Thompson, 2009).

Including students directly in the productivity of the project should help them develop their soft skills via working together with mentors and peers to produce a publication or presentation and helping them build their communication skills through explaining scientific findings (Freudenberg, Brimble, Vyvyan, & Corby, 2008). This additional skill development experienced by students on more productive Creative Inquiry projects should in turn increase their chances of pursuing graduate school by improving their self-efficacy in their ability to both be accepted and perform well as a graduate student (Carpi, Ronan, Falconer, & Lents, 2017). The effects of high project productivity may also be direct, as students who directly contribute to the productivity of their project will be able to highlight the experience during their graduate school application process. Project productivity may also be a sign of close mentor supervision, as it can be tied to mentors who are motivated to actively mentor undergraduates and will more closely help develop their skills and help them pursue graduate school (Morales, Grineski, & Collins, 2017). Overall, I predicted that students on productive projects will further develop their skills and gain more concrete evidence of the development they have undergone, making it more likely they will pursue and be accepted into graduate school.

*H7: Higher project productivity will strengthen the positive relationship between skill development and graduate school attendance.*
The hypothesized effect of project productivity on growth opportunities and graduate school attendance comes directly from previous research with Creative Inquiry. My colleagues and I sought to predict which projects would be most productive using project demographics as well as variables from the student survey and ultimately the average of overall growth opportunities for students on the project was the only significant predictor (Allard-Keese, Morgan, & Speziale, 2019). Specifically, the items related to determining career plans and preparing for continuing education after graduation showed the strongest relationship with project productivity, suggesting the success of the project is closely tied to whether students undergo career-oriented growth opportunities during their time participating. In addition to being tied to career/graduate school intentions, project productivity helps students gain acceptance into graduate school by bolstering their resume and serving as evidence as to the growth opportunities the students have experienced (Ferrari, Weyers, & Davis, 2002). Based on this reasoning, I predicted that the relationship between growth opportunities and graduate school attendance will depend in part upon project productivity.

H8: Higher project productivity will strengthen the positive relationship between growth opportunities and graduate school attendance.

Satisfaction with Mentor

Mentorship can be one of the most influential factors on undergraduate career choice (Behar-Horenstein, Roberts, & Dix, 2010). So, student satisfaction with their mentor should have a marked effect on what they get out of UR participation. Having a mentor they are satisfied with can be a powerful socialization tool for students both in
their academic field and for their career following graduation (Ingram, Bruning, & Mikawoz, 2009). On the other hand, having a discouraging relationship with their mentor can lead students to become disheartened with their UR experience and miss out on development opportunities (Yaffe, Bender, & Sechrest, 2017). However, these negative experiences are comparatively uncommon due to the voluntary nature of UR mentorship (Byrne & Keefe, 2002) and the majority of mentors seek to connect with and develop their students (Potter, Abrams, Townson, & Williams, 2009). Creative Inquiry student data supports the idea that the majority of mentors are engaged with their students as over 60% of student survey respondents report being very satisfied with their mentor’s involvement.

There are specific behaviors mentors can engage in to help ensure both their effectiveness as UR mentors and students’ satisfaction with their involvement. Shellito, Shea, Weissman, Mueller-Solger, and Davis (2001) surveyed UR participants about what they expect from their mentors and compiled a list of recommendations for UR mentors to make a maximum impact on their students. The majority of these recommendations are also applicable to general mentoring recommendations, such as clear communication, respect, and consideration for mentees as individuals (Eller, Lev, & Feurer, 2014). The recommendations that are specific to the UR context include encouraging publications and/or presentations, offering career guidance, and defining projects to be appropriate for students’ interests and abilities. Shanahan et al. (2015) found similar recommendations from a review of the existing literature while adding that UR mentors should help build a community within the research team and gradually increase student ownership of the
project. Overall, the most effective mentors are those who take the time to truly develop the individual students within their project and help them achieve their research-oriented and professional goals. This dissertation takes the perspective that effective mentoring and a student’s satisfaction with their mentor are analogous and that high satisfaction with mentor indicates that the student received effective mentoring during their time with Creative Inquiry (Schrodt, Cawyer, & Sanders, 2003). The effects of a good mentor can be far-reaching for undergraduates (Gafney, 2005) and this is reflected in the model by satisfaction with mentor moderating all proposed relationships.

Mentoring and skill development are closely related. In particular, mentors can be crucial in the development of soft skills for students as mentors can both provide opportunities for students to apply them and share their experiences with students (Chikumba, 2011). Mentors can further help build their students’ soft skills by encouraging them to present and/or publish their work, which can help them develop their communication and teamwork skills (Shellito et al., 2001). These learning and skill development experiences help improve students’ self-efficacy both in terms of their ability to perform in the lab as well as in their career (Carpi, Ronan, Falconer, & Lents, 2017). In addition to improving self-efficacy through skill development, mentors can help improve students’ self-efficacy simply through the act of interacting with them one-on-one and providing guidance when needed (DeFreitas & Bravo Jr, 2012). Overall, because mentorship and skill development are often closely interconnected and mentors can help students recognize that their skills are improving (Ishiyama, 2007), I predicted that
satisfaction with mentor will moderate the effects of skill development on work self-efficacy.

*H9: Higher satisfaction with mentor will strengthen the positive relationship between skill development and work self-efficacy.*

Similarly, mentors should affect whether the skill development students undergo leads them to graduate school. Research activities that build soft skills are frequently highlighted in the graduate school application process, such as publishing or presenting findings. Effective mentors help develop their students by encouraging them to pursue these activities, which simultaneously helps develop their skills and build their resumes (Records & Emerson, 2003). In addition to helping students gain acceptance to graduate school, mentors can improve students’ confidence in pursuing graduate school. Close mentoring while participating in UR helps students socialize to what graduate school is like and helps them feel more comfortable applying (Carpi, Ronan, Falconer, & Lents, 2015). By helping students create a more concrete record of their skill development and helping them recognize they are capable of applying their skills in a post-graduate context, effective mentors should enhance the effect of skill development on graduate school attendance and I predicted satisfaction with mentor will moderate the relationship to reflect this.

*H10: Higher satisfaction with mentor will strengthen the positive relationship between skill development and graduate school attendance.*

One of the key expectations UR participants is that their mentor will help them refine their career goals and help prepare them for graduate school if they choose to
pursue that path (Shellito et al., 2001). Mentors can help with career goals by exposing students to concepts they would not experience in the classroom and by helping them network with professionals in the field, which helps them socialize to their intended profession (Shanahan et al., 2015; Shellito et al., 2001). I previously hypothesized that the growth opportunities students experience help them socialize to graduate school and makes them more confident and comfortable pursuing it (Borrego, Knight, Gibbs Jr., & Crede, 2018; Villarejo, Barlow, Kogan, Veazey, & Sweeney, 2008) and I further hypothesized that the student’s relationship with their mentor will affect this process as the mentor’s involvement helps facilitate whether the growth opportunities, such as networking and career preparation, occur in the first place.

**H11: Higher satisfaction with mentor will strengthen the positive relationship between growth opportunities and graduate school attendance.**

In addition, satisfaction with mentor should affect the relationship between growth opportunities and career choice satisfaction for similar reasons. One of the key impacts mentors have is they can help students clarify their career goals and interests, which is directly aligned with growth opportunities (Shellito et al., 2001). This opportunity can be an incentive for mentors with some studies suggesting that the majority of UR mentors may choose to do so for the opportunity to help guide undergraduates’ career paths directly (Millsapugh & Millenbah, 2004). Mentors can also facilitate growth opportunities, such as by helping students network with professionals and their peers (Shanahan et al., 2015). Because an effective mentor can have such an effect on how growth opportunities help refine students’ career interests, I predicted it
will determine whether that growth ultimately leads to improved career choice satisfaction following graduation.

\textit{H12: Higher satisfaction with mentor will strengthen the positive relationship between growth opportunities and career choice satisfaction.}
METHOD

Participants and Procedure

Participants were alumni of Clemson University who participated in Creative Inquiry for at least one semester during their undergraduate career dating back to 2014 at the earliest who completed at least one annual student satisfaction survey during their time with Creative Inquiry. These alumni were recruited using their alumni email addresses with Clemson University, which are kept active following graduation. Alumni were sent an email inviting them to participate in this study and informing them of the financial incentive they could potentially receive as a result. Upon accepting the invitation, participants filled out the survey on their computer or mobile device. Personally-identifying information was collected for survey-matching purposes, but participants were informed that matching was the only purpose for the information gathering and it would be deleted from the data once survey matching was completed. Once the participants completed the survey, they were finished with the study.

Approximately 4,400 CI alumni met the criteria for having completed a student survey during their time with CI since 2014, when Clemson University began retaining alumni email addresses and the survey was created in its current form. Participation was incentivized by entering alumni into a drawing for a $50 gift card for every 50 participants, up to a maximum of 40 gift cards. Participants were asked to provide their most recent email address for the incentive raffle and were asked if they were comfortable sharing their email with Creative Inquiry for future studies, but were assured this did not affect their chances of winning a gift card if they choose not to do so. Once
the alumni data were collected, alumni surveys were matched to the most recent student survey the alumni took while they were participating in Creative Inquiry.

Of the 4,400 CI alumni who were invited to participate, 797 responded to the survey, giving the survey an 18% response rate overall. Of these, participants who only completed the demographics section as well as 10 current CI students who were erroneously included in the sample were excluded, leaving the final sample of 634 usable responses. These responses were then matched to the last student survey participants completed. Following cleaning of identifying information for matching purposes, all 634 participants’ alumni surveys were matched to student surveys. Of this sample, most (83%) graduated between 2017 and 2020 and a majority (53%) pursued graduate school following graduation from Clemson University. About 1/5 (21%) of participants indicated they were currently unemployed, but of those, 60% indicated this was because they were full-time students. Over half (53%) of participants indicated their current job was at least somewhat related to their work with Creative Inquiry and a similar proportion (53%) indicated their time with Creative Inquiry was very or extremely helpful in helping them achieve their career goals. Over half (53%) of participants indicated they spent most of their time working with faculty directly rather than graduate students and most (61%) participants communicated with their Creative Inquiry mentor at least once following graduation.

Due to the ongoing COVID-19 pandemic in the United States, the impact of the virus on the responses to this survey was also assessed. Most (72%) participants’ jobs were unaffected by the pandemic. Only 6% of participants indicated that COVID affected
their responses to the survey. Of these, most (66%) indicated that they were unemployed or having to pursue other employment than what they wanted as a result of the economic conditions arising from the pandemic. A few responses from participants in the health industry indicated that COVID shaped their job unexpectedly, such as increased workload and adapting to “telehealth” practices. Overall, due to the relatively small proportion of participants who indicated they were impacted by the virus and the fact that a review of their responses did not uncover any obvious irregularities, these participants were kept in the data and analyzed.

Measures – Student Survey and Creative Inquiry Data

The scales measuring skill development, growth opportunities, and satisfaction with mentor were created in 2014 as part of the student survey that is administered to CI undergraduates every semester. The student surveys are predominantly used internally within the Creative Inquiry program to gauge student outcomes based on responses to the individual items, though they have been used in scale aggregate form in presentations at professional conferences (Allard-Keese, Morgan, & Speziale, 2019). The information regarding participation length and project productivity was drawn from internal Creative Inquiry data that are maintained each semester and archived. For each participant, their most recent student survey was tied to their participation length and project productivity before ultimately linking their student information to the alumni survey they completed for this study.

Skill Development: The skill development scale consisted of items measuring “soft” skills like teamwork and leadership. The total scale consists of 15 items on a 1-7
Likert scale asking respondents to estimate how much they gained in each item area due to their participation in CI. An example item is “Clearly communicate my thoughts orally.” The mean for this scale was 5.47, the standard deviation was 1.25, and the Cronbach’s alpha was .91. The full scale for skill development can be seen in Appendix A.

_Growth opportunities:_ The growth opportunities scale measured the degree to which respondents believe their participation in CI gave them access to specific opportunities. These opportunities include post-graduation plans, networking, and further major-relevant experience. The total scale consists of 10 items on a 1-7 strongly disagree-strongly agree Likert scale. An example item is “CI helped me see real world applications of information presented in my other classes.” The mean for this scale was 5.82, the standard deviation was 0.95, and the Cronbach’s alpha was .88. The full scale for growth opportunities can be seen in Appendix B.

_Length of CI Participation:_ CI participation is measured in the student survey with a single item: “How many semesters (including this one) have you participated in a CI (Choose One)?” Students select a number between 1 and 10. Participants reported participating in CI for an average of 2.54 semesters with a standard deviation of 1.66.

_Project Productivity:_ Project productivity was gathered from CI’s historical data and tied to the individual responses. Project productivity was measured by summing together reported accomplishments in 5 categories: conference presentations, professional publications, grants, mentor awards, and student awards. These accomplishments are reported by the mentor to Creative Inquiry as anything that came from the CI team,
whether or not the students were directly involved in the accomplishment. Projects reported an average of 8.32 accomplishments with very high variability ($SD=14.65$). This high variability is due to the high frequency of projects with very few reported accomplishments and the few projects that reported many accomplishments (one project reported 113).

*Satisfaction with mentor:* Satisfaction with mentor was measured by a single item in the student survey: “Indicate the level of satisfaction with your involvement with your CI mentor(s).” Responses are measured with a 1-5 very dissatisfied-very satisfied Likert scale. The mean for this item was 4.65 with a standard deviation of 0.74.

**Measures – Alumni Survey**

The measures for graduate school attendance, work self-efficacy, and career choice satisfaction were measured in the alumni survey administered to Clemson graduates who participated in Creative Inquiry. Skill development and growth opportunities also were assessed in the alumni survey to compare responses before graduation and once alumni are settled in their post-graduation careers.

*Graduate School Attendance:* Graduate school attendance was measured by a single yes/no item: “Following your graduation from Clemson University, did you attend/are you currently enrolled in a post-graduate education program? (i.e., Masters, PhD, law school, doctor of medicine, etc.).” 346 participants (55%) indicated that they attended graduate school following graduation.

*Work Self-Efficacy:* Work self-efficacy was measured by the short form of the occupational self-efficacy scale developed by Schyns and von Collani (2002). This short-
form scale has been validated and used successfully in both workplace and educational contexts and in multiple countries (Rigotti, Schyns, & Mohr, 2008; Runhaar, Sanders, & Yang, 2010). The scale consists of 8 items on a standard 1-7 strongly disagree-strongly agree Likert scale. An example item is “No matter what comes my way in my job, I’m usually able to handle it.” The mean for this scale was 5.94, the standard deviation was 0.67, and the Cronbach’s alpha was .90. The full scale for self-efficacy can be seen in Appendix D.

**Career Choice Satisfaction:** Career choice satisfaction was adapted from a scale developed by Clark, Murdock, and Koetting (2009). This scale was originally developed for a sample of doctoral students in counseling psychology and was adapted to be general in career choice. The scale consists of 4 items; 3 from the original study were not included as they were future tense. The items are on a 1-7 Likert scale, the first is very dissatisfied-very satisfied and the following three are very unlikely-very likely. An example item is “How satisfied are you with your current career?” The mean for this scale was 5.29, the standard deviation was 1.18, and the Cronbach’s alpha was .77. The full scale can be seen in Appendix E.

**Additional Variables**

The alumni survey also included several variables that were not included in any hypotheses. The purpose of these variables was to support the existing hypotheses and help ensure good data quality by providing a descriptive context for responses, aiding in data matching, and providing a control for historical events.
Data Matching: Participants’ full names and graduation year were requested to tie their alumni responses to their student surveys. The graduation year is to differentiate between students with the same names. Ultimately, all participants with usable alumni survey data were successfully matched to a corresponding student survey.

Job Information: These included current job title (measured by text entry), job classification (full-time/part-time/unemployed), and level of relation of the job to the alumni’s work with Creative Inquiry (1-5 not at all related-very closely related). The purpose of including these was to better understand what types of roles alumni of Creative Inquiry seek out following graduation. From the job title, using O*NET, it is possible to infer information such as seniority, salary, and job complexity (Heidemeier & Moser, 2009). This information could help inform future research using these data.

Creative Inquiry Impact: This consisted of four questions. The first was “How helpful was your time in Creative Inquiry with regard to helping you achieve your career goals? (i.e., attending graduate school, finding a job after graduation, etc.)” with a 1-5 Likert scale of not at all helpful to extremely helpful. The second was “How did your participation in Creative Inquiry impact your life? Please be as detailed as possible” with an extended text entry box. These are included as a way to support the model by asking directly whether or not alumni’s time with Creative Inquiry impacted their later career. The third question was “Did you work primarily with graduate students or faculty during your time with Creative Inquiry?” and was measured on a 1-5 slider of primarily faculty on one end and primarily graduate students on the other. The final question was “Do you keep in contact with your Creative Inquiry mentor following graduation?” with options of
“No,” “We communicated once or twice,” and “We communicate regularly.” For a review of the results from these items, please reference the Participants and Procedure section.

COVID-19: This consisted of two questions. The first was “To what degree was your job affected by the COVID-19/Coronavirus Pandemic?” with options of my job was unaffected/my work hours were reduced/I was temporarily laid off/I was permanently laid off. The second was “Did the COVID-19/Coronavirus affect your responses to any question in this survey?” with options of yes/no and a text box for details if alumni answer yes. The purpose of these was to gauge the degree of effect the COVID-19 pandemic had on the data, since the data collection occurred while the COVID-19 pandemic was still ongoing in the United States. For a review of the results from these items, please reference the Participants and Procedure section.

Analysis Approach

Once the data were aggregated, preliminary analyses were conducted to assess data quality. These included descriptive statistics, bivariate correlations, scale reliability, and exploratory factor analyses. The goal of these analyses was to determine if there were any issues with the data, such as non-normal distributions, floor or ceiling effects with regard to item responses, scale unreliability, or unexpected variable relationships/factor structures. In addition, because the predictors were also assessed as part of the alumni survey, I compared responses as a student and as an alumnus to see whether or not these responses change following graduation. In addition, I compared student survey responses between those who chose to complete the alumni survey and those who did not. This
allowed me to better know whether attrition was truly random or if there was response bias in the data. For example, if student survey scales for alumni respondents have higher means than non-respondents, this could indicate students who were not satisfied with Creative Inquiry chose not to complete the alumni survey, causing the scores to be inflated on average.

Following preliminary analyses, the main model was assessed using structural equation modeling (SEM) in EQS. Hypotheses were assessed using the statistical significance of the corresponding path coefficients in parallel with the overall model fit, as assessed by the model Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), and the Standardized Root Mean Square Residual (SRMR). The model was created as a latent variable model, meaning the proposed relationships are modeled between the factors themselves as reflected by the items composing them rather than a single average score of the items. One advantage of using SEM is the examination of multiple dependent variables in parallel without the need to assess separate models, thus lowering the risk of committing a Type-I error (Raykov & Marcoulides, 2000). In addition, using SEM allows for examining how well the model fits the data and assessment of alternative models using Lagrange Multiplier and Wald tests (Hu & Bentler, 1999). Given previous findings within CI, the model also included a covariance between skill development and growth opportunities to reflect the positive relationship between the two predictors. This covariance conceptually makes sense, as the experiences associated with CI participation should also improve skills along the way and previous research using these variables suggests this to be the case (Allard-Keese,
Morgan, & Speziale, 2019). This covariance is not tied to any specific hypotheses but is included for model accuracy.

Moderation hypotheses were tested using hierarchical linear regression including predictors and outcomes based on the SEM results. In each regression model, both main effects as well as the interaction effect were included and hypotheses were assessed based on the statistical significance of the interaction effect in each regression model and the improvement in the model $R^2$ upon entering the interaction term. The research question of whether or not the moderating variables show direct effects was also assessed as part of this process through statistical significance of the coefficients and change in the model $R^2$. 
RESULTS

Preliminary Analyses

Descriptive statistics and bivariate Pearson correlations appear in Table 1. All psychological variables (skill development, growth opportunities, work self-efficacy, career satisfaction, and satisfaction with mentor) exhibited negative skew characterized by high means and relatively few low ratings. However, these scales also showed standard deviations between .67 and 1.2, suggesting a reasonable amount of variability in scale responses. The predictors correlated with the outcomes, though they both had the strongest relationship with work self-efficacy (skill development correlated at $r = .19$, $p < .05$, and growth opportunities correlated at $r = .18$, $p < .05$) and the correlation between skill development and graduate school attendance was not statistically significant ($r = .07$, $p > .05$). As expected, the predictors also had a large correlation between them ($r = .72$, $p < .05$). The moderators correlated with the predictors – most notably satisfaction with mentor, which had correlations above .4 for both skill development ($r = .42$, $p < .05$) and growth opportunities ($r = .45$, $p < .05$). For the outcomes, only satisfaction with mentor correlated with work self-efficacy and career satisfaction. No other correlations between moderators and outcomes were significant.

Because both the student and alumni surveys measured skill development and growth opportunities, comparison between responses pre and post-graduation were possible. On average, responses to the student survey were 0.58 points higher for skill development and 0.18 points higher for growth opportunities when compared to the alumni survey. A Welch 2-Sample t-test concluded both of these differences were
significant \((p < .05)\), suggesting student survey responses were statistically significantly higher in both cases. The alumni and student responses for skill development and personal growth showed Pearson correlations of .40 and .44 respectively, both significant \((p < .05)\). These correlations show the scales are not interchangeable with each other, but still relate to each other fairly strongly. Pace (1979) found that alumni perceptions, student perceptions, and faculty perceptions of UR participation were all fundamentally similar – these sources tend to correlate highly with each other. I ultimately chose to utilize the student survey responses because of the desire to preserve and support the causal direction of the model, though the fact that these responses were different should be kept in mind when interpreting the results.

In addition, I compared the average student survey responses on skill development, growth opportunities, and mentor satisfaction between eligible participants who chose to complete the alumni survey and those who did not. The purpose of this was to assess whether there was selection bias in the data. For example, if only students with a favorable opinion of their growth from participating in CI responded to the survey, the responses would be biased. Overall, the responses for those who chose to complete the alumni survey were slightly higher on average for all three scales (.05 for skill development, .15 for growth opportunities, and .06 for mentor satisfaction). I conducted a multivariate analysis of variance (MANOVA) to see whether or not these differences were statistically significant. Ultimately, the differences for growth opportunities and mentor satisfaction were significant \((p < .05)\) and the differences for skill development were not. However, the average differences were substantially lower than the standard
deviations for the scales (less than 10% of 1 SD), suggesting that they are not particularly large gaps despite statistical significance. The implications of this potential sampling bias are discussed in the limitations section of the discussion.

I also examined the college representation of the responses to the alumni survey and how they compare to overall student survey responses. CI projects in the sciences and the humanities often differ in their approach and the colleges were assessed as a rough estimation of the representation of each. Overall, 362 alumni participants came from projects in the Colleges of Engineering, Computing, and Applied Sciences, Behavioral, Social, and Health Sciences, Science, or Agriculture, Forestry, and Life Sciences with the first two colleges constituting the majority. 71 alumni participants came from projects in the colleges of Education, Architecture, Arts, and Humanities, Business, or University Administration. 202 students were unable to be tied to a specific college for their CI project (as they did not indicate their CI project number when completing the student survey). These numbers closely matched the overall representation from the student survey responses.

Finally, because the scales for skill development and growth opportunities were not created with the goal of statistical analysis in mind, an exploratory factor analysis (EFA) is appropriate to assess whether or not the items are measuring the intended underlying factor. EFAs were conducted on each scale composed of multiple items using Maximum Likelihood Estimation and can be seen in Tables 2-6. The EFA of skill development can be seen in Table 2 and suggests a 2-factor solution for the scale with items 3 and 14 forming their own factor (Factor 1: Eigenvalue = 7.40, Variance
Explained = 52.86%; Factor 2: Eigenvalue = 1.60, Variance Explained = 11.40%). These items are “Develop a sense of belonging within my academic discipline” and “Understand the ethical issues surrounding my work.” These items may tap into a better understanding of one’s discipline rather than overall skill development. However, both items exhibited item-total correlations above .4, suggesting they fit acceptably well into the scale and were initially allowed to remain for the main analyses. The EFA for growth opportunities can be seen in Table 3 and suggested a 1-factor solution and did not unearth any issues with the scale (Eigenvalue = 5.16, Variance Explained = 51.63%). In addition, EFAs for work self-efficacy (Eigenvalue = 4.64, Variance Explained = 58.02%) and career choice satisfaction (Eigenvalue = 2.50, Variance Explained = 62.45%) can be seen in Tables 4 & 5 and suggested a 1-factor solution with no issues, as expected from validated scales.

**Structural Equation Modeling**

Hypotheses 1-4 were tested via structural equation modeling (SEM) in EQS. Using SEM allows for modelling multiple outcomes simultaneously as well as how well the proposed model fit the data and whether alternative models exist. These alternative models were assessed using Lagrange Multiplier (LM) and Wald tests, which examine whether paths should be added or removed to the model. Following the recommendation of Hu and Bentler (1999), I used the Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), and the Standardized Root Mean Square Residual (SRMR) to assess model fit. Further following their recommendations, the CFI should
have a value of .95 or above and the RMSEA and SRMR should have values lower than .06 and .08, respectively.

The initial model tested the main hypotheses and with a covariance between the predictors included for accuracy. SEM results for the initial hypothesized model, including path coefficients and fit statistics, can be seen in Figure 2. The path representing hypothesis 1 between skill development and growth opportunities had a coefficient of .103 ($p < .05$), supporting the hypothesis. The path representing hypothesis 2 between skill development and graduate school attendance had a coefficient of -.025 but was not significant ($p > .05$), failing to support the hypothesis. The path representing hypothesis 3 between growth opportunities and graduate school attendance had a coefficient of .089 ($p < .05$), supporting the hypothesis. The path representing hypothesis 4 between growth opportunities and career choice satisfaction had a coefficient of .189 ($p < .05$), supporting the hypothesis. The modeled covariance between skill development and growth opportunities had a coefficient of .709 ($p < .05$). The CFI was reported at .84, the RMSEA was reported at .07, and the SRMR was reported at .07.

The Lagrange multiplier (LM) test suggested adding an error covariance between items 3 and 14 under the skill development factor. Making this addition significantly improved the model fit, as this new model reported a CFI of .89, an RMSEA of .06, and an SRMR of .06. This additional relationship further supports the finding from the preliminary exploratory factor analysis suggesting these items may form a separate factor from skill development. This new model can be seen in Figure 3.
I then ran one final SEM with these items excluded entirely. This final model was comparable to the error covariance model, reporting a CFI of .90, an RMSEA of .06, and an SRMR of .06. In this final model, the path representing hypothesis 1 between skill development and growth opportunities had a coefficient of .090 ($p < .05$), supporting the hypothesis. The path representing hypothesis 2 between skill development and graduate school attendance had a coefficient of -.017 but was not significant ($p > .05$), failing to support the hypothesis. The path representing hypothesis 3 between growth opportunities and graduate school attendance had a coefficient of .085 ($p < .05$), supporting the hypothesis. The path representing hypothesis 4 between growth opportunities and career choice satisfaction had a coefficient of .190 ($p < .05$), supporting the hypothesis. The modeled covariance between skill development and growth opportunities had a coefficient of .800 ($p < .05$). This final model can be seen in Figure 4.

**Moderation**

Hypotheses 5-12 were assessed using hierarchical linear regression in R. The results for moderation analyses appear in Tables 7-13. All changes in the model $R^2$ were not significantly different from zero when introducing the interaction term. Introducing the interaction between skill development and participation length predicting work self-efficacy improved the model $R^2$ by <.001 ($p > .05$), failing to support hypothesis 5. Introducing the interaction between growth opportunities and participation length predicting career satisfaction improved the model $R^2$ by <.001 ($p > .05$), failing to support hypothesis 6. Introducing the interaction between skill development and project productivity predicting graduate school attendance improved the model $R^2$ by <.001 ($p >$
.05), failing to support hypothesis 7. Introducing the interaction between growth opportunities and project productivity predicting graduate school attendance improved the model $R^2$ by $.001 (p > .05)$, failing to support hypothesis 8. Introducing the interaction between skill development and satisfaction with mentor predicting work self-efficacy improved the model $R^2$ by $.001 (p > .05)$, failing to support hypothesis 9. Introducing the interaction between skill development and satisfaction with mentor predicting graduate school attendance improved the model $R^2$ by $.001 (p > .05)$, failing to support hypothesis 10. Introducing the interaction between growth opportunities and satisfaction with mentor predicting graduate school attendance improved the model $R^2$ by $.001 (p > .05)$, failing to support hypothesis 11. Introducing the interaction between growth opportunities and satisfaction with mentor predicting Career Choice Satisfaction improved the model $R^2$ by $.001 (p > .05)$, failing to support hypothesis 12. In addition, research question 1 was assessed by looking at the main effects of the moderators on the outcomes of interest as part of the regression analyses. No main effects were significantly different from zero.
DISCUSSION

Summary of Findings

This dissertation sought to shed light on exactly how UR participation leads to positive outcomes and to investigate whether are not there are within-program differences that affect whether these processes occur. Ultimately, I concluded that certain positive outcomes from UR participation, specifically work self-efficacy, graduate school attendance, and career choice satisfaction, are affected by the skill development students undergo and the growth opportunities take advantage of during their time participating in undergraduate research. These relationships were unaffected by within-project differences students experienced as part of their time participating, specifically the participation length, project productivity, and the students’ satisfaction with their mentor. By taking a within-program perspective, this dissertation theoretically showed how UR participation helps develop students and helps show UR practitioners what their program should emphasize to maximize beneficial outcomes for students.

The main hypotheses were mostly supported by the SEM analysis. Skill development significantly predicted work self-efficacy and growth opportunities significantly predicted graduate school attendance and career choice satisfaction. Only the path between skill development and graduate school attendance was not statistically significant. Two out of the three model fit indices were within acceptable values and the third was borderline, suggesting the final model acceptably fits the data. The path coefficients were generally weak, with the paths between skill development/work self-efficacy and growth opportunities/graduate school attendance being around or below .1.
The path between growth opportunities/career choice satisfaction was stronger at around .2, but still rather low. These weak, yet significant relationships are understandable given the myriad of factors that affect psychological states such as self-efficacy and satisfaction as well as those that determine career success, but the significance of the path coefficients shows that participating in undergraduate research does have lasting positive effects. Ultimately, the results support the central hypothesis that the development students undergo as part of their participation in undergraduate research lead them to be better off following graduation, in terms of both psychological well-being and in concrete achievement.

In addition, the SEM introduced two relationships not tied to any specific hypotheses. The first is a modeled covariance between skill development and growth opportunities, which was significant. The predictors had a covariance of .8, suggesting the two are highly related to each other. This, combined with the high correlation between the two aggregated variables during preliminary analyses, suggests skill development and growth opportunities are tied to one another. This relationship makes sense conceptually, as the opportunities students take advantage of likely improve their skills along the way. However, the two constructs are distinct from each other, as an exploratory factor analysis of all the items together shows the items map onto two separate factors (see Table 6). In addition, growth opportunities predicted later graduate school attendance whereas the relationship between skill development and graduate school attendance was insignificant. Based on this evidence, the two constructs appear to be distinct from one another, despite being conceptually similar.
The secondary moderation hypotheses and the research question were universally unsupported by the regression analyses. All analyses showed a change in $R^2$ that was either close to zero or not statistically significant when entering both the additional predictor as a main effect and the interaction term. Based on this evidence, it appears participation length, project productivity, and satisfaction with mentor are not significant factors when assessing a student’s takeaways from undergraduate research participation. This finding was somewhat foreshadowed by the bivariate correlations in the preliminary analyses, in which the relationship between satisfaction with mentor and career choice satisfaction was the only significant correlation among the moderators and the outcomes. This relationship did not translate to a significant interaction coefficient, though the main effect of satisfaction with mentor was a significant predictor at the $\alpha = .10$ level prior to the introduction of the interaction term – suggesting the relation may be approaching significance. Future research should include a larger sample size to investigate whether there truly is a relationship between mentorship quality and later career choice satisfaction (though this effect may be very small), or alternatively whether overall trait satisfaction affects satisfaction with both mentorship and career choice.

Overall, students who experienced more skill development and growth opportunities throughout their time in Creative Inquiry reported higher self-efficacy at work, greater satisfaction with their career choice, and were more likely to attend graduate school following graduation from Clemson University. These relationships were unaffected by factors relating to the project they participated with, such as participation length, project productivity, and mentor satisfaction.
Practical and Theoretical Significance

A key contribution of this dissertation to the field of undergraduate research is the look at UR participation outcomes from a within-program perspective. By tying positive post-graduation outcomes to the level of skill and personal development undergraduates undergo, this dissertation helps close an existing literature gap on exactly how UR participation helps undergraduates. The skill development participants undergo leads to improvements in work self-efficacy and the growth opportunities they experience both improves their likelihood of attending graduate school and leaves them more satisfied with their career choice. Taken together, these results show that UR participation can lead to positive effects that participants carry forward into their careers regardless of scientific field or post-graduate education plans.

Another key contribution is the examination of these effects at multiple time points. Previous research has measured outcomes either immediately following UR participation or years afterwards once students became alumni and are entrenched in their careers (Bauer & Bennett, 2003; Russell, Hancock, & McCullough, 2007). Including data from both time points allowed me to make somewhat stronger causal inferences between the variables of interest. This staggering of data collections also helps support the model’s causal direction by creating a temporal order to the variables (Wheaton, 1978), though there are still limits to these inferences. Another advantage is the larger sample size compared to other UR studies. Previous studies have worked with smaller focused UR programs and have included as few as 22 participants to form conclusions from (Bauer & Bennett, 2003). The final sample size of over 600 in this dissertation allowed
for sufficient power to detect the hypothesized variable relationships where other studies from the UR literature may not have been able to do so.

Theoretically, this dissertation looks at UR from an interdisciplinary perspective. By introducing I/O psychology concepts to undergraduate research, outcomes were accounted for that had not previously been considered in the field. Specifically, work self-efficacy and career choice satisfaction are novel concepts in the UR literature and showing that UR participation can lead to improvements in these areas years following graduation extends the timeframe in which the UR literature usually operates. Previous research has focused on academia-specific outcomes; the incorporation of these more career-focused variables shows that UR participation is rewarding for all students regardless of post-graduation career path. In addition, this dissertation sheds light on exactly why participation is beneficial by looking at two specific positive aspects – skill development and growth opportunities. Previous research has focused on scientific skill development and academic socialization rather than more generalizable positive development (Ingram, Bruning, & Mikawoz, 2009) and this dissertation shows that these more general areas for growth can be equally as important for future success.

Looking at the findings from the opposite perspective, this dissertation helps expand the field of I/O Psychology by showing that the activities college students engage in can lead to positive effects once they enter the workforce. The literature on vocational fit is expanded with the knowledge that the growth opportunities UR participants experience help them decide on their career path and ultimately leave them more satisfied with their choice in the future. When matching a person to a job, it is crucial that there is
a good fit and candidates who got the most they could out of UR participation should fit better than those who did not. The selection literature is expanded by knowing UR participants who take the time to develop their soft skills are ultimately left more self-efficacious at work as a result. This dissertation shows it is not enough to look for UR participation as a resume line – candidates must have put in the effort to grow from the experience. This development will lead to improved self-efficacy in the workplace which should in turn improve job performance (Lunenberg, 2011), meaning selection practitioners should ask questions about what candidates did during their time in UR to determine whether or not they developed their soft skills.

For the moderators, even non-significant findings can lead to conclusions worth considering. Based on the results of this dissertation, it does not appear that attributes of the project or the amount of time spent in UR affect how students grow and develop – the positive effects of UR participation are more universally applicable. In terms of participation length, the findings may suggest even a single semester can be beneficial for students so long as they are able to sharpen their skills and have sufficient access to growth opportunities if the effects truly are nonsignificant. This stands in contrast with previous findings suggesting students need at least a year of participation to benefit from UR (Gates, Teller, Bernat, & Delgado, 1998). This could be because the small team-based approach of Creative Inquiry leads to more individualized development, thus accelerating the process. In contrast, the findings could also suggest participation length may have a curvilinear effect. If this is the case, both very short and very long times spent participating would show few positive benefits from participation. This could explain
why the findings were nonsignificant as different regression techniques should be used. Future research should investigate whether or not this is the case as the literature suggests the latter curvilinear effect may be the case.

In terms of project productivity, these results suggest the mentor does not necessarily need to produce academic deliverables in order for their students to grow from the experience. Project productivity did not even significantly correlate with graduate school attendance, suggesting students may not be especially involved with the academic work the mentor produces as part of the project or at least they are not using it as leverage to gain acceptance into graduate school. This finding is surprising, as previous work concluded students who are able to present or publish as part of their time participating are more likely to be accepted to graduate school (Wilson et al., 2018). Perhaps the issue of acceptance is not how skill development and growth opportunities affect graduate school attendance but rather interest in attending. The fact that only the relationship between growth opportunities and graduate school attendance was significant supports this idea – it is possible that UR participation can help students decide if further academic pursuits are right for them rather than directly assisting them gain entrance to graduate school. If this is the case, project productivity would be less important as students can determine their interest in other ways, such as poster sessions internal to the UR program or by networking with current graduate students. This could also indicate that productivity should be measured in other ways. Focusing on accomplishments the student directly contributed to our even was the primary author for could be a better indicator for growth and development and better affect graduate school attendance as
these direct accomplishments would be more likely to be included as part of the application. This measure would also be better as project productivity was measured at the time of this dissertation – meaning alumni may have graduated before certain project accomplishments existed. Future research in UR should keep the distinction between interest and ability in mind when considering graduate school attendance as an outcome of interest and consider focusing on student productivity rather than project.

In terms of satisfaction with mentor, this non-significant finding was the most surprising of all. The UR literature is clear that quality mentorship is one of the most important aspects of UR participation and one of the key drivers of positive outcomes (Behar-Horenstein, Roberts, & Dix, 2010). However, this non-significant relationship is most likely due to the fact that skill development and growth opportunities can be thought of as proxies for good mentorship in a similar way to satisfaction with mentor. A good mentor should be providing opportunities for students to refine their interests and structure their team so students improve their work-related skills and asking students how satisfied they are with their mentor may be measuring the same thing in different words. This idea is supported by the high correlations between the predictors and satisfaction with mentor and would explain why satisfaction with mentor did not add improve the regression model when skill development and growth opportunities were already accounted for. The UR literature already has plenty of evidence that mentorship is important, but this dissertation shows that how it is measured can determine how those effects manifest.
Regarding implications for practice, UR program directors and other professionals in this field can use this dissertation as guidance for what activities best lead to positive outcomes for student participants. Focusing programs on general skill development and fostering opportunities for personal growth can help ensure participants are ultimately prepared for the workplace and satisfied with their career choices. In addition, if the primary goal for the program is to prepare students for post-graduate studies, this dissertation shows that providing opportunities for personal growth can make graduate school attendance more likely. Students who take advantage of these opportunities ultimately become more confident in their ability to both gain acceptance to and be successful in graduate school (Borrego, Knight, Gibbs Jr, & Crede, 2018) and UR professionals should keep this in mind.

For I/O Psychology professionals, the practical implications of this dissertation are less immediately relevant, but still important to keep in mind. When hiring new employees, the fact that they participated in UR may have benefits beyond research-specific areas. If the candidate used their time to develop their soft skills and seek out opportunities, they should ultimately be more self-efficacious and satisfied with their career choice than other candidates. However, this dissertation shows that UR participation does not always lead to these positive outcomes – they are dependent on growth and development. Therefore, hiring managers should ask about the activities candidates engaged in as part of their UR experience rather than making assumptions when seeing UR experience on a resume.

Limitations
One limitation of this study is its heavy reliance on self-report. For example, the skill development of participants is purely based on their self-assessment of their own improvement rather than pre and post-tests of skills. However, the soft skills used in this dissertation are often difficult to accurately measure from an outside perspective, causing self-report to be a frequently used method of assessment (Goldenburg, Matheson, & Mantler, 2006). Similarly, growth opportunities are difficult to measure objectively and are more easily ascertained by asking participants whether or not they experienced them. These methodological concerns likely cannot be corrected in future research but should be kept in mind when interpreting results.

Another limitation is the scope of eligible alumni. Creative Inquiry was founded in 2005 but usage of the current student survey did not begin until fall semester 2014. Because of this, nine years’ worth of alumni were not included in this dissertation and most participants graduated within the last three years. Though the sample size had sufficient power to detect the proposed main effects, this dissertation did not include the majority of alumni from Creative Inquiry. Fortunately for the outcome of graduate school attendance, which usually occurs shortly following graduation, the sample should be unaffected by excluding senior alumni. There is also sufficient time for alumni to be established in their post-graduation career, since the majority had graduated from Clemson over one year ago and the most recent graduating class had graduate two months prior to responding to the survey. That said, future research using this sample will need to consider this ceiling effect with regard to job-specific outcomes such as seniority or salary since those who would potentially measure the highest are not included.
The skew towards recent graduates also affected the sample: specifically alumni who immediately pursued graduate school following graduation from Clemson University. These individuals were frequently still in graduate school at the time of this study, putting them in a slightly different life phase than alumni who entered the labor market directly following graduation. Because of this, their assessment of their self-efficacy at work may have been altered because their work consisted of either temporary jobs or as a graduate assistant and their career choice satisfaction may have been different due to them not yet being truly in their careers. Following the assessment of the final model, I ran two separate SEM models including working participants and those who were graduate students at the time of responding. The two models were largely identical, though the path between skill development and graduate school attendance was significant in the graduate student subsample. In light of this difference, future research may wish to fully the split the data and analyze current graduate students or working alumni separately or simply only assess one group or the other. This could lead to a similar split between alumni who graduated 1-2 years ago versus those who graduated 3-5 years ago due to the different degree of establishment in their careers and future research may want to investigate and/or split these subsamples as well.

The results of this dissertation may also be affected by sampling bias in multiple ways. The student surveys are required every semester, but students who leave Creative Inquiry may not complete one. Because the alumni survey invitation list was created solely based on students who completed student surveys, students who may not have completed a survey due to dissatisfaction will not be represented in this sample. The high
means for skill development, growth opportunities, and satisfaction with mentor suggest this may be the case – though it may also be an indicator of a successful program. In addition, as discussed in Preliminary Analyses, an assessment of student survey responses revealed small yet statistically significant differences in a couple of the scales between those who responded to the alumni survey and those who did not. This could be due to another selection bias where alumni with a favorable opinion of their time participating in Creative Inquiry were more likely to respond than those who had an unfavorable opinion. The incentive for participating was intended to counteract this effect, but it appears to have been only partially successful. If the response rate were higher, this could have helped to balance out the skew in several variables. In the future, UR programs will want to ensure they are obtaining samples that represent the full breadth of participants, both satisfied and dissatisfied.

Another limitation is the use of proxy variables for the concepts I sought to measure. Skill development directly measured soft skill acquisition, but growth opportunities was used as a way to measure career-interest refinement in the context of this dissertation and satisfaction with mentor was used as a broad measure of mentorship quality rather than a full scale measuring all the aspects of what good mentorship would look like. In this dissertation, these measures were pre-collected and unalterable, but future research should proactively directly measure what it is that should be assessed.

In particular, future research should use a previously validated scale measuring mentorship quality rather than satisfaction with mentor as a proxy. The satisfaction with mentor item only looked at mentorship quality from a broad satisfaction perspective and
exhibited a very high mean with limited range, restricting the item’s ability to truly moderate effects. This is partially due to the use of this item as a form of quality control within Creative Inquiry: low ratings on this item are rare but actions are taken to correct the issues based on students’ responses. Potential replacements could include measures of the concrete behaviors mentors engaged in, such as relationship building, networking access, and preparation for graduation (similar to Dreher & Ash, 1990) or potentially aspects of emotional support rather than informational, such as expressing concern and empathy (Ko, Wang, & Xu, 2013). These more comprehensive assessments of mentorship quality have been tied to both academic and professional success (Jacobi, 1991; Mathieu, Eschleman, & Cheng, 2019). Using a more comprehensive scale will both better measure the outcome of interest and help separate the construct from skill development and growth opportunities even further.

This dissertation also did not make the distinction between various types of projects within Creative Inquiry. Because of the fully open nature of Creative Inquiry, the program has representation of all colleges and a wide variety of academic disciplines. When considering the sample, I did not distinguish between more scientifically oriented projects versus more applied ones. For example, the sample included students who researched how to implement an insect proboscis design into engineering concepts and treated them the same as participants who created an art exhibit. The moderator of project productivity could have served as a slight proxy for this distinction as scientific projects are more likely to present and publish results, but the sample itself was not split. Future
research using broad UR programs should examine these project differences to see if they affect participant outcomes.

Finally, one of the key strengths of this dissertation may also be viewed as a limitation. Because this is a within-program study, no comparisons can be made between students who participated and those who graduated without participating on any outcome variables. The goal of this dissertation is to shed light on the mechanisms through which UR leads to positive outcomes, but future research may also wish to include a control sample to compare against to have a better understanding of the baseline to compare the outcome variables against. This could take the form of assessing the outcome variables in a sample of alumni who did not participate in UR to examine whether UR participants are significantly different.

**Future Directions**

Now that this dissertation has suggested that the benefits of UR participation lead to positive psychological outcomes, future research should compare these outcomes between students who participate in UR and students who do not. Evidence is already clear that UR participants attend graduate school at higher rates (Russell et al., 2018) but it would be interesting to see if UR participants exhibit higher work self-efficacy and career choice satisfaction than non-participants following graduation. Given that UR participants are exposed to personal development opportunities not available in a normal undergraduate curriculum, it would make sense that they would feel more capable and satisfied once they have transitioned into their careers.
In addition, future research should investigate whether graduates who participated in UR exhibit higher job performance. Evidence already suggests UR participants become higher-performing graduate students (Hunter, Laursen, & Seymour, 2007), but there is currently a literature gap on how they generally perform as employees. Given the soft skill development UR participants undergo, they should be better prepared for the workplace than other undergraduates, but future research is needed to determine if this is truly the case.

Future research should take the findings from this dissertation and investigate whether they replicate at other UR programs at other universities. UR programs can be highly varied from each other and the different characteristics of other institutions could lead to different findings. Potential differences could include whether the institution is a more focused liberal-arts school or an R1 university, whether the program is more selective in terms of student participants, more variable in terms of mentorship quality, and the size of the UR team. Future research could also investigate whether these findings are applicable to UR as a whole by sampling from a variety of institutional programs at once. This would help identify the truly universal UR participation benefits and identify which aspects of specific UR programs are the most beneficial.

Finally, future research should compare UR participation to internship opportunities and compare and contrast the development students undergo in each. Both help develop skills and provide opportunities for students, but on the surface, they appear to set students on different career paths. Internships are more of a preview of the workplace whereas UR participation can often take the form of graduate school activities.
It would be interesting to see how internships and UR participation affect post-graduation outcomes both similarly and differently.

Though the moderation results for this dissertation were non-significant, future research should continue down the line of thinking that other factors affect whether skill development and growth opportunities lead to positive outcomes following graduation. The findings of this dissertation suggest the benefits are universally applicable, but perhaps the right individual differences were not being measured. One example would be cognitive ability, which has already been shown to relate to graduate school performance (Rothstein, Paunnonen, Rush, & King, 1994) and one marker of cognitive ability, grade point average, is a key consideration when admitting students to graduate school. Cognitive ability has been tied to training success (Hunter, 1986) and students with high cognitive ability to see greater success in their skill development as a result. Future research may want to consider the effects cognitive ability could have on the predictors and their outcomes, whether measured directly through a test or indirectly through GPA/GRE/etc. Another example would be approaching the effects of mentorship from another angle. This dissertation reported inconclusive results from the effects of project productivity and students’ satisfaction with their mentor, but other measures could be more impactful, as discussed in the limitations section. Whether the project was based in the sciences or the humanities could also have an impact, especially with regard to graduate school attendance. Finally, the level of involvement in UR may be an additional moderator. Creative Inquiry allows students to take 1-3 credits of participation and this
could potentially impact whether or not they participate enough to develop their skills and pursue opportunities.

Future research should also further investigate the issue of causality with regard to the predictors and outcomes. This dissertation takes the perspective that the skill development and growth opportunities students experience lead to positive outcomes following graduation and supports this causal pathway via data collection at staggered timepoints. However, the argument can be made that students may enter into CI with a baseline self-efficacy that helps them build skills or enter already planning to attend graduate school and structure their UR experience around this idea. The literature suggests this may be the case, as while improvements in skill development and graduate school interest are clear, the baseline is already quite high in some cases (Odera, Lamm, Odera, Duryea, & Davis 2015; Russell, Hancock, & McCullough, 2007). Future research may wish to establish a baseline by providing UR participants with a pre-test before entering in the program to better determine the effects participation has on the students and also to help profile the kinds of students who seek out UR experiences.

In general, this dissertation expands the undergraduate research literature by introducing concepts from psychology, examining variables from a during and post-participation perspective, and by following a within-program approach. These types of analyses are fairly rare in the UR literature (Sams et al., 2015) and having examples of their successful use could lead to more research of positive psychological outcomes from UR participation. Overall, this dissertation helps illuminate the benefits of undergraduate
research and help universities adopt and mold the scientist-learner approach touted as one of the best methods for educating undergraduates.
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Table 1

*Means, Standard Deviations, and Correlations with Confidence Intervals*

<table>
<thead>
<tr>
<th>Variable</th>
<th>$M$</th>
<th>$SD$</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>1. Skill Development</td>
<td>5.47</td>
<td>1.25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Growth Opportunities</td>
<td>5.82</td>
<td>0.95</td>
<td>.72**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[0.68, 0.76]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Work Self-Efficacy</td>
<td>5.94</td>
<td>0.67</td>
<td>.19**</td>
<td>.18**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[0.11, 0.26]</td>
<td>[0.11, 0.26]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Graduate School Attendance</td>
<td>0.55</td>
<td>0.50</td>
<td>.07</td>
<td>.13**</td>
<td>-.07</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[-0.01, 0.15]</td>
<td>[0.05, 0.21]</td>
<td>[-0.15, 0.01]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Career Choice Satisfaction</td>
<td>5.29</td>
<td>1.18</td>
<td>.11**</td>
<td>.11**</td>
<td>.24**</td>
<td>.27**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[0.03, 0.19]</td>
<td>[0.03, 0.19]</td>
<td>[0.16, 0.31]</td>
<td>[0.20, 0.34]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Participation Length</td>
<td>2.54</td>
<td>1.66</td>
<td>.17**</td>
<td>.25**</td>
<td>.02</td>
<td>.07</td>
<td>.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[0.09, 0.24]</td>
<td>[0.17, 0.32]</td>
<td>[-0.06, 0.10]</td>
<td>[-0.01, 0.15]</td>
<td>[-0.06, 0.10]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variable</td>
<td>M</td>
<td>SD</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>--------------------------------</td>
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<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>7. Project Productivity</td>
<td>8.32</td>
<td>14.65</td>
<td>.10*</td>
<td>.13**</td>
<td>-.01</td>
<td>.06</td>
<td>.02</td>
<td>.09*</td>
<td></td>
</tr>
<tr>
<td>8. Satisfaction with Mentor</td>
<td>4.65</td>
<td>0.74</td>
<td>.42**</td>
<td>.45**</td>
<td>.12**</td>
<td>.02</td>
<td>.12**</td>
<td>.13**</td>
<td>.03</td>
</tr>
</tbody>
</table>

*Note.* M and SD are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. The confidence interval is a plausible range of population correlations that could have caused the sample correlation (Cumming, 2014). * indicates $p < .05$. ** indicates $p < .01$. 
Table 2

*Summary of Exploratory Factor Analysis Results for Skill Development Measure Using Maximum Likelihood Estimation (N = 634)*

<table>
<thead>
<tr>
<th>Item</th>
<th>Factor Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Understand information presented in courses outside CI.</td>
<td>0.697 0.020</td>
</tr>
<tr>
<td>2. Develop a sense of belonging within the Clemson community.</td>
<td>0.733 -0.037</td>
</tr>
<tr>
<td>3. Develop a sense of belonging within my academic discipline.</td>
<td>-0.022 0.864</td>
</tr>
<tr>
<td>4. Effectively manage my time.</td>
<td>0.835 -0.068</td>
</tr>
<tr>
<td>5. Contribute to the ideas of a group.</td>
<td>0.832 0.019</td>
</tr>
<tr>
<td>6. Solve complex problems.</td>
<td>0.716 0.022</td>
</tr>
<tr>
<td>7. Understand what it is like to be a graduate student. (Even if you do not have an interest in higher level education such as graduate, medical, veterinary, pharmacy and law school.)</td>
<td>0.557 -0.003</td>
</tr>
<tr>
<td>8. Clearly communicate my thoughts orally.</td>
<td>0.825 0.013</td>
</tr>
<tr>
<td>9. Clearly communicate my thoughts in written papers or reports.</td>
<td>0.774 -0.001</td>
</tr>
<tr>
<td>10. Work independently.</td>
<td>0.759 0.000</td>
</tr>
<tr>
<td>11. Work collaboratively with others.</td>
<td>0.772 0.067</td>
</tr>
</tbody>
</table>
12. Serve as a leader. | .704 | .047

13. Apply knowledge gained from CI or other courses to real world problems. | .724 | -.059

14. Understand the ethical issues surrounding my work. | .012 | .963

| Eigenvalues | 7.40 | 1.60 |
| % of variance | 52.86 | 11.40 |

*Note: Factor loadings over .40 appear in bold.*
### Table 3

**Summary of Exploratory Factor Analysis Results for Growth Opportunities Measure**

*Using Maximum Likelihood Estimation (N = 634)*

<table>
<thead>
<tr>
<th>Item</th>
<th>Factor Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. CI helped me see real world applications of information presented in my other classes.</td>
<td>.712</td>
</tr>
<tr>
<td>2. CI helped to determine my plans for after graduation.</td>
<td>.695</td>
</tr>
<tr>
<td>3. CI allowed me to network with professionals outside Clemson.</td>
<td>.516</td>
</tr>
<tr>
<td>4. CI provided me opportunities not offered in the normal undergraduate curriculum.</td>
<td>.763</td>
</tr>
<tr>
<td>5. I believe CI helped to prepare me for my future career.</td>
<td>.829</td>
</tr>
<tr>
<td>6. I believe CI helped to prepare me for continuing education after graduation. (Even if you do not have an interest in higher level education such as graduate, medical, veterinary, pharmacy, and law school.)</td>
<td>.760</td>
</tr>
<tr>
<td>7. CI allowed me to build relationships with other Clemson students and/or faculty.</td>
<td>.654</td>
</tr>
<tr>
<td>8. CI allowed me to participate in the research process. (Where ‘research’ can be considered any investigation, discovery, design or problem-solving activity or project.)</td>
<td>.672</td>
</tr>
<tr>
<td>9. CI taught me information relevant to my major/field of study.</td>
<td>.745</td>
</tr>
<tr>
<td>10. CI gave me the chance to work with people in other majors/fields.</td>
<td>.367</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>--------</td>
</tr>
<tr>
<td>Eigenvalues</td>
<td>5.16</td>
</tr>
<tr>
<td>% of variance</td>
<td>51.63</td>
</tr>
</tbody>
</table>

*Note:* Factor loadings over .40 appear in bold.
### Table 4

*Summary of Exploratory Factor Analysis Results for Work Self-Efficacy Measure Using Maximum Likelihood Estimation (N = 634)*

<table>
<thead>
<tr>
<th>Item</th>
<th>Factor Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Thanks to my resourcefulness, I know how to handle unforeseen situations in my job.</td>
<td>.631</td>
</tr>
<tr>
<td>2. If I am in trouble at my work, I can usually think of something to do.</td>
<td>.739</td>
</tr>
<tr>
<td>3. I can remain calm when facing difficulties in my job because I can rely on my abilities.</td>
<td>.740</td>
</tr>
<tr>
<td>4. When I am confronted with a problem in my job, I can usually find several solutions.</td>
<td>.783</td>
</tr>
<tr>
<td>5. No matter what comes my way in my job, I’m usually able to handle it.</td>
<td>.792</td>
</tr>
<tr>
<td>6. My past experiences in my job have prepared me well for my occupational future.</td>
<td>.664</td>
</tr>
<tr>
<td>7. I meet the goals that I set for myself in my job.</td>
<td>.690</td>
</tr>
<tr>
<td>8. I feel prepared to meet most of the demands in my job.</td>
<td>.720</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Eigenvalues</th>
<th>4.64</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of variance</td>
<td>58.02</td>
</tr>
</tbody>
</table>

*Note: Factor loadings over .40 appear in bold.*
Table 5

Summary of Exploratory Factor Analysis Results for Career Choice Satisfaction Measure

*Using Maximum Likelihood Estimation (N = 634)*

<table>
<thead>
<tr>
<th>Item</th>
<th>Factor Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How satisfied are you with your choice in career?</td>
<td>.816</td>
</tr>
<tr>
<td>2. How likely is it that you will someday make a career change</td>
<td>.601</td>
</tr>
<tr>
<td>outside of your current field?</td>
<td></td>
</tr>
<tr>
<td>3. If you were to start over again knowing what you know now, how</td>
<td>.722</td>
</tr>
<tr>
<td>likely would you be to choose your current career?</td>
<td></td>
</tr>
<tr>
<td>4. How likely would you be to recommend your current field to</td>
<td>.691</td>
</tr>
<tr>
<td>others?</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Eigenvalues</th>
<th>2.50</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of variance</td>
<td>62.45</td>
</tr>
</tbody>
</table>

*Note: Factor loadings over .40 appear in bold.*
Table 6

Summary of Exploratory Factor Analysis Results for a Combined Measure of Skill Development and Personal Growth Using Maximum Likelihood Estimation ($N = 634$)

<table>
<thead>
<tr>
<th>Item</th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Understand information presented in courses outside CI.</td>
<td><strong>.634</strong></td>
<td>.047</td>
<td>.042</td>
</tr>
<tr>
<td>2. Develop a sense of belonging within the Clemson community.</td>
<td><strong>.653</strong></td>
<td>.089</td>
<td>.033</td>
</tr>
<tr>
<td>3. Develop a sense of belonging within my academic discipline.</td>
<td>-.069</td>
<td>.009</td>
<td><strong>1.018</strong></td>
</tr>
<tr>
<td>4. Effectively manage my time.</td>
<td><strong>.862</strong></td>
<td>-.097</td>
<td>-.036</td>
</tr>
<tr>
<td>5. Contribute to the ideas of a group.</td>
<td><strong>.828</strong></td>
<td>.074</td>
<td>.007</td>
</tr>
<tr>
<td>6. Solve complex problems.</td>
<td><strong>.684</strong></td>
<td>.037</td>
<td>.011</td>
</tr>
<tr>
<td>7. Understand what it is like to be a graduate student. (Even if you do not have an interest in higher level education such as graduate, medical, veterinary, pharmacy and law school.)</td>
<td><strong>.445</strong></td>
<td>.077</td>
<td>-.006</td>
</tr>
<tr>
<td>8. Clearly communicate my thoughts orally.</td>
<td><strong>.839</strong></td>
<td>-.038</td>
<td>.021</td>
</tr>
<tr>
<td>9. Clearly communicate my thoughts in written papers or reports.</td>
<td><strong>.803</strong></td>
<td>-.091</td>
<td>-.013</td>
</tr>
</tbody>
</table>
10. Work independently. | .777 | -.073 | .008
11. Work collaboratively with others. | .737 | .122 | .050
12. Serve as a leader. | .744 | .001 | .015
13. Apply knowledge gained from CI or other courses to real world problems. | .609 | .190 | -.110
14. Understand the ethical issues surrounding my work. | .101 | -.022 | .809
1. CI helped me see real world applications of information presented in my other classes. | .158 | .592 | .055
2. CI helped to determine my plans for after graduation. | .030 | .579 | -.024
3. CI allowed me to network with professionals outside Clemson. | .211 | .397 | -.104
4. CI provided me opportunities not offered in the normal undergraduate curriculum. | -.047 | .842 | -.076
5. I believe CI helped to prepare me for my future career. | -.078 | .835 | .021
6. I believe CI helped to prepare me for continuing education after graduation. (Even if you do not have an interest in higher level education such as graduate, medical, veterinary, pharmacy, and law school.) | -.032 | .702 | .083
<table>
<thead>
<tr>
<th></th>
<th>CI allowed me to build relationships with other Clemson students and/or faculty.</th>
<th>-.012</th>
<th>.735</th>
<th>-.033</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.</td>
<td>CI allowed me to participate in the research process. (Where ‘research’ can be considered any investigation, discovery, design or problem-solving activity or project.)</td>
<td>.037</td>
<td>.665</td>
<td>-.023</td>
</tr>
<tr>
<td>9.</td>
<td>CI taught me information relevant to my major/field of study.</td>
<td>.009</td>
<td>.684</td>
<td>.064</td>
</tr>
<tr>
<td>10.</td>
<td>CI gave me the chance to work with people in other majors/fields.</td>
<td>.119</td>
<td>.332</td>
<td>.042</td>
</tr>
</tbody>
</table>

Eigenvalues

% of variance

*Note: Factor loadings over .40 appear in bold.*
### Table 7

**Hypothesis 5 regression results using Work Self-Efficacy as the criterion**

<table>
<thead>
<tr>
<th>Predictor</th>
<th>$b$</th>
<th>95% CI [LL, UL]</th>
<th>$sr^2$</th>
<th>95% CI [LL, UL]</th>
<th>Fit</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>5.32**</td>
<td>[4.90, 5.74]</td>
<td>.01</td>
<td>[-.00, .03]</td>
<td>$\Delta R^2 = .001$</td>
</tr>
<tr>
<td>Skill Dev</td>
<td>0.12**</td>
<td>[0.04, 0.19]</td>
<td>.00</td>
<td>[-.00, .00]</td>
<td>$\Delta R^2 = .001$</td>
</tr>
<tr>
<td>Partic Length</td>
<td>0.03</td>
<td>[-0.12, 0.19]</td>
<td>.00</td>
<td>[-.00, .00]</td>
<td>$\Delta R^2 = .001$</td>
</tr>
<tr>
<td>SD*PL</td>
<td>-0.01</td>
<td>[-0.03, 0.02]</td>
<td>.00</td>
<td>[-.00, .00]</td>
<td>$\Delta R^2 = .001$</td>
</tr>
</tbody>
</table>

$R^2 = .035**$

95% CI [.01, .07]

*Note. A significant $b$-weight indicates the semi-partial correlation is also significant. $b$ represents unstandardized regression weights. $sr^2$ represents the semi-partial correlation squared. LL and UL indicate the lower and upper limits of a confidence interval, respectively.

* indicates $p < .05$. ** indicates $p < .01$. 
Table 8

*Hypothesis 6 regression results using Career Choice Satisfaction as the criterion*

<table>
<thead>
<tr>
<th>Predictor</th>
<th>$b$</th>
<th>95% CI</th>
<th>$sr^2$</th>
<th>95% CI</th>
<th>Fit</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>4.75**</td>
<td>[3.63, 5.86]</td>
<td>.00</td>
<td>[-.00, .01]</td>
<td></td>
</tr>
<tr>
<td>Pers Growth</td>
<td>0.10</td>
<td>[-0.09, 0.29]</td>
<td>.00</td>
<td>[-.00, .00]</td>
<td>$\Delta R^2 = &lt;.001$</td>
</tr>
<tr>
<td>Partic Length</td>
<td>-0.14</td>
<td>[-0.58, 0.30]</td>
<td>.00</td>
<td>[-.00, .00]</td>
<td>$\Delta R^2 = &lt;.001$</td>
</tr>
<tr>
<td>PG*PL</td>
<td>0.02</td>
<td>[-0.05, 0.09]</td>
<td>.00</td>
<td>[-.00, .00]</td>
<td></td>
</tr>
</tbody>
</table>

$R^2 = .013^*$

95% CI[.00, .03]

*Note. A significant $b$-weight indicates the semi-partial correlation is also significant. $b$ represents unstandardized regression weights. $sr^2$ represents the semi-partial correlation squared. LL and UL indicate the lower and upper limits of a confidence interval, respectively.

* indicates $p < .05$. ** indicates $p < .01$. 
### Table 9

**Hypothesis 7 regression results using Graduate School Attendance as the criterion**

<table>
<thead>
<tr>
<th>Predictor</th>
<th>( b )</th>
<th>95% CI [LL, UL]</th>
<th>( sr^2 )</th>
<th>95% CI [LL, UL]</th>
<th>Fit</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>0.37**</td>
<td>[0.17, 0.58]</td>
<td>.00</td>
<td>[-.01, .02]</td>
<td>( \Delta R^2 = .001 )</td>
</tr>
<tr>
<td>Skill Dev</td>
<td>0.03</td>
<td>[-0.01, 0.07]</td>
<td>.00</td>
<td>[-.00, .00]</td>
<td>( \Delta R^2 = &lt;.001 )</td>
</tr>
<tr>
<td>Project Prod</td>
<td>0.00</td>
<td>[-0.01, 0.02]</td>
<td>.00</td>
<td>[-.00, .00]</td>
<td></td>
</tr>
<tr>
<td>SD*PP</td>
<td>-0.00</td>
<td>[-0.00, 0.00]</td>
<td>.00</td>
<td>[-.00, .00]</td>
<td></td>
</tr>
</tbody>
</table>

\[ R^2 = .006 \]

\[ 95\% \text{ CI} [.00, .02] \]

**Note.** A significant \( b \)-weight indicates the semi-partial correlation is also significant. \( b \) represents unstandardized regression weights. \( sr^2 \) represents the semi-partial correlation squared. LL and UL indicate the lower and upper limits of a confidence interval, respectively.

* indicates \( p < .05 \). ** indicates \( p < .01 \).
Table 10

Hypothesis 8 regression results using Graduate School Attendance as the criterion

<table>
<thead>
<tr>
<th>Predictor</th>
<th>$b$</th>
<th>95% CI</th>
<th>$sr^2$</th>
<th>95% CI</th>
<th>Fit</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>0.14</td>
<td>[-0.16, 0.44]</td>
<td>.01</td>
<td>[-.01, .03]</td>
<td>$\Delta R^2 = .001$</td>
</tr>
<tr>
<td>Pers Growth</td>
<td>0.07**</td>
<td>[0.02, 0.12]</td>
<td>.00</td>
<td>[-.00, .00]</td>
<td>$\Delta R^2 = &lt;.001$</td>
</tr>
<tr>
<td>Project Prod</td>
<td>0.00</td>
<td>[-0.02, 0.02]</td>
<td>.00</td>
<td>[-.00, .00]</td>
<td>$R^2 = .016^*$</td>
</tr>
<tr>
<td>PG*PP</td>
<td>-0.00</td>
<td>[-0.00, 0.00]</td>
<td>.00</td>
<td>[-.00, .00]</td>
<td>95% CI[.00,.04]</td>
</tr>
</tbody>
</table>

Note. A significant $b$-weight indicates the semi-partial correlation is also significant. $b$ represents unstandardized regression weights. $sr^2$ represents the semi-partial correlation squared. $LL$ and $UL$ indicate the lower and upper limits of a confidence interval, respectively.
* indicates $p < .05$. ** indicates $p < .01$. 
Table 11

Hypothesis 9 regression results using Work Self-Efficacy as the criterion

<table>
<thead>
<tr>
<th>Predictor</th>
<th>b</th>
<th>95% CI</th>
<th>sr²</th>
<th>95% CI</th>
<th>Fit</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>5.63**</td>
<td>[4.65, 6.62]</td>
<td>.00</td>
<td>[-.00, .00]</td>
<td></td>
</tr>
<tr>
<td>Skill Dev</td>
<td>0.00</td>
<td>[-0.20, 0.20]</td>
<td>.00</td>
<td>[-.00, .00]</td>
<td>ΔR² = .002</td>
</tr>
<tr>
<td>Sat w/ Mentor</td>
<td>-0.04</td>
<td>[-0.27, 0.18]</td>
<td>.00</td>
<td>[-.00, .01]</td>
<td>ΔR² = &lt;.001</td>
</tr>
<tr>
<td>SD*SM</td>
<td>0.02</td>
<td>[-0.03, 0.06]</td>
<td>.00</td>
<td>[-.00, .01]</td>
<td></td>
</tr>
</tbody>
</table>

ΔR² = .002

ΔR² = <.001

R² = .038**

95% CI [.01, .07]

Note. A significant b-weight indicates the semi-partial correlation is also significant. b represents unstandardized regression weights. sr² represents the semi-partial correlation squared. LL and UL indicate the lower and upper limits of a confidence interval, respectively.

* indicates p < .05. ** indicates p < .01.
Table 12

Hypotheses 10 and 11 regression results using Graduate School as the criterion

<table>
<thead>
<tr>
<th>Predictor</th>
<th>$b$</th>
<th>95% CI</th>
<th>$sr^2$</th>
<th>95% CI</th>
<th>Fit</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>0.60</td>
<td>[-0.69, 1.90]</td>
<td>.00</td>
<td>[-0.00, 0.00]</td>
<td>$\Delta R^2 = .001$</td>
</tr>
<tr>
<td>Skill Dev</td>
<td>-0.02</td>
<td>[-0.27, 0.23]</td>
<td>.00</td>
<td>[-0.00, 0.00]</td>
<td></td>
</tr>
<tr>
<td>Pers Growth</td>
<td>0.01</td>
<td>[-0.36, 0.38]</td>
<td>.00</td>
<td>[-0.00, 0.00]</td>
<td></td>
</tr>
<tr>
<td>Sat w/ Mentor</td>
<td>-0.11</td>
<td>[-0.40, 0.19]</td>
<td>.00</td>
<td>[-0.00, 0.01]</td>
<td>$\Delta R^2 = .001$</td>
</tr>
<tr>
<td>SD*SM</td>
<td>0.00</td>
<td>[-0.05, 0.06]</td>
<td>.00</td>
<td>[-0.00, 0.00]</td>
<td></td>
</tr>
<tr>
<td>PG*SM</td>
<td>0.02</td>
<td>[-0.07, 0.10]</td>
<td>.00</td>
<td>[-0.00, 0.00]</td>
<td></td>
</tr>
</tbody>
</table>

$R^2 = .017$

95% CI [.00, .03]

Note. A significant $b$-weight indicates the semi-partial correlation is also significant. $b$ represents unstandardized regression weights. $sr^2$ represents the semi-partial correlation squared. $LL$ and $UL$ indicate the lower and upper limits of a confidence interval, respectively. * indicates $p < .05$. ** indicates $p < .01$. 


<table>
<thead>
<tr>
<th>Predictor</th>
<th>$b$</th>
<th>95% CI [LL, UL]</th>
<th>$sr^2$</th>
<th>95% CI [LL, UL]</th>
<th>Fit</th>
<th>$\Delta R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>4.27**</td>
<td>[1.39, 7.15]</td>
<td>.00</td>
<td>[-.00, .00]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pers Growth</td>
<td>0.07</td>
<td>[-.46, .60]</td>
<td>.00</td>
<td>[-.00, .00]</td>
<td></td>
<td>$=.005$</td>
</tr>
<tr>
<td>Sat w/ Mentor</td>
<td>0.09</td>
<td>[-.57, .75]</td>
<td>.00</td>
<td>[-.00, .00]</td>
<td></td>
<td>$&lt;.001$</td>
</tr>
<tr>
<td>PG*SM</td>
<td>0.01</td>
<td>[-.11, .13]</td>
<td>.00</td>
<td>[-.00, .00]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$R^2 = .018^*$  
95% CI[.00,.03]

* indicates $p < .05$. ** indicates $p < .01$.  

Note. A significant $b$-weight indicates the semi-partial correlation is also significant. $b$ represents unstandardized regression weights. $sr^2$ represents the semi-partial correlation squared. LL and UL indicate the lower and upper limits of a confidence interval, respectively.
Figure 1

The full proposed model including hypotheses.
Figure 2

Initial SEM results testing the main hypotheses.

*Coefficient is significant at the .05 level.*
Figure 3

SEM results testing the main hypotheses with modeled error covariance for Skill Development items 3 and 14.
Figure 4

*SEM results testing the main hypotheses with items exhibiting error covariance excluded.*
Appendix A – Skill Development

Prompt: Please indicate how much you GAINED in the following areas AS A RESULT OF your CI experience.

Response Options:

1 = No gain due to CI
2 =
3 =
4 =
5 =
6 =
7 = Great gain due to CI

Items:

Understand information presented in courses outside CI.

Develop a sense of belonging within the Clemson community.

Develop a sense of belonging within my academic discipline.

Effectively manage my time.

Contribute to the ideas of a group.

Solve complex problems.

Understand what it is like to be a graduate student. (Even if you do not have an interest in higher level education such as graduate, medical, veterinary, pharmacy and law school.)
Clearly communicate my thoughts orally.

Clearly communicate my thoughts in written papers or reports.

Work independently.

Work collaboratively with others.

Serve as a leader.

Apply knowledge gained from CI or other courses to real world problems.

Understand the ethical issues surrounding my work.

*Citation:* Self-developed.
Appendix B – Growth Opportunities

Prompt: Please rate your level of agreement or disagreement with the following statements.

Response Options

1 = Strongly Disagree

2 =

3 =

4 = Neither Disagree nor Agree

5 =

6 =

7 = Strongly Agree

Items:

CI helped me see real world applications of information presented in my other classes.

CI helped to determine my plans for after graduation.

CI allowed me to network with professionals outside Clemson.

CI provided me opportunities not offered in the normal undergraduate curriculum.

I believe CI helped to prepare me for my future career.

I believe CI helped to prepare me for continuing education after graduation. (Even if you do not have an interest in higher level education such as graduate, medical, veterinary, pharmacy, and law school.)

CI allowed me to build relationships with other Clemson students and/or faculty.
CI allowed me to participate in the research process. (Where ‘research’ can be considered any investigation, discovery, design or problem-solving activity or project.)

CI taught me information relevant to my major/field of study.

CI gave me the chance to work with people in other majors/fields.

_Citation:_ Self-developed.
Appendix C – Graduate School Attendance

Prompt: Following your graduation from Clemson University, did you attend/are you currently enrolled in a post-graduate education program? (i.e., Masters, PhD, law school, doctor of medicine, etc.)

Response Options: yes/no
Appendix D – Work Self-Efficacy

Prompt: Please indicate your level of agreement with the following statements.

Response Options:
1 = Strongly Disagree
2 = Disagree
3 = Slightly Disagree
4 = Neither Agree nor Disagree
5 = Slightly Agree
6 = Agree
7 = Strongly Agree

Items:
Thanks to my resourcefulness, I know how to handle unforeseen situations in my job.
If I am in trouble at my work, I can usually think of something to do.
I can remain calm when facing difficulties in my job because I can rely on my abilities.
When I am confronted with a problem in my job, I can usually find several solutions.
No matter what comes my way in my job, I’m usually able to handle it.
My past experiences in my job have prepared me well for my occupational future.
I meet the goals that I set for myself in my job.
I feel prepared to meet most of the demands in my job.

Citation: Schyns & von Collani, 2002 (short form)
Appendix E – Career Choice Satisfaction

Prompt: Please indicate your level of agreement with the following statements.

Response Options:
1 = Very Unlikely
2 = Unlikely
3 = Slightly Unlikely
4 = Neither Likely nor Unlikely
5 = Slightly Likely
6 = Likely
7 = Very Likely

Items:
How satisfied are you with your choice in career? (this item is 1-7 very dissatisfied-very satisfied)
How likely is it that you will someday make a career change outside of your current field?
If you were to start over again knowing what you know now, how likely would you be to choose your current career?
How likely would you be to recommend your current field to others?

Citation: Clark, Murdock, and Koetting (2009)