ABSTRACT

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As interaction with technology increasingly permeates our daily routines, it has been argued that it is easier for humans to avoid social interactions, potentially leading to disconnections with family, friends, and society (McPherson, Smith-Lovin & Brashears, 2006; Parigi & Henson, 2014). This is often referred to as social disconnect. Social disconnect can be found widely but some groups are perceived to suffer from social disconnect worse than others (McPherson et al., 2006). Researchers have found that Science, Technology, Engineering and Mathematics (STEM) students are a group that tend to struggle with social disconnect (Cheryan et al., 2013a; Cheryan et al., 2013b; Fisher et al., 2002; Schott et al., 2000).

One-way researchers have studied this disconnect is through social connectedness. Lee and colleagues (2001) defined social connectedness as “an attribute of the self that reflects cognitions of enduring interpersonal closeness with the social world in toto” (p. 310). Social connectedness is important for all individuals as it has ties to an overall sense of wellbeing. At the most fundamental level, people are wired to socially connect (Crosier et al., 2012). Therefore, it’s important to understand social connectedness.

In the study, the main purpose was to examine and improve the social connectedness of STEM students. This was by done by incorporating recreational camp activities at a STEM summer camp for high-school students. The study examined the social connectedness of campers for pre-camp and post-camp using retrospective surveying. Two main takeaways were found. First, results showed that participation in both physical and non-physical activities improved post-test social connectedness scores. Second, results showed that both males and females significantly improved their social connectedness scores and no significant differences
were found when comparing males and females. In this research, camp programming was found to enhance the social connectedness of STEM students and this means that future researchers, colleges and STEM programs can continue to study and utilize the addition of camp activities to encourage social connectedness and relationship building between STEM students.
Camp Programming and Social Connectedness: A Study of STEM Students

by
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Caleb Gwaltney is a Masters student at North Carolina State University in the Department of Parks, Recreation and Tourism Management. His research generally focuses on youth development, recreational programming and sport studies. Caleb started as an undergraduate student at North Carolina State University, where he completed his undergraduate work in Sport Management. During graduate school, Caleb had the opportunity to work with the Department of Engineering on his research project with the help of Susan D’Amico and The Engineering Place. Without this partnership, his research would not have been possible. Moving forward, Caleb intends to continue working in the recreation and sport programming field as a professional.
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CHAPTER ONE: INTRODUCTION

As interaction with technology increasingly permeates our daily routines, it has been argued that it is easier for humans to avoid social interactions, potentially leading to disconnections with family, friends, and society (McPherson, Smith-Lovin & Brashears, 2006; Parigi & Henson, 2014). This is often referred to as social disconnect. Lee and Robbins (1995) define social disconnect as

“A person struggling to feel connected that begins to feel different and distant from other people. He or she may find it hard to accept social roles and responsibilities, leading the person into greater isolation. In the extreme case, the person may distance him or herself from society and lead a solitary life” (p. 233).

Social disconnect can be found in a wide array of groups but some groups are perceived to suffer from social disconnect worse than others (McPherson et al., 2006). A group that is often perceived or characterized by people and media as struggling with social disconnect are Science, Technology, Engineering, and Mathematics (STEM) students. Researchers have found that STEM students are subjected to negative stereotypes based on social skills deficits (Cheryan, Siy, Vichayapai, Drury, & Kim, 2011). In addition, researchers have found truth to these perceptions and shown that STEM students do struggle with social disconnect (Cheryan, Drury & Vichayapai, 2013; Cheryan, Plaut, Handron & Hudson, 2013; Fisher & Margolis, 2002; Schott & Selwyn, 2000).

The struggle with social disconnect is part of a larger issue that is currently hindering the STEM field. Currently, the STEM field covers a wide array of subjects. Breiner, Johnson, Harkness, and Koehler (2012) define STEM students as individuals engaged in the study of Science, Technology, Engineering or Math. This also includes computer science students in the
United States (Guzdial & Morrison, 2016). For a field that covers vast disciplines, it would seem likely that many students enter and stay in the field. However, this is not the case. Graham, Frederick, Byars-Winston, Hunter, and Handelsman (2013) state, “Less than half of the three million students who enter U.S. colleges yearly intending to major in a STEM field persist in STEM until graduation” (p. 1455). While at the same time, there are an estimated 2.4 million unfilled STEM jobs and growing yearly in the United States (White & Shakibnia, 2019). These issues tend to work in tandem and students leaving the STEM field could be due to a variety of reasons but one of those reasons is the struggle with social disconnect. One-way researchers have studied this disconnect is through social connectedness.

**What Is Social Connectedness?**

Many of the definitions of social connectedness emerge from social psychology. Social connectedness has been characterized as an attribute of the self that reflects cognitions of enduring interpersonal closeness with the social world overall (Lee, Draper and Lee, 2001). Further, the broad concept of social connectedness refers to the desire people have to create and maintain relationships, the social bonds they have with others, and the feeling of belongingness that results from these bonds (Baumeister & Leary, 1995; Grieve, Indian, Witteveen, Tolan & Marrington, 2013). Further, Lee and Robbins (1998) state,

> “the experience of interpersonal closeness in the social world includes proximal and distal relationships with family, friends, peers, acquaintances, strangers, community, and society. It is the aggregate of all these social experiences that is gradually internalized by the individual and serves as the foundation for a sense of connectedness. The enduring sense of connectedness provides people with a social lens with which to perceive the world in which they live” (p. 338).
For the purpose of this research paper, I will utilize Lee and colleagues (2001) definition of social connectedness. Lee and colleagues defined social connectedness as “an attribute of the self that reflects cognitions of enduring interpersonal closeness with the social world in toto” (p. 310). The emphasis of social connectedness is on the independent self in relation to others. This is different than belongingness as defined by group membership or peer affiliation (Baumeister & Leary, 1995) and loneliness as defined by emotional feelings regarding the loss of specific relationships (Marangoni & Ickes, 1989).

In their definition, Lee and colleagues (2001) suggests people with high connectedness tend to feel very close with other people, easily identify with others, perceive others as friendly and approachable, and participate in social groups and activities (Lee et al., 2001). Conversely, people who experience acute or repeated interpersonal failures in life (e.g., abandonment, peer rejection, isolation, criticism) experience narcissistic wounds to the self and are more likely to manifest low connectedness in adulthood (Lee & Robbins, 1995). These individuals often see themselves as outsiders, feel misunderstood by others, have difficulty relating with the social world, and are uncomfortable in social situations. Further, these individuals are “able to develop some relationships with people and groups, but they nevertheless feel a lack of connectedness deep within themselves that subsequently affects their ability to interact with the larger social world” (Lee et al., 2011, p. 310).

STEM Students

Research has shown the importance of the student’s peer group (Astin, 1977). The peer group is an important factor as the values, beliefs, and aspirations of individual students generally tend to change in the direction of the dominant values, beliefs, and aspirations of the peer group (Astin, 1977). This becomes more critical for students in the early adulthood stage, as
this stage is a key developmental period for establishing social connectedness and a more mature expression of belongingness (Baker & Baker, 1987; Lee & Robbins, 1995). Those who do not develop connectedness will showcase symptoms associated with a lack of belonging, including few friendships, lack of group participation, feeling unrelated to others, and even a lack of connection with society (Lee & Robbins, 2000). Thus, students in STEM need to develop their social connectedness.

Within the STEM field, male and female students face different experiences. Women remain a minority in the STEM field in the United States (Snyder, Dillow, & Hoffman, 2009). The low number of females in STEM fields may be partly attributed to low social connectedness. Bakan (1966) found that STEM careers are perceived as being especially incompatible with communion, or an orientation to care about other people. Women in particular tend to endorse communal goals (e.g., working with or helping other people), so they may be more likely than men to opt out of STEM careers in favor of careers that seem to afford communion (Diekman et al., 2010). Ultimately, if women feel more comfortable with relationships or people in STEM then they are more likely to have a sense of social connectedness (Lee & Robbins, 2000).

Women also face additional stereotypes which include that they are less naturally gifted, skilled, and represented across many STEM domains (Reuben, Sapienza & Zingales, 2014). These stereotypes can cause women to second guess their career. Clark, Dyar, Maung & London (2016) state, “if women begin to notice the underrepresentation of women in their STEM fields and signs within the environment, including messages from representatives of their STEM fields (e.g., peers, professors), suggesting that women are not valued as scientists, they may leave the profession” (p. 2). Additionally, STEM careers often tend to elicit thoughts of the "lone scientist" or technology and machinery which discourages women from joining initially (Diekman et al.,
2010). These widespread problems are difficult to change, but an enhanced sense of social connectedness could help (Good, Rattan & Dweck, 2012; Marra, Rodgers, Shen & Bogue, 2012).

**Why Social Connectedness Matters**

Social connectedness is important for all individuals as it has ties to an overall sense of well-being. At the most fundamental level, people are wired to socially connect (Crosier, Webster, & Dillon, 2012), they are social beings who strive to connect and form bonds with each other (Baumeister & Leary, 1995). Further, social connectedness can give individuals an enhanced sense of safety. A growing sense of safety and trust in others allow those social connections to develop (Aisenberg & Herrenkohl, 2008; Hammack, Richards, Luo, Edlynn & Roy, 2004). In addition, the development of close social relationships has positive links to well-being and life satisfaction (Baumeister & Leary, 1995; Diener & Seligman, 2002), positive affect, and low negative physical and psychological effects, like depression and ill health (Diener & Ryan, 2009).

Further, socially connected individuals experience higher life satisfaction and happiness, while a lack of social connectedness is associated with negative impacts such as depression, anxiety, or loneliness (Baumeister & Leary, 1995). Additionally, people with low connectedness tend to feel interpersonally distant from other people and from the world at large (Lee & Robbins, 1998; Lee et al., 2001). This research makes it clear that social connectedness is needed and that there is also a clear distinction between men and women with regards to social connections in STEM.
**Statement of Problem**

Due to growing technological advances and social disconnect, modern STEM students are not engaging socially with their peers and community (Cheryan, Drury & Vichayapai, 2013; Cheryan, Plaut, Handron & Hudson, 2013; Fisher & Margolis, 2002; Schott & Selwyn, 2000). Ultimately, it’s important to monitor, as a vast body of research has found that social connections have been essential to demonstrating achievement and persistence outcomes for students (Wilson et. al, 2015). Further, for STEM students, a lack of social connectedness and integration in their social system can directly impact individual learning and their lack of connectedness with their peers or advisors could cause them to leave college (Braxton, 2000; Enochs & Roland, 2006; Tinto, 1975). It has also been shown throughout literature that if connectedness issues are not addressed, it can result in negative health effects and a lower overall sense of well-being (Baumeister & Leary, 1995; Diener & Ryan, 2009). Therefore, it’s important to research and address these trends before the onset of college, so that STEM students have a better sense of social connectedness and relationship building when they enter the collegiate setting.

**Problem Intervention**

Social connectedness can be studied to improve social disconnect and this can be done in many ways. One way to potentially connect and overcome a lack of social connectedness could be through summer camp programming activities as an intervention. Summer camps are an ideal intervention because they provide an opportunity to impact social connectedness before the onset of college. Additionally, summer camps are a setting often characterized by unique relationship-building opportunities and are ideally situated to promote a connectedness among young people (Sibthorp, Browne & Bialeschki, 2010). Thus, a summer camp provides an excellent opportunity for providing camp programming with the intent to improve social connectedness. These
summer camps often provide youth with intra- and interpersonal skills, values and social competence (Thurber, Scanlin, Scheuler & Henderson, 2007; Bialeschki, Henderson & James, 2007; Henderson, Bialeschki & James, 2007). Further, a camper that is socially connected can experience benefits in the short and long term (Sibthorp et al., 2010). Based on these notions, a summer camp should be ideal for researching the social connectedness of STEM students.

Within recreation and summer camp programming, researchers have studied social connection through a variety of methods. According to Fraser-Thomas, Cote, and Deakin (2005), sport and physical activity programming experiences foster citizenship, social success, positive peer relationships, and leadership skills. In addition, Wankel and Berger (1990) highlight that through sport and physical activity, youth have opportunities to experience positive intergroup relations, community integration, social status, and social mobility.

However, the benefits of social connectedness are not limited to sport or physical activity. Research has shown that non-sport recreational environments can also improve social connectedness. The recreational nature of activities provides more opportunities for socialization which indicates that non-sport recreational environments can facilitate the building of social networks as well (Schulenkorf, Thomson & Schlenker, 2011). However, it should be noted that prior research has demonstrated the benefits of sports participation over no physical activity participation for positive youth development and that participation in a diverse set of activities is generally associated with more positive development for youth (Linver, Roth & Brooks-Gunn, 2009). Therefore, in this project, I will compare physical activity and non-physical activity programming. Ultimately, recreation and summer camp programming might be a potential intervention for improving social connectedness. However, this specific research topic and connection has yet to be explored.
**Purpose of this Study**

The main purpose of this study is to examine if summer camp programming can improve the social connectedness of STEM students. Within this, I compare campers who participate in both physical activities and non-physical activities against campers who participated in only non-physical activities. A second purpose I compare is the social connectedness of male and female STEM students. I utilize this study to fill two gaps in the current literature. The first gap is the study of STEM students, their social connectedness, and the use of summer camp programming to impact social connectedness. There has been no prior research that focuses on the combined impact of these topics. In addition, I will focus on rising eleventh and twelfth grade high school students. According to Garriott, Hultgren and Frazier (2017), “A limitation of the current literature on STEM… is its confinement to college student samples”. This study focuses on a population of high-school students/campers who are enrolled in a STEM summer camp. Thus, I will provide the field with new insight on upcoming collegiate students and will showcase the use of camp programming as an intervention within STEM populations with intent of improving social connectedness.
Research Questions

Research Question #1 (RQ1): How does camp programming impact the social connectedness of high school STEM students?

- RQ1A: Do campers who participate in both physical activity and non-physical activity significantly improve their social connectedness scores?
- RQ1B. Do campers who do not participate in physical activity significantly improve their social connectedness scores?
- RQ1C. Do males and females significantly improve their social connectedness scores?

Research Question #2 (RQ2): If campers felt their social connectedness improved, what were the reported reasons?
CHAPTER TWO: LITERATURE REVIEW

In this chapter, the theory and origin of social connectedness is defined. Following this, student development and its relationship to social connectedness will be discussed. Further, a review of how social connectedness has been studied will be presented. Next, literature related to connectedness/belonging in STEM and gender research in STEM will be reviewed. Succeeding these will be a section on the method that I intend to use for this project and a section on summer camps as an ideal place for activities will be covered. The section will be wrapped up with a conclusion of these topics.

Social Connectedness Theory

The theory of social connectedness derives from social capital theory. Most authors agree that social capital has its roots in social networks, some even define social capital simply as "social connectedness" (Carroll & Stanfield, 2003). In particular, Coleman’s view of social capital has close ties to social connectedness. According to Coleman (1988), social networks are essential to people because they provide embeddedness in systems of norms, control, and trust. However, social connectedness has grown into a standalone theory as social capital theory often has implicit political and civic ties including Coleman’s theory (1988). In modern social connectedness theory, the core focus is the aggregate of social experiences that is gradually internalized by the individual and the emphasis of social connectedness is on the independent self in relation to others (Lee et. al, 2001). Ultimately, the understanding of relationships is important for individuals and society but could be particularly useful to understand when researching students.
Student Development

An enhanced sense of social connectedness could be beneficial for student development. Astin (1977) explains, “The student's peer group is the single most potent source of influence on growth and development” (p. 398). “Every aspect of the student's development (cognitive, affective, psychological, and behavioral) is impacted in some way by peer group characteristics. Moreover, the values, beliefs, and aspirations of individual students generally tend to change in the direction of the dominant values, beliefs, and aspirations of the peer group” (Astin, 1977). However, peer groups are not the only factor in determining a student’s development. Bourdieu (1973) states, “the way that parents, teachers and advisors see and interact with students influences students’ expectations of themselves, their senses of fit in academic environments, and their future goals”. Thus, a student’s connectedness and peers can alter their development.

How Social Connectedness Impacts Student Development

Social connectedness carries importance in student development. One reason is that the late adolescence and early adulthood stage represent a critical developmental period for establishing social connectedness and a more mature expression of belongingness (Baker & Baker, 1987; Lee & Robbins, 1995). In this stage, students who exhibit low social connectedness, showcase symptoms associated with a lack of belonging, including few friendships, lack of group participation, feeling unrelated to others, and even a lack of connection with society (Lee & Robbins, 2000). Further, people who exhibit high levels of social connectedness tend to have better mental health, reduced mortality risks (Seeman, 1996) and better well-being (Lee et al., 2001). Therefore, a high level of social connectedness could improve the condition of students during this critical development stage. This research holds true for the STEM field as well.
Social Connectedness in STEM

Research in STEM fields have often shown that academic skills are necessary to thrive. However, social engagement (i.e., sense of belonging, connectedness) has been shown to be critical to predicting STEM success (Clark et al., 2016). Furthermore, Wilson and colleagues (2015) state, “that both social and academic connections have been essential to demonstrating achievement and persistence outcomes for students” (p. 571). In his study, Tinto (1975) proposed that academic persistence occurs by creating a space for educational expectations and commitments but also the academic and social systems within a college or university. Thus, integration into the academic and social systems is the best outcome for students.

A sense of connectedness has been shown to play a key role in persistence and interest within STEM majors (Wilson et al., 2015). Additionally, efforts to enhance connectedness among students... are likely to result in increased persistence in STEM majors (Wilson et al., 2016). Alternatively, a lack of connectedness can provide negative outcomes. Many researchers have found that a low sense of connectedness in one’s STEM field has been shown to undermine persistence in STEM (Rosenthal, London, Levy & Lobel, 2011; Good et al., 2012). Further, in a study of STEM students, a lack of belonging was found to be a significant contributor to students’ decision to leave engineering regardless of gender (Marra et al., 2012). In their study, Good and colleagues (2012) found gender differences in sense of connectedness in STEM fields, with women reporting a lower sense of connectedness than men. This supports earlier research that showcased that a lack of social connectedness or isolation has been found to be a major reason in women leaving engineering (Brainard & Carlin, 1998). However, even after these studies, this topic is still relatively unexplored and needs to be addressed.
Social Connectedness Gender Research

Another piece of social connectedness is examining relationships and bonds based on gender. Social connectedness has been found to impact men and women differently but also found to be equally important in women and men’s lives (Lee & Robbins, 2000). Further, Lee and Robbins (2000) found that college women and men differ in the types of relationships that satisfy the need for social connectedness. Women develop social connectedness through intimacy and physical proximity to others, whereas men develop connectedness through social comparison with others. “Social comparison in relationships occurs specifically through expressions of competency, power and status” (Lee & Robbins, 2000, pg. 2). Further, Lee and Robbins (1998) found in their research that women who lack social connectedness in their lives have lower self-esteem, are less satisfied with their social relationships, perceive their environments as more threatening, and are less likely to assume a social identity in social situations. Additionally, men are more likely than women to experience loneliness in college (Sundberg, 1988). Therefore, these studies show that women and men both need and value social connectedness. However, differences exist in the types of relationships that women and men pursue and in the outcomes of their relationships.

How Has Social Connectedness Been Studied?

There are several scales that have been used to measure social connectedness. Lee and Robbins (1995) developed the Social Connectedness Scale (SCS) to measure social connectedness. According to Lee et. al (2001), “in a series of studies, the SCS was validated as relatively distinct from proxy measures of connectedness such as social reassurance, social identity, loneliness, social support size, group membership, and social provisions” (pg. 311). The SCS is the only self-report scale available that measures social connectedness. Lee et. al (2001)
states, “despite its high internal item consistency and construct validity, the scale has psychometric limitations, including all negatively worded items and a negative skewness in the response distribution” (pg. 311).

A second scale that has been used is the Collective Self-Esteem Scale. The scale was developed to measure the self-esteem that arises from knowledge of membership in one's social groups combined with the emotional importance one attaches to being a member of that group (Luhtanen & Crocker, 1992). According to Lee et al., (2001), “The scale consists of 16 items evenly divided into four subscales. The Membership subscale measures the most individualistic of the four types of collective self-esteem, that is, how worthy one feels to belong to social groups. The Private subscale measures one's personal judgments about how good social groups are. The Public subscale measures one's judgments about how others evaluate the groups to which he or she belongs. The Identity subscale measures the most collectivistic of the four types of self-esteem, that is, one's determination of how membership in various groups contributes to identity” (p. 313). In the Collective Self-Esteem Scale, participants rate items using a 7-point Likert-type scale ranging from 1 (strongly disagree) to 7 (strongly agree). The higher scores on a given subscale indicate a greater level of self-esteem in each area (Lee et. al, 2001).

Another scale that can measure social connectedness is The UCLA Loneliness Scale. The scale was developed by Russell, Peplau and Ferguson (1978). The scale consists of 20 items, half reflecting emotional satisfaction with social relationships and half reflecting emotional dissatisfaction (Lee et. al, 2001). The UCLA Loneliness scale was originally developed because social connectedness scales were too lengthy and internal consistency widely varied (Russell et. al, 1978). Each statement on the scale is numbered 1-4, with statements ranging from “I never feel this way” to “I often feel this way”. At the end, the total score of participants ranges from
20-80 to determine their social connectedness. The UCLA Loneliness Scale has been validated in numerous ways and showcases a high internal consistency (Lee et. al, 2001).

Lastly, the Social Connectedness Scale - Revised (SCS-R) was created by Lee et. al (2001). According to Lee et. al (2001), “The SCS-R measures social connectedness as a psychological sense of belonging or, more specifically, as a cognition of enduring interpersonal closeness with the social world in toto (p. 316). The SCS-R scale consists of 20 items (10 positive and 10 negative) rated on a 6-point Likert scale. The scale assesses experiences of closeness in interpersonal contexts, as well as difficulties establishing and maintaining a sense of closeness. Sample items include "I feel disconnected from the world around me" and "I don't feel related to anyone." Negatively worded items are reverse scored so that a higher score indicates a greater degree of social connectedness (Williams & Galliher, 2006).

Social Connectedness in This Study

The social connectedness of STEM students was studied at a summer engineering camp and through camp programming activities by utilizing the Social Connectedness Scale-Revised (SCS-R). Camp activities can directly impact and create social connectedness within groups or a community. The camp activities that were included were sport and physical activities but also included creative activities, bonding activities and field trip opportunities.

Summer Camps

Research has shown that summer camps can have a positive impact on youth if designed correctly. However, positive outcomes do not just occur because adolescents attend camp; these desired outcomes must be planned, measured, and then incorporated (Garst et al., 2011). In their study, Roth and Brooks-Gunn showcased that the most effective summer camp programs offer primarily structured activities and limit the amount of unstructured time (2009). Thus, the
planning of activities is essential for summer camps. Planned camp activities promote youth development through features including experiential learning and choice. Direct experience is a powerful medium for learning, and camp activities commonly provide youth with opportunities for holistic engagement (Bialeschki, Henderson & James, 2007). By choosing activities in which to participate, campers are more likely to engage their intrinsic interests, a central component of youth development. It is not surprising that many campers report an overall sense of competence following their experience in summer camp activities (Hough & Browne, 2009).

A major benefit that summer camps provide is the strengthening of intra- and interpersonal skills, values and social competence (Thurber et al., 2007; Bialeschki et al., 2007; Henderson et al., 2007). Another skill that campers learn is connectedness. Connectedness can be described as one’s beliefs that they are cared for as an individual (Blum & Libbey, 2004). This is enhanced through supportive relationships with peers combined with setting characteristics such as sustained experiences. This fosters deep friendships with peers and adults and therefore a sense of belonging and connectedness (Gillard, Watt & Witt, 2009). Ultimately, a camper that is connected can experience benefits in the short and long term. Sibthorp and colleagues (2010) recognize the short-term benefits as academic achievement and competence, reduction in behavior problems in school, and improved social adjustment. Long-term, generalized benefits include reductions in trait anger and overall mental well-being (Sibthorp et al., 2010). Thus, connectedness is considered essential to the optimal development of young people (Eccles & Gootman, 2002; Pittman, Irby, Tolman, Yohalem & Ferber, 2003; Lerner, Lerner & Almerigi, 2005).

Another impact that summer camps can provide is physical benefits. Jago and Baranowski (2004) suggested that structured summer opportunities such as youth camps could
provide an opportunity for children to be physically active. Further, in their study, Hickerson and Henderson found that summer camps are a place where youth can participate in adequate amounts of physical activity while learning new skills and activities (2010). Additionally, camp professionals recognize health and physical inactivity as a pertinent issue (Hickerson & Henderson, 2014). This is important as past research has shown that youth physical activity rates decline as they enter adolescence (Gortmaker et al., 2012; Troiano et al., 2008) and some researchers have found that youth may be prone to sedentary behaviors during summer months because of a lack of structure and supervision throughout the day (Carrel, Clark, Peterson & Eickhoff, 2007). Thus, the need to offer structured varied activities is crucial and summer camps provide an optimal place for youth to experience physical activity.

**Conclusion**

In this chapter, a few important distinctions and connections have been made. First, it is made clear that social connectedness is the theory behind this research. Social connectedness stemmed from social capital theory and has ties to Coleman’s viewpoint (1988) but it’s essential to deviate from social capital theory because of the political and civic ties. Therefore, social connectedness can be used as the main theory and its emphasis on relationship building with regards to the independent self in relation to others is important (Lee et. al, 2001).

Further, the student’s peer group has been shown to have strong ties to social connectedness (Astin, 1977). Additionally, a sense of social connectedness has also been found to be important for persistence and interest in STEM (Clark et al., 2016; Wilson et al., 2015). Wilson and colleagues (2015) state, “that both social and academic connections have been essential to demonstrating achievement and persistence outcomes for students” (p. 571). Additionally, efforts to enhance connectedness among students... are likely to result in increased
persistence in STEM majors (Wilson et al., 2016). Other research has shown that low levels of social connectedness may cause a lack of persistence for students in STEM (London et al., 2011; Good et al., 2012).

Social connectedness has been found to impact men and women differently. Lee and Robbins (2000) found that college women and men differ in the types of relationships that satisfy their need for social connectedness. Women develop social connectedness through intimacy and physical proximity to others and men develop social connectedness through social comparison (Lee and Robbins, 2000). Further, Good and colleagues (2012) found gender differences in sense of connectedness in STEM fields, with women reporting a lower sense of connectedness than men. In a similar manner, Brainard and Carlin (1998) found a lack of social connectedness to be a key reason in women leaving engineering. Ultimately, this lack of social connectedness carries negative impact for both genders (Lee and Robbins, 1998; Sundberg, 1988).

Several scales have been explained in this review, which include the Social Connectedness Scale, the Collective Self-Esteem Scale, the UCLA Loneliness Scale and the Social Connectedness Scale - Revised. For the purpose of this study, the SCS-R will be utilized. The original scale was created by Lee and Robbins (1995) but has been adapted by Lee and colleagues (2001). The scale assesses experiences of closeness in interpersonal contexts, as well as difficulties establishing and maintaining a sense of closeness. For this study, I will adapt this scale for camp activities in a summer camp setting. Lastly, summer camps were shown to have been an ideal place to conduct a social connectedness study as they provide the perfect mix of recreational activities and opportunity to build connectedness among young adults (Sibthorp et al., 2010).
CHAPTER THREE: METHODS

The purpose of this study was to measure the impact of camp programming activities on high school STEM students. This chapter presents the methods that were used to conduct this study and how these relate to social connectedness. The research questions, design and setting have been outlined first. Followed by a discussion of the questions, participants and instrumentation. The subsequent sections will cover the measures that were used. Additionally, the original scale and adapted scale that have been created are showcased. Lastly, an explanation on how data analysis and procedure were conducted completes the chapter.

Research Design

This study implemented a quantitative approach using an online questionnaire to answer the outlined research questions. However, a few questions were asked that were qualitative. Survey questions were provided that do not refer to individuals by a specific name but rather questions that refer to their “social network” or general terms. A mostly quantitative method was purposeful for this study since the method focuses on aspects of social behavior which can be quantified and patterned rather than just finding them and interpreting the meanings (Rahman, 2017). Further, a quantitative research method attempts to investigate the answers to the questions starting with how many, how much, to what extent (Rasinger, 2013). In other words, this method lays heavy stress on measuring variables that exist in the social world (Rahman, 2017).

A quantitative design produces several key advantages. The first being that quantitative findings can potentially be generalized to a whole population or a sub-population because it involves a larger sample (Carr, 1994). The second advantage is that data analysis can be less time
consuming since data software can be used to produce results (Connolly, 2007). This was useful since this study was a large census.

**Research Setting and Census**

This study took place at North Carolina State University (NCSU) which has an established engineering department. NCSU hosts annual residential engineering summer camps for campers that focus on ten different engineering fields. For residential camps, campers are rising eleventh and twelfth graders that intend to or are considering majoring in STEM fields in college. Residential camps took place over the course of three weeks. On average, one-hundred and fifty campers participated in camp each week, which resulted in over four-hundred and fifty responses. In this project, all campers that attended were asked to complete a questionnaire at the end of their camp week. This study operated as a census for all engineering campers and responses were received from every camper unless they choose not to partake in the study.

**Participants and Instrumentation**

To begin, permission was granted from the Engineering Department at the university. These departments oversee the residential camps. Second, this study was approved by an Institutional Review Board (IRB) and since this project is being completed by minors, the permission of parents was needed to conduct this study and to use the data. After these were approved, all questionnaires were conducted on the final day of camp each week and this occurred three times. Each questionnaire was self-administered and was completed online through Qualtrics on computers provided to participants.

Prior to implementation, this study was pilot tested for clarity and understanding. The pilot test was conducted with summer camp counselors who are slightly older than participants in this study (18 and 19 years old compared to 16 and 17 years old). Although the counselors are on
average 1-2 years older than participants, they were able to provide feedback on the clarity of the questions and the scale.

Measures

This project utilized a retrospective post-then-pre design. The retrospective post-then-pre design is a popular way to assess learners’ self-reported changes in knowledge, awareness, skills, confidence, attitudes or behaviors. It takes less time, is less intrusive and for self-reported change, avoids pretest sensitivity and response shift bias (Howard, 1980; Rockwell & Kohn, 1989; Pratt, McGuigan & Katzev, 2000; Lam & Bengo, 2003). Further studies have suggested “that a more accurate assessment of changes in self-reported knowledge and behavior may be produced by retrospective designs than by the traditional pre-post design” (Pratt et al., 2000, pg. 343). Lastly, when surveying youth (under 18 years of age), response shift bias is more prevalent and youth often tend to overestimate their scores in pretests (Young & Kallemeyn, 2019). Therefore, it was important to utilize a retrospective design to minimize overestimation by youth.

In the traditional pre-post design, participants answer questions before a program, engage in the activity or course, then answer the same questions again after finishing the program. In the retrospective post-then-pre design, both before and after information is collected at the same time (Klatt & Taylor-Powell, 2005). This allows participants to assess themselves after the program and then they can reflect on how they were before the program more accurately. Additionally, in typical retrospective post-then-pre design, the post-test question often precedes the retrospective pretest question (Howard, Schmeck, & Bray, 1979). However, switching the question order may increase comprehension for youth, who need more time to process, understand and respond to surveys than adults (de Leeuw, 2011). Thus, this was done for the adapted scale in this study.
The main reason for selecting the retrospective post-then-pre design over the typical pre-post design is that the retrospective post-then-pre design works as a way to control response shift bias in the traditional pre-post design (Howard, 1980). Response shift occurs when a participant uses a different frame of understanding about a question between the pre- and post periods. It can create a problem when assessing self-reported change (Rockwell & Kohn, 1989). Often this response shift is due to the participant not being able to accurately assess their skills, knowledge or behaviors before the study (Klatt & Taylor-Powell, 2005). This is especially the case when conducting studies with youth (Young & Kallemeyn, 2019).

It’s also crucial to note the advantages that the retrospective post-then-pre design provides. The retrospective post-then-pre design provides more versatility than a regular pre-post design. Klatt and Taylor-Powell (2005) state, “the retrospective method has been used to evaluate many types of programs for different audiences in varied settings and appears to reduce response shift bias across contexts.” (p. 2). In addition, the retrospective post-then-pre design is more convenient for the data collector. Collecting responses for both measures at the same time gives you before and after data for each learner (Klatt & Taylor-Powell, 2005). By collecting both at the same time, the only way to lose data is if a participant does not complete their questionnaire.

**Context of Questions**

The questions for this study were related to camp activities and social connectedness. Each camp lasts five days and campers have a four-hour timeframe each day to engage in prearranged camp activities. The activities were designed based on four categories, which were field trips, bonding activities, creative activities and physical activities. These categories were chosen to provide the campers with a broad perspective of recreation. Five field trips were
planned for the camp. These included street shopping at local restaurants and stores, trips to go bowling, a trip to an arboretum, a trip to play disc golf and a trip to the local mall. For bonding activities, the purpose was to allow the campers to relax and connect with each other. Some of these activities included playing card and board games, karaoke, trivia and charades. Creative activities were designed to let students express themselves artistically. These activities included painting, graffiting, tie-dying clothing and spray painting. Lastly, physical activities were designed to get the campers moving and connecting while working on teamwork skills. These activities were wide ranging but included basketball, soccer, volleyball, walking in the park, swimming, kickball and disc golf.

**Social Connectedness Scale - Revised**

For the purpose of this study, the Social Connectedness Scale-Revised (SCS-R) was revised to fit this study. In addition, demographic information of campers was collected. The scale SCS-R branches from the Social Connectedness Scale (SCS) that was developed by Lee and Robbins (1995) according to psychoanalytic self-psychology theory (Kohut, 1984; Wolf, 1988). Originally, “the Social Connectedness Scale measured the degree of interpersonal closeness that is experienced between an individual and his or her social world (e.g., friends, peers, society) as well as the degree of difficulty in maintaining this sense of closeness” (Lee & Robbins, 1998, p. 339). However, Lee et. al (2001) found that the SCS scale had psychometric limitations, including all negatively worded items and a negative skewness in the response distribution.

Thus, the SCS-R was developed to eliminate response bias from the negative items. “The SCS-R scale measures an individual’s perception of self in relation to the social environment, using 20 self-report items (10 positive perceptions and 10 negative perceptions)” (Grieve et. al,
24

2013, p. 605). Negative perception items are reverse scored so when the scale is summed, higher scores indicate higher levels of social connectedness.

**Figure 1. The Social Connectedness Scale - Revised**

Directions: Following are a number of statements that reflect various ways in which we view ourselves. Rate the degree to which you agree or disagree with each statement using the following scale (1 = Strongly Disagree and 6 = Strongly Agree). There is no right or wrong answer. Do not spend too much time with any one statement and do not leave any unanswered.

Strongly Disagree 1, Disagree 2, Mildly Disagree 3, Mildly Agree 4, Agree 5, Strongly Agree 6

1. I feel comfortable in the presence of strangers........................................... 1 2 3 4 5 6
2. I am in tune with the world............................................................................ 1 2 3 4 5 6
3. Even among my friends, there is no sense of brother/sisterhood.................. 1 2 3 4 5 6
4. I fit in well in new situations.......................................................................... 1 2 3 4 5 6
5. I feel close to people........................................................................................ 1 2 3 4 5 6
6. I feel disconnected from the world around me.............................................. 1 2 3 4 5 6
7. Even around people I know, I don't feel that I really belong. ....................... 1 2 3 4 5 6
8. I see people as friendly and approachable.................................................... 1 2 3 4 5 6
9. I feel like an outsider....................................................................................... 1 2 3 4 5 6
10. I feel understood by the people I know........................................................ 1 2 3 4 5 6
11. I feel distant from people............................................................................. 1 2 3 4 5 6
12. I am able to relate to my peers..................................................................... 1 2 3 4 5 6
13. I have little sense of togetherness with my peers........................................ 1 2 3 4 5 6
14. I find myself actively involved in people’s lives........................................... 1 2 3 4 5 6
Figure 1. The Social Connectedness Scale – Revised (continued)

15. I catch myself losing a sense of connectedness with society………………… 1 2 3 4 5 6
16. I am able to connect with other people………………………………………… 1 2 3 4 5 6
17. I see myself as a loner………………………………………………………… 1 2 3 4 5 6
18. I don’t feel related to most people…………………………………………… 1 2 3 4 5 6
19. My friends feel like family……………………………………………………… 1 2 3 4 5 6
20. I don't feel I participate with anyone or any group………………………… 1 2 3 4 5 6
LSCS-R Scale

For this study, the Social Connectedness Scale-Revised (Lee et al., 2001) was adapted and split to measure social connectedness. Specifically, social connectedness before and after participating in camp programming activities. The focus of the scale was on the individual’s perception of self in relation to programming, others and social connectedness. Each scale consisted of 19 items adapted to reflect an individual’s feelings towards camp activities. In previous scales, negatively worded items were used. However, research on youth has shown that negatively formulated questions appear to have a negative effect on the reliability of responses (Otter, Mellenbergh & Glopper, 1995). Therefore, this scale was revised to remove negatively worded questions or items. Due to this, item number 11 was removed from the original scale because of repetitiveness.

Figure 2. Camp Programming and Social Connectedness Scale Before Camp (LSCS-R)

Directions: Following are a number of statements that reflect various ways in which we view ourselves. Rate the degree to which you agree or disagree with each statement using the following scale (1 = Strongly Disagree and 6 = Strongly Agree). There is no right or wrong answer. Do not spend too much time with any one statement and do not leave any unanswered. Strongly Disagree 1, Disagree 2, Mildly Disagree 3, Mildly Agree 4, Agree 5, Strongly Agree 6

1. I felt comfortable in the presence of strangers during camp activities…………….. 1 2 3 4 5 6
2. I felt in tune with the world……………………………………………………………… 1 2 3 4 5 6
3. I felt a sense of brother/sisterhood with people during camp…………………… 1 2 3 4 5 6
4. I felt that I fit in well when participating in new camp activities or situations…… 1 2 3 4 5 6
5. I felt close to people during camp activities............................................... 1 2 3 4 5 6
<table>
<thead>
<tr>
<th>Question</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. I felt connected to the people around me during camp activities</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>7. During camp activities, I felt that I belonged.</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>8. I saw people as friendly and approachable during camp activities</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>9. During camp activities, I was a willing participant</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>10. I felt understood by people during camp activities</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>11. I felt like I was able to relate to my peers during camp activities</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>12. I felt a great sense of togetherness with my peers during camp activities</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>13. I found myself actively involved in people’s camp activities</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>14. I had a strong sense of connectedness with society</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>15. I was able to connect with other people during camp activities</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>16. I saw myself as a contributor during camp activities</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>17. I felt related to most people during camp activities</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>18. My friends felt connected to me during camp activities</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>19. I feel that I participated well with groups or others in camp activities</td>
<td>1 2 3 4 5 6</td>
</tr>
</tbody>
</table>
Figure 3. Camp Programming and Social Connectedness Scale After Camp (LSCS-R)

For this scale, camp activities will be defined as all night-time and free-time activities that campers participated in during the camp week.

Strongly Disagree 1, Disagree 2, Mildly Disagree 3, Mildly Agree 4, Agree 5, Strongly Agree 6

1. I feel comfortable in the presence of strangers during camp activities................. 1 2 3 4 5 6
2. I feel in tune with the world................................................................. 1 2 3 4 5 6
3. I feel a sense of brother/sisterhood with people during camp.......................... 1 2 3 4 5 6
4. I feel that I fit in well when participating in new camp activities or situations...... 1 2 3 4 5 6
5. I feel close to people during camp activities........................................... 1 2 3 4 5 6
6. I feel connected to the people around me during camp activities..................... 1 2 3 4 5 6
7. During future camp activities, I now feel that I belong. ................................... 1 2 3 4 5 6
8. I see people as friendly and approachable during camp activities..................... 1 2 3 4 5 6
9. During camp activities, I will be a willing participant..................................... 1 2 3 4 5 6
10. I feel understood by people during camp activities..................................... 1 2 3 4 5 6
11. I feel like I can relate to my peers during camp activities............................. 1 2 3 4 5 6
12. I feel a great sense of togetherness with my peers during camp activities....... 1 2 3 4 5 6
13. I will try to be actively involved in people’s camp activities.......................... 1 2 3 4 5 6
14. I have a strong sense of connectedness with society.................................... 1 2 3 4 5 6
15. I am able to connect with other people during camp activities....................... 1 2 3 4 5 6
16. I see myself as a contributor during future camp activities............................ 1 2 3 4 5 6
17. I feel that I can relate to most people during camp activities.......................... 1 2 3 4 5 6
18. My friends feel more connected to me during camp activities........................ 1 2 3 4 5 6
19. I feel that I can participate well with groups or others in camp activities......... 1 2 3 4 5 6
In addition to the LSCS-R scale, a few open-ended questions were asked.

1. Which camp activities did you participate in?
2. Which activities did you enjoy the most?
3. If you felt your social connectedness, what are the reasons?

Analysis Procedure

The primary analysis of this data was conducted by using SPSS version 25 and the qualitative assessment was conducted using NVivo. To begin, the data was scanned for the presence of outliers, incomplete questionnaires and normality of distributions. This was completed to ensure that all questionnaires meet the assumptions of normality. Frequencies, means, standard deviations and intercorrelations between items were then examined. Internal consistency reliability analysis (Cronbach’s α) was used to estimate the internal reliability of the LSCS-R scale. Exploratory Factor Analysis (EFA) was conducted to determine if the factors loadings or acceptable (> .40) of measured (indicator) variables conform to what is expected based on previous research utilizing the SCS-R. After scale assessment, mean scores were calculated for LSCS-R pre and LSCS-R post.

For RQ1, a t-test was conducted to determine significant (p < .05) differences between LSCS-R pre and LSCS-R post mean scores based on physical activity. For RQ1, a t-test was conducted to determine significant differences within LSCS-R pre mean scores and LSCS-R post mean scores based on gender categories. An ANOVA test was conducted to investigate significant differences in LSCS-R scores based on gender from pre and post.

Finally, an Ordinary Least Squares (OSL) regression was conducted to predict the association of participation in different types of recreational activities and social connectedness
at camp. During the survey, campers selected the activities they participated in at camp. Based on the activities, I assigned a numbered value to each camper’s selections. For example, if they participated in basketball, dodgeball and kickball throughout the week, they were assigned a 3 for physical activities. This was also repeated for non-physical activities until each camper had an assigned numbered value for both physical and non-physical activities. The OLS regression was then conducted using the numbered values and the campers’ pre-test social connected score was used as the control variable.

For RQ2, a qualitative assessment was conducted using a thematic approach to evaluate camper responses. According to Braun and Clarke (2006), a thematic analysis is essentially a method for identifying and analyzing patterns in qualitative data. The researcher can then take patterns of meaning (themes) across a data set and make sense of shared meanings and experiences (Braun & Clarke, 2012). Thus, the qualitative assessment in this project was completed by scanning self-reported camper responses and identifying patterns or similar meanings in the responses. For example, if two campers both reported that “they enjoyed volleyball because it helped them make friends”, these would be grouped together. This process was repeated until clear themes could be identified, and this was carried out for all open-ended questions.
CHAPTER FOUR: RESULTS

The first step was to ensure that the scale loaded. Exploratory factor analysis (EFA) was run on the before camp (Table 1 & 2) and after camp items related to social connectedness (Table 3 & 4). This included nineteen measures to ensure that survey items grouped as expected. However, two items “I feel comfortable in the presence of strangers during camp activities and I feel in tune with the world” did not load. Therefore, the final EFA included a grouping of the remaining seventeen items. The before camp items loaded onto a single factor (Cronbach’s α = .957). These items were combined to a single variable using arithmetic mean ($M = 81.94$). The after camp items also loaded onto a single factor (Cronbach’s $a = .976$). These items were also combined to a single variable using arithmetic mean ($M = 85.01$). The result is a +3.07 overall change on the social connectedness scale for the items that loaded, and campers were tested on.

Table 1.

<table>
<thead>
<tr>
<th>Item</th>
<th>Initial</th>
<th>Extraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>I felt a sense of brother/sisterhood…</td>
<td>1</td>
<td>0.502</td>
</tr>
<tr>
<td>I felt that I fit in well…</td>
<td>1</td>
<td>0.607</td>
</tr>
<tr>
<td>I felt close to people during camp…</td>
<td>1</td>
<td>0.621</td>
</tr>
<tr>
<td>I felt connected to the people…</td>
<td>1</td>
<td>0.608</td>
</tr>
<tr>
<td>During camp activities…</td>
<td>1</td>
<td>0.657</td>
</tr>
<tr>
<td>I saw people as friendly…</td>
<td>1</td>
<td>0.522</td>
</tr>
</tbody>
</table>
Table 1. Exploratory Factor Analysis – Before Item Communalities (continued)

<table>
<thead>
<tr>
<th>Statement</th>
<th>Communalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>During camp activities… willing</td>
<td>0.404</td>
</tr>
<tr>
<td>I felt understood by people…</td>
<td>0.631</td>
</tr>
<tr>
<td>felt like I was able to relate…</td>
<td>0.601</td>
</tr>
<tr>
<td>I felt a great sense of togetherness…</td>
<td>0.681</td>
</tr>
<tr>
<td>I found myself actively involved…</td>
<td>0.609</td>
</tr>
<tr>
<td>I had a strong sense of connectedness…</td>
<td>0.545</td>
</tr>
<tr>
<td>I was able to connect with other people…</td>
<td>0.716</td>
</tr>
<tr>
<td>I saw myself as a contributor…</td>
<td>0.598</td>
</tr>
<tr>
<td>I felt related to most people…</td>
<td>0.629</td>
</tr>
<tr>
<td>My friends felt connected…</td>
<td>0.592</td>
</tr>
<tr>
<td>I feel that I participated well…</td>
<td>0.644</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis
Table 2.

<table>
<thead>
<tr>
<th>Item</th>
<th>Component 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>I was able to connect with other people…</td>
<td>0.846</td>
</tr>
<tr>
<td>I felt a great sense of togetherness…</td>
<td>0.825</td>
</tr>
<tr>
<td>During camp activities… belonged</td>
<td>0.810</td>
</tr>
<tr>
<td>I feel that I participated well…</td>
<td>0.802</td>
</tr>
<tr>
<td>I felt understood by people…</td>
<td>0.794</td>
</tr>
<tr>
<td>I felt related to most people…</td>
<td>0.793</td>
</tr>
<tr>
<td>I felt close to people during camp…</td>
<td>0.788</td>
</tr>
<tr>
<td>I found myself actively involved…</td>
<td>0.780</td>
</tr>
<tr>
<td>I felt connected to the people…</td>
<td>0.780</td>
</tr>
<tr>
<td>I felt that I fit in well…</td>
<td>0.779</td>
</tr>
<tr>
<td>felt like I was able to relate…</td>
<td>0.775</td>
</tr>
<tr>
<td>I saw myself as a contributor…</td>
<td>0.773</td>
</tr>
<tr>
<td>My friends felt connected…</td>
<td>0.769</td>
</tr>
<tr>
<td>I had a strong sense of connectedness…</td>
<td>0.738</td>
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</table>
Table 2. Exploratory Factor Analysis – Before Item Matrix $a$ (continued)

<table>
<thead>
<tr>
<th>Item</th>
<th>Factor Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>I saw people as friendly…</td>
<td>0.722</td>
</tr>
<tr>
<td>I felt a sense of brother/sisterhood…</td>
<td>0.709</td>
</tr>
<tr>
<td>During camp activities… willing</td>
<td>0.636</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis.

a. 1 components extracted.
<table>
<thead>
<tr>
<th>Item</th>
<th>Initial</th>
<th>Extraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>I feel a sense of brother/sisterhood…</td>
<td>1</td>
<td>0.665</td>
</tr>
<tr>
<td>I feel that I fit in well…</td>
<td>1</td>
<td>0.724</td>
</tr>
<tr>
<td>I feel close to people during camp…</td>
<td>1</td>
<td>0.751</td>
</tr>
<tr>
<td>I feel connected to the people…</td>
<td>1</td>
<td>0.780</td>
</tr>
<tr>
<td>During future camp activities… belong</td>
<td>1</td>
<td>0.747</td>
</tr>
<tr>
<td>I see people as friendly…</td>
<td>1</td>
<td>0.766</td>
</tr>
<tr>
<td>During camp activities… willing</td>
<td>1</td>
<td>0.633</td>
</tr>
<tr>
<td>I feel understood by people…</td>
<td>1</td>
<td>0.755</td>
</tr>
<tr>
<td>I feel like I can relate to my peers…</td>
<td>1</td>
<td>0.712</td>
</tr>
<tr>
<td>feel a great sense of togetherness…</td>
<td>1</td>
<td>0.770</td>
</tr>
<tr>
<td>I will try to be actively involved…</td>
<td>1</td>
<td>0.737</td>
</tr>
<tr>
<td>I have a strong sense of connectedness…</td>
<td>1</td>
<td>0.684</td>
</tr>
<tr>
<td>I am able to connect with other people…</td>
<td>1</td>
<td>0.760</td>
</tr>
<tr>
<td>I see myself as a contributor…</td>
<td>1</td>
<td>0.695</td>
</tr>
</tbody>
</table>
Table 3. Exploratory Factor Analysis – After Item Communalities (continued)

<table>
<thead>
<tr>
<th>Statement</th>
<th>Communalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>I feel that I can relate to most people…</td>
<td>1</td>
</tr>
<tr>
<td>My friends feel more connected…</td>
<td>1</td>
</tr>
<tr>
<td>I feel that I can participate well…</td>
<td>1</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis.
Table 4.

<table>
<thead>
<tr>
<th>Item</th>
<th>Component 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>I feel that I can relate to most people…</td>
<td>0.899</td>
</tr>
<tr>
<td>I feel connected to the people…</td>
<td>0.883</td>
</tr>
<tr>
<td>feel a great sense of togetherness…</td>
<td>0.877</td>
</tr>
<tr>
<td>I see people as friendly…</td>
<td>0.875</td>
</tr>
<tr>
<td>I am able to connect with other people…</td>
<td>0.872</td>
</tr>
<tr>
<td>I feel understood by people…</td>
<td>0.869</td>
</tr>
<tr>
<td>I feel close to people during camp…</td>
<td>0.866</td>
</tr>
<tr>
<td>During future camp activities… belong</td>
<td>0.864</td>
</tr>
<tr>
<td>I will try to be actively involved…</td>
<td>0.858</td>
</tr>
<tr>
<td>I feel that I fit in well…</td>
<td>0.851</td>
</tr>
<tr>
<td>I feel like I can relate to my peers…</td>
<td>0.844</td>
</tr>
<tr>
<td>I see myself as a contributor…</td>
<td>0.833</td>
</tr>
<tr>
<td>My friends feel more connected…</td>
<td>0.829</td>
</tr>
<tr>
<td>I have a strong sense of connectedness…</td>
<td>0.827</td>
</tr>
<tr>
<td>I feel a sense of brother/sisterhood…</td>
<td>0.815</td>
</tr>
</tbody>
</table>
Table 4. Exploratory Factor Analysis – After Item Matrix a (continued)

<table>
<thead>
<tr>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>I feel that I can participate well…</td>
</tr>
<tr>
<td>0.806</td>
</tr>
<tr>
<td>During camp activities… willing</td>
</tr>
<tr>
<td>0.796</td>
</tr>
</tbody>
</table>

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

Descriptive Statistics

Four hundred and fifty-one campers (N = 451) participated in this study. Of those 451, 78% (n = 350) completed the survey correctly. Sixty-four percent (n = 224) of all campers identified as males and thirty-six percent (n = 127) identified as females. Another identification option was available for campers to select but zero surveys were returned with this marked (see Table 5). Forty percent (n = 140) of the campers were high-school juniors and sixty percent (n = 211) were high-school seniors.
Table 5.

<table>
<thead>
<tr>
<th>Gender Identification</th>
<th>N</th>
<th>%</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>224</td>
<td>63.8</td>
<td>63.8</td>
</tr>
<tr>
<td>Female</td>
<td>127</td>
<td>36.2</td>
<td>100.0</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>351</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Week one of the summer camp had one hundred and twenty-two campers (35%), week two had one hundred and nineteen campers (34%) and week three had one hundred ten campers (31%).

**Statistical Analysis**

A paired samples t-test was conducted to see if camper perceptions of social connectedness significantly differ based on participation in camp activities (campers who participated in combo activities versus campers who participated in no physical activities). The results of the analysis (see Tables 6-8) showcased that those who participated in combo activities (n = 290) had statistically significant change (M before = 81.87, M after = 85.30) in their social connectedness scores (p < .000).
Table 6.

Paired Samples Statistics - Combo versus No PA

<table>
<thead>
<tr>
<th>Participation in Camp Activities</th>
<th>Mean</th>
<th>N</th>
<th>SD</th>
<th>Std. Error of Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combo (physical + non-physical)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 1 SC Before (SCB)</td>
<td>91.52</td>
<td>290</td>
<td>13.60</td>
<td>0.80</td>
</tr>
<tr>
<td>SC After (SCA)</td>
<td>95.17</td>
<td>290</td>
<td>13.90</td>
<td>0.82</td>
</tr>
<tr>
<td>No physical activity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 1 SCB</td>
<td>91.97</td>
<td>61</td>
<td>12.08</td>
<td>1.54</td>
</tr>
<tr>
<td>SCA</td>
<td>93.20</td>
<td>61</td>
<td>13.81</td>
<td>1.77</td>
</tr>
</tbody>
</table>

Additionally, when looking at participation in camp activities, the effect size for combo activities (r = .748) and non-physical activities (r = .821) are both considered large (Cohen, 1992).

Table 7.

Paired Samples Correlations - Combo versus No PA

<table>
<thead>
<tr>
<th>Participation in Camp Activities</th>
<th>N</th>
<th>Correlation</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combo (physical + non-physical)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 1 SC Before &amp; After</td>
<td>290</td>
<td>0.75</td>
<td>0.000</td>
</tr>
<tr>
<td>No physical activity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 1 SC Before &amp; After</td>
<td>61</td>
<td>0.82</td>
<td>0.000</td>
</tr>
</tbody>
</table>
Table 8.

<table>
<thead>
<tr>
<th>Participation in Camp Activities</th>
<th>Mean</th>
<th>SD</th>
<th>Std. Error Mean</th>
<th>95% CI Lower</th>
<th>95% CI Upper</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combo</td>
<td>-3.43</td>
<td>8.88</td>
<td>0.52</td>
<td>-4.458</td>
<td>-2.40</td>
<td>-6.58</td>
<td>289</td>
<td>0.000</td>
</tr>
<tr>
<td>SCB - SCA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No physical activity</td>
<td>-1.38</td>
<td>7.26</td>
<td>.930</td>
<td>-3.24</td>
<td>0.48</td>
<td>-1.48</td>
<td>60</td>
<td>0.144</td>
</tr>
<tr>
<td>SCB - SCA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Those who did not participate in physical activities ($n = 61$) had no statistically significant change ($M_{before} = 82.30$, $M_{after} = 83.67$) in their social connectedness scores ($p = .114$).

An analysis was also conducted to compare the two groups with a similar population ($n = 61$). Males ($n = 38$) and females ($n = 23$) were randomly selected from the combo activities group to match the gender pool of those who did not participate in physical activities. When looking at the demographically represented groups with similar population, the effect size for combo activities ($r = .799$) and non-physical activities ($r = .821$) are both considered large (Cohen, 1992). The results of the analysis (see Table 9) showcased that those who participated in combo activities ($n = 61$) had statistically significant change ($M_{before} = 81.75$, $M_{after} = 87.88$) in their social connectedness scores ($p < .000$).
Table 9.

Paired Samples Test - Combo versus No PA (61 vs. 61)

<table>
<thead>
<tr>
<th>Participation in Camp Activities</th>
<th>Mean</th>
<th>SD</th>
<th>Std. Error Mean</th>
<th>95% CI Lower</th>
<th>95% CI Upper</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combo</td>
<td>-6.13</td>
<td>8.23</td>
<td>1.05</td>
<td>-8.24</td>
<td>-4.02</td>
<td>-5.82</td>
<td>60</td>
<td>0.000</td>
</tr>
<tr>
<td>SCB - SCA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No physical activity</td>
<td>-1.38</td>
<td>7.26</td>
<td>.93</td>
<td>-3.24</td>
<td>0.48</td>
<td>-1.48</td>
<td>60</td>
<td>0.144</td>
</tr>
<tr>
<td>SCB - SCA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A paired samples t-test was conducted to analyze if social connectedness scores differed between male and female campers (see Table 10).

Table 10.

Paired Samples Test – Social Connectedness by Gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Mean</th>
<th>SD</th>
<th>Std. Error Mean</th>
<th>95% CI Lower</th>
<th>95% CI Upper</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>-3.21</td>
<td>8.20</td>
<td>.55</td>
<td>-4.29</td>
<td>-2.13</td>
<td>-5.86</td>
<td>223</td>
<td>0.000</td>
</tr>
<tr>
<td>SCB - SCA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>-2.83</td>
<td>9.42</td>
<td>.84</td>
<td>-4.49</td>
<td>-1.18</td>
<td>-3.39</td>
<td>126</td>
<td>0.001</td>
</tr>
<tr>
<td>SCB - SCA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Based on Cohen (1992), when examining social connectedness by gender, the measure of effect size for males was large ($r = .773$). Further, males ($n = 224$) showcased a statistically
significant difference in their social connectedness scores \((-3.21 \text{ mean change}, t = -5.58, p < .000)\). Additionally, females had a large effect size \((r = .729)\). Females also showed significant difference in their social connectedness scores \((-2.83 \text{ mean change}, t = -3.392, p < .001)\).

However, the results showcased that there was no statistically significant difference between genders. Overall, both genders significantly improved their social connectedness scores.

**Ordinary Least Squares (OSL) Regression**

OLS regression was used to predict the association of participation in different types of recreational activities and social connectedness at camp (see Table 11). Pre-test Social Connectedness was included in the model as a control variable. The final model estimated that each Physical Activity in which campers participated in was associated with an increase of .851 on post-test social connectedness scores and each Non-physical Activity in which campers participated in was associated with an increase of .820 on post-test social connectedness scores. Thus, both Physical and Non-physical Activity participation was associated with higher social connectedness scores at the end of the camp. Main effects for Gender and Camp Week were also tested in earlier models and were found to have no significant association with Post-test Social Connectedness.
Table 11:

OSL Regression of Pre-TSC, Physical Activities and Non-physical Activities

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>β</th>
<th>S.E.</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>17.265</td>
<td>--</td>
<td>3.434</td>
<td>&lt;.000</td>
</tr>
<tr>
<td>Physical Activities</td>
<td>.851</td>
<td>.097</td>
<td>2.463</td>
<td>.014</td>
</tr>
<tr>
<td>Non-physical Activities</td>
<td>.820</td>
<td>.083</td>
<td>2.108</td>
<td>.036</td>
</tr>
<tr>
<td>Pre-TSC</td>
<td>.774</td>
<td>.759</td>
<td>21.817</td>
<td>&lt;.000</td>
</tr>
<tr>
<td>N</td>
<td>350</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R²</td>
<td>.579</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Qualitative Analysis

Qualitative analysis was conducted on open-ended questions and RQ2. The open-ended questions asked campers about their favorite activities. A thematic word analysis was conducted to find themes and group similar responses from campers. Roughly forty-one percent of campers (n = 143) reported that physical activities were their favorite activities. These activities included volleyball, basketball, disc golf, soccer, swimming, walking at a local park, bowling, kickball, four-square and ultimate frisbee. Roughly twenty-seven percent of campers (n = 95) stated that their favorite activities were ones where they could “meet new people or hang out with friends”. Additionally, roughly nineteen percent (n = 67) of campers stated that their favorite activities were non-physical activities. This included trips off the campus to the local mall, an arboretum and businesses surrounding the campus. This also included activities like karaoke, card games, board games, trivia, painting, tie-dying shirts and painting an expression tunnel. To conclude,
roughly thirteen percent of campers \((n = 46)\) did not specify or provided no valid response for their favorite activity.

For RQ2, campers reported that their social connectedness improved because the camp activities gave them a chance to meet, interact and communicate with other campers. Campers indicated that they did not have this chance in the classroom setting and that the activities provided an outlet for socializing with their fellow campers. Additionally, the chance to find common interests during activities was reported as a reason for social connectedness improvement. Campers were able to find people who enjoyed similar activities, and this gave them the opportunity to participate together and socially connect with each other.
CHAPTER FIVE: DISCUSSION

Creating a sense of social connectedness is vital for all individuals because people are wired to be socially connected (Crosier, Webster, & Dillon, 2012) and people are social beings who strive to connect (Baumeister & Leary, 1995). Further, the development of an individual’s social connectedness returns positive benefits related to health, happiness and life satisfaction (Baumeister & Leary, 1995; Diener & Seligman, 2002). Although studies have shown the benefits of improving social connectedness, it has remained relatively unexplored in STEM research. Further, previous studies in STEM research have not examined the influence of summer camp programming on peer to peer social connection. Therefore, the main purpose of the study was to examine if summer camp programming could improve the social connectedness of STEM students. A second purpose was to understand the differences in social connectedness between male and female STEM students. Lastly, it was important to understand why campers thought their social connectedness improved.

RQ1 asked about the impact of camp programming on the social connectedness of high school STEM students. RQ1A and RQ1B focused on whether camper perceptions of social connectedness significantly differed based on participation in camp activities (campers who participated in both physical activity and non-physical activity versus campers who participated in no physical activities). Ordinary linear regression results showed that participation in both physical and non-physical activities were found to improve post-test social connectedness scores. These findings are consistent with research demonstrating that participation in a diverse set of activities is generally associated with more positive development for youth (Linver, Roth & Brooks-Gunn, 2009). Thus, both physical activities and non-physical activities are usable when attempting to impact social connectedness.
RQ1C compared male and female campers’ social connectedness scores. Results showed that both males and females significantly improved their social connectedness scores and no significant differences were found when comparing males and females. The results contrast prior research that showcased that men and women experience different levels of social connection and integration in STEM (Sax, 1994). However, it should be noted that a possible explanation for this finding could be because this study is the first to examine male and female differences outside of the classroom or workplace environment and with a focus on social connectedness in summer camp programming.

RQ2 asked campers why they felt their social connectedness improved. First, campers reported that the activities gave them a chance to meet, interact and communicate with other campers. Socialization was an inherent part of these activities and provided this chance. Previous research has highlighted the importance of socialization and peer interactions as an important form of social engagement among adolescents and a necessary component of human development (Hodges, Boivin, Vitaro, & Bukowski, 1999; Kroger, 2007). The activities also gave campers a chance to meet others outside of their engineering workshop groups. In addition, many campers added that the activities “forced them out of their comfort zone but in a good way”. Ultimately, campers reported that this improved their ability to connect socially. Second, the chance to find common ground or interests and bond through activity was a driving force behind campers’ self-reported social connectedness improvement. This supports previous research that has stated that friendship and similar interests are highly correlated (Yang et al., 2011). Many campers alluded to this in their responses and felt that similar interests were a key factor in improving their ability to socially connect with their peers.
The findings in this research lead to a few conclusions. First, participation in physical and non-physical activities has a positive impact on self-reported social connectedness. It’s important that STEM organizations incorporate both in their programs, curriculum or activities to encourage positive student relationships and social connectedness. Second, study findings contrasted previous research that reported differences between male and female stem student experiences (Brainard & Carlin, 1998; Good et al., 2012; Sax, 1994). Having STEM students participate in camp programming activities could be a bridge for closing the student gender gap in STEM education fields.

This research could possibly help to provide a way to lower the attrition rate in STEM education and could be a way to narrow the gender gap. In this research, camp programming was found to enhance the social connectedness of STEM students and this means that future researchers, colleges and STEM programs can continue to study and utilize the addition of camp activities to encourage social connectedness and relationship building between STEM students. Ultimately, more studies will need to be conducted to show that physical activity and recreation is a key concept that should be incorporated into STEM fields.

Limitations

As with any research study, there are a few limitations that should be noted. The most important limitation in this study was the lack of control over activities. Campers were able to choose the activities they participated in and this meant that they were not random. The sample size for participants who did not participate in physical activity was still reasonable \((n = 61)\) but could benefit from being similar in size to those who did participate in physical activity. Due to this, researchers should seek to control the activities that participants engage in.
A second limitation was the age of participants (16-17 years old). The scale and questions for this study had to be changed to account for the age of participants and if this had not been done, the responses and implications of this study could have been different. Additionally, many of the surveys that were returned were not completed properly and had inadequate or irrelevant responses. Additionally, with this age range, it could be difficult to transfer these results to college-aged populations (18+ years old). Although close in age, these populations could have vastly different answers based on their experiences on a college campus versus their experiences at a summer camp while on a college campus.

A third potential limitation was the influence of summer camp counselors on participants. For this summer camp, there were fourteen counselors that ran or implemented these summer camp activities with groups of campers (twelve-fourteen per group). It’s possible that the summer camp counselors could have had an influence on the ability of campers to socially connect or participate within the individual activities. Although not a major concern, it should be noted. Future studies could change this by utilizing one person to incorporate activities for STEM students.

**Recommendations for Future Research**

After conducting this research and thoroughly reviewing the process, I have a few recommendations for future researchers. First, researchers need to have control over the activities that are selected for campers. This needs to occur in two ways. The researcher needs to carefully select activities that incorporate a broad range of activities, can easily be conducted and that can easily be evaluated. The researcher also needs to control the activities that people participate in, so that participants are not self-selecting whether they participate in physical activities. This can
be done randomly and can ensure that results are not being biased because of participant self-selection.

Second, I recommend that researchers attempt to analyze camp or recreational programming at a university or with college students. This research was conducted on upcoming college students, but future research could benefit by focusing on enrolled STEM students. For example, there are currently programs being run that could be evaluated. Students in the College of Engineering and Applied Science at the University of Colorado Boulder are participating in restricted STEM student only dance and hip-hop courses (Bruner, 2019). The possibilities to conduct research are available and research on STEM populations needs to be conducted. This will allow a greater understanding of STEM student social connectedness and the impact of summer or recreational camp programming.

Third, I recommend having continuity throughout the activities that are being implemented with regards to the instructor. It’s important that each participant receives the same instruction, motivation and context in their activities. In this research, the different counselors could have impacted participants differently and provided them with a different sense of social connectedness. Removing that variability could provide consistent results for future studies. In addition, I would encourage future researchers to ensure that they have a good control. A good control and continuity with regards to instruction should provide more consistent results in future studies.

Conclusion

The main purpose of the study was to examine if summer camp programming could improve the social connectedness of STEM students. To recap, Lee and colleagues (2001) definition of social connectedness was utilized, which is “an attribute of the self that reflects
cognitions of enduring interpersonal closeness with the social world in toto” (p. 310). In this definition, the emphasis of social connectedness is on the independent self in relation to others. Based on this definition and purpose, a conclusion can be made that the social connectedness of STEM summer campers can be significantly improved by camp activities, which includes both physical and non-physical activities.

A second purpose was to understand differences between male and female STEM campers. Men and women in STEM face different stereotypes (Clark et al., 2016; Diekman et al., 2010; Reuben et al., 2014), career compatibility (Bakan, 1966) and women tend to be underrepresented (Snyder et al., 2009). Prior research has stated that an enhanced sense of social connectedness could mend these differences, so it was important to gain an understanding of these differences (Good et al., 2012; Marra et al., 2012). Contrary to previous research, a conclusion can be made for this population that no significant difference exists in social connectedness between male and female STEM campers. However, this could be due to a variety of uncontrollable reasons and needs to be researched further in the future. Ultimately, additional studies need to be conducted on summer camp activities and social connectedness to gain an understanding of these factors and their connection to each other.
REFERENCES


