PROMOTING STEM MOTIVATION IN AMERICAN INDIAN ADOLESCENTS: AN INTERVENTION

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A dissertation submitted to the faculty at the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Psychology and Neuroscience in The Graduate School.

Chapel Hill
2017

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ABSTRACT

Adam J. Hoffman: Promoting STEM Motivation in American Indian Adolescents: An Intervention
(Under the direction of Beth Kurtz-Costes)

It has been documented that American Indians and girls consistently underperform in STEM achievement compared to their European American and male counterparts, starting as early as adolescence. The goal of the current study was to develop a brief intervention aimed at mitigating the STEM achievement gap by shaping ethnic and gender identities to be congruent with STEM motivation among American Indian middle school students. For the intervention, 212 (\(M_{\text{age}} = 12.7\)) American Indian middle school students were randomly assigned to one of four experimental conditions or a control condition. Students in each condition were given a biography and photograph of a successful STEM scientist, a list of positive characteristics (e.g., hard-working, responsible, etc.), and paper. After reading the biography, students in the experimental conditions wrote a short, self-affirmation essay using the list of characteristics provided and describe how they shared the same characteristics as the scientist and why the characteristics were important. In the control condition, students read a biography of a scientist and used the list of characteristics to write an essay explaining why other people might find those characteristics important. The experimental conditions matched the student and scientist featured in the biography on ethnicity but not gender; gender but not ethnicity; both ethnicity and gender; or no match on ethnicity or gender. I hypothesized that students who were assigned to an
experimental condition (i.e., engaging in the self-affirmation task) would have significant increases in science motivation measures compared to students who were assigned to the control condition. Further, I hypothesized a matching effect of the scientist to the student in intervention efficacy, such that students who were matched to the scientist on ethnicity and gender would have the largest increases in science motivation and students who were not matched to the scientist on ethnicity or gender would have the smallest increases in science motivation. Next, I hypothesized that students who were matched to the scientist on ethnicity would have increases in dimensions of ethnic identity (e.g., ethnic centrality or ethnic regard), compared to students who were not matched to the scientists on ethnicity or students in the control condition, where no increases in ethnic identity were expected. Similarly, students who were matched to the scientist on gender would have increases in dimensions of gender identity, compared to students who were not matched to the scientists on gender or students in the control condition, where no increases in gender identity were expected. Finally, I hypothesized that students with higher levels of ethnic or gender centrality would report greater increases in science motivation when matched to the scientist on ethnicity or gender, respectively, compared to students with lower levels of ethnic or gender centrality. A series of repeated-measures analyses of covariance and multiple regression analyses were conducted to test the study questions. In general, results did not support study hypotheses. Implications and directions for futures research regarding self-affirmation theory and practice via intervention are considered.
This dissertation is dedicated to Beth, my mentor, and Gavin, my partner in life and beloved. From the bottom of my heart, thank you both for all that you have given me. You have deeply enriched my life in so many ways and I will always cherish our time together.
ACKNOWLEDGMENTS

Many individuals and organizations were integral in the planning and implementation of this dissertation research. I would like to thank the organizations that offered grant funding to support either myself or the dissertation study; The American Psychological Association’s Division 9 – The Society for the Psychological Study of Social Issues, The National Science Foundation, and The Department of Psychology and Neuroscience at The University of North Carolina at Chapel Hill (UNC). I offer sincere thanks to the Native Nation (most specifically, the Nation’s IRB and Tribal Council) for allowing me to conduct this research with participants from this Nation. I am grateful to the teachers and school administration for their flexibility and support facilitating the data collection process. I thank the participants who took the time to participate in the study. To Chelsea Nehler, I am grateful for our conversations and the thoughts and ideas that you contributed toward the study, making it as strong as possible. Thank you, Brenda Allen, for helping me collection a majority of the data. I really appreciate you literally running from classroom to classroom with me to collect the data. I would like to thank Gavin Huskey for introducing me to this Nation and supporting me and my ideas regarding ways I could potentially aid this Nation and other Native communities. To the Identity and Motivation Lab (or BKC Lab) thank you for all of your support over the years and with the help received specifically for this dissertation. I would like to thank Dr. Peter Ornstein for his speculation and encouragement of this study and supporting me from the very first stages in the conceptualization of the study. I offer a hearty thanks to Randi Byrd, Dr. Amy Locklear Hertel,
and the rest of the staff at the American Indian Center at UNC for their guidance and support in helping me learn about how to engage in research with Native Nations and communities. I would like to thank my mother (Meredith Hoffman), sister (Angela Taulbee), uncle (Karl Jernstedt), and grandparents (Maurice and Noma Jernstedt) and the rest of my family for their continued support and encouragement of my education from preschool to graduate school. Finally, I offer a million thank yous to my mentor, Dr. Beth Kurtz-Costes. Without her support, dedication, and hard work, this dissertation would not have possible. This study was so meaningful to me. Thank you for allowing me to pursue my goals and dreams over the past five years, Beth.
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CHAPTER 1: INTRODUCTION

Recent data from the United States National Science Board have revealed that since 2000, members of underrepresented groups in science and engineering, namely American Indians and women, have increasingly enrolled in science and engineering post-secondary degree programs (National Science Board, 2014). Not only are members of these groups enrolling in science and engineering programs at increased rates, they are graduating at increased rates, as well. For example, between 2000 and 2012, the percentage of science and engineering doctoral degrees earned by American Indians/Alaska Natives in United States, increased from 0.42% to 0.45% of all such degrees awarded (National Science Board, 2014). Similarly, women earned approximately 43% of science and engineering doctoral degrees in 2000, and by 2012 that number had increased to 46% (National Science Board, 2014). American Indians/Alaska Natives and women represent approximately 0.90% and 49% of the college-age population of the United States, respectively (National Science Board, 2014). Thus, in spite of these gains, these groups are still underrepresented in science and engineering doctoral degree attainment.

Researchers have found only a small narrowing of ethnic/racial and gender achievement gaps in STEM education in the past 20 years (National Science Board, 2014). These ethnic/racial and gender achievement gaps are observed as early as elementary and middle school, respectively. Among ethnic/racial minority groups in the United States, American Indians consistently have the lowest levels of math and science achievement (National Assessment of Educational Progress (NAEP), 2015a; NAEP, 2015b), and an achievement gap in standardized
mathematics and science scores between American Indian and White students appears as early as the 4th grade (NAEP, 2011). In terms of the gender achievement gap, boys begin to outperform girls in math and science in the 8th grade, and this gap widens as students proceed to high school and post-secondary education (NAEP, 2015a; NAEP, 2015b).

Given these persistent achievement gaps, researchers are investigating how various social psychological phenomena are related to and may be important actors in the formation and maintenance of motivation, and subsequently, achievement. One such phenomenon that has been shown to be related to motivation is social identity. Indeed, research suggests that various dimensions of social identities (e.g. ethnic/racial or gender centrality) are related to a host of academic outcomes, including motivation (Rivas-Drake et al., 2014; Rogers, Scott, & Way, 2015; Leaper, Farkas, & Brown, 2012).

The current study was an intervention grounded in developmental and social psychological theory, with aims of increasing STEM motivation by promoting positive ethnic and gender identities among American Indian middle school students. In the study, students engaged in a self-affirmation task, reading a biography of a pictured STEM scientist. Conditions varied according to whether the scientist was matched to the student on ethnic and/or gender identities. After reading the biography, students choose three positive traits from a word bank and wrote a short essay describing how they shared those traits with the scientist. I hypothesized that students who made self-affirmations with a STEM scientist of the same ethnicity and gender as themselves would report increased STEM motivation (i.e. science interest, science self-efficacy and approach goal orientations).

**Fostering Motivation to Close STEM Achievement Gaps**

Numerous theories and empirical studies have demonstrated the importance of motivation
in shaping academic achievement (Winne & Nesbitt, 2010). Among the many motivational factors that have been examined, researchers have studied academic self-efficacy, individual interest, and approach goal orientations (Cromley, Perez, & Kaplan, 2016; Winne & Nesbitt, 2010). Academic self-efficacy is defined as the belief that one has the ability to successfully complete an academic task (Schunk, 1991). Robust effects suggest that academic self-efficacy is a strong predictor of academic achievement across various indices and subject domains (Schunk & Pajares, 2005). Individual interest represents a student’s enduring predisposition to attend to specific academic tasks, activities, or subject domains and is a significant predictor of academic achievement (Eccles & Wigfield, 2002; Hidi, 2006). Finally, approach goal orientations have also demonstrated strong relations to and prediction of academic achievement. Broadly, goal orientations can be defined as the purpose for behavior that is pursued in competence-relevant settings (Midgley, Kaplan, & Middleton, 2001).

These motivational factors and their effects on academic achievement are well-established (Meece, Anderman, & Anderman, 2006; Winne & Nesbit, 2010). Thus, in the development of interventions aimed at increasing STEM achievement in American Indians, an avenue of success could be derived from fostering the promotion of STEM self-efficacy, individual interest, and approach goal orientations. In the current intervention study, STEM self-efficacy, individual interest, and approach goal orientations were used as the primary outcome measures to assess the efficacy of the intervention. Moreover, students’ social identities—in particular, aspects of their ethnic/racial and gender identities—were expected to play a significant role in the efficacy of the intervention.
The Development of Social Identities

It is clear that from a young age children categorize themselves and others using the social identities of ethnicity/race and gender. As early as three months old, infants can discern adult faces of different genders, and infants at six months of age can discern between faces of different races (Katz & Kofkin, 1997; Quinn, Yahr, Kuhn, Slater, & Pascalis, 2002). By the ages of 3 and 4, children are able to accurately label and sort others on the basis of ethnic/racial and gender identities, respectively (Aboud, 2003; Leinbach & Fagot, 1986). By the early elementary school years, children express stereotypes associated with ethnic/racial and gender identities (Ambady, Shih, Kim, & Pittinsky, 2001). Youth’s understanding of social identities is developing as they age through childhood, however it is not until adolescence that youth are equipped with advanced social cognition and socioemotional development (e.g. more developed introspection, metacognition, and abstract thinking) needed to explore their own social identities and decide what these identities mean to them (Umaña-Taylor et al., 2014).

One of the primary tasks of adolescence is the development of identity. In his theory of psychosocial development, Erikson (1993) posited that adolescents seek to resolve role confusion by exploring and experimenting with different possible identities to find a personal identity that provides a unique, but positive fit for the individual. This normative development of individual or personal identity is shaped in part by youth’s understanding of social identities such as ethnicity/race and gender. For example, during adolescence youth develop more advanced capacities in the interpretation of social experiences, including understanding how social group membership could impact their life choices or the interactions they have with others (Quintana, 1998, Umaña-Taylor et al., 2014).

Since the inception and continued advancement of research regarding social identities
and their development, a prevailing distinction that has emerged in identity models are content and process models of identity (Umaña-Taylor et al., 2014). Process models of identity are inherently developmental, as these models aim to identify how identity develops from an unexamined or nonexistent state to a fully achieved state of identity (Schwartz et al., 2014). In contrast, the primary goal of content models is to identify the different parts or dimensions that work jointly to offer an overall conception of an identity (Schwartz et al., 2014). Put simply, process models represent how identities develop, and content models represent what dimensions characterize an identity. For the purpose of the current study, I examined the content of identity. For a review of models of process identity see Phinney (1989).

Many content models of identity have been developed to explain various dimensions of ethnic/racial and gender identities. Utilizing theoretical principles from various social identity theories, Sellers, Smith, Shelton, Rowley, and Chavous (1998) developed the Multidimensional Model of Racial Identity (MMRI), a content model of racial identity for African Americans. Four components or dimensions of African American racial identity were identified in their model: salience, centrality, regard, and ideology. Sellers et al. defined racial identity in African Americans as “the significance and qualitative meaning that individuals attribute to their membership within the Black racial group within their self-concepts” (Sellers et al., 1998, page 23). Consequently, the goal of the dimensions of this model is to recognize both the significance (salience and centrality) and meaning (regard and ideology) of being African American with regard to an individual’s self-concept. Given this model’s theoretical grounding in social identity theory, some of the model dimensions have been assessed in other ethnic/racial groups (e.g. Puerto Rican, Dominican, and Chinese Americans; Rivas-Drake, Hughes, & Way, 2009) and even in other social identities (e.g., religious centrality and gender regard; Davis & Kiang, 2016;
Rogers et al., 2015), as some of these dimensions are believed to be universal among all social identities. Centrality (the degree of importance a particular social identity has for an individual) and regard (the meaning and affect toward an in-group social group) are two dimensions of identity that can be applied to other ethnic/racial groups and to other social identities. For example, researchers have measured gender centrality and regard among adolescent youth (Rogers et al., 2015; Wilson & Leaper; 2016).

**Social Identities and Relations to Academic Outcomes in Adolescence**

Adolescence is an important developmental period in terms of youth’s understanding of and decisions about possibilities for their educational and occupational futures (Kroger, 2003). Two divergent theoretical perspectives have emerged in the explanation of the relation between racial/ethnic identity and academic outcomes. It is important to note that these models were developed for explaining the potential relations between ethnic/racial identities and academic outcomes in African Americans. However, many aspects of these perspectives can be applied to American Indians.

The first theoretical perspective posits that group identification and the understanding of social barriers that ethnic/racial minority adolescents may face are protective and facilitate positive academic outcomes (O’Connor, 1999; Sanders, 1997). This perspective suggests that adolescents can learn about and understand racism and the past and current struggles for education among their ethnic/racial group. Learning about racism and the struggles their ethnic/racial group face, adolescents may develop a stronger sense of ethnic/racial group community (Spencer, Noll, Stolzfus, & Harpalani, 2001). Thus, a stronger connection to their ethnic/racial group and pride in their ethnic/racial identity enables youth to be resilient when they encounter negative academic stereotypes and discrimination. According to the other theoretical
perspective, adolescents’ awareness of race-related barriers leads to academic disengagement (Fordham, 1988; Fordham & Ogbu, 1986). Therefore, having a stronger connection to an ethnic/racial identity might result in declines in motivation.

Over the past 20 years, researchers found empirical support for both of these theoretical perspectives (Rivas-Drake et al., 2014, Rogers et al., 2015; Wilson & Leaper, 2016). Across various studies with different ethnic/racial minority youth samples, research has shown positive correlations between dimensions of ethnic/racial identity similar to ethnic/racial centrality, private regard, and public regard and academic achievement and motivation (e.g., Adelabu, 2008; Chavous, Rivas-Drake, Smalls, Griffin, & Cogburn, 2008; Rivas-Drake, 2011; Supple, Ghazarian, Frabutt, Plunkett, & Sands, 2006).

However, the research literature also illustrates ways in which aspects of racial/ethnic identity can act as a risk factor in academic outcomes for African American and American Indian adolescents. Among African American samples, research has revealed that higher levels of identity exploration and affirmation (regard) negatively predicted adolescents’ academic achievement (Worrell, 2007). In another study, adolescents with low racial centrality, private regard, and public regard had significantly higher GPAs than adolescents with higher racial centrality and regard (Harper & Tuckman, 2006). Finally, it is important to note that some null relationships have been observed between ethnic/racial identity and academic outcomes among African Americans adolescents (Gushue & Whitson, 2006; Wong, Eccles, & Sameroff, 2003).

Shifting to studies with American Indian adolescents, results from one study revealed a negative relation between ethnic identity exploration and GPA among adolescent Navajo girls (Jones & Galliher, 2007). However, two studies with American Indian adolescent samples found no significant relation between ethnic identity and academic outcomes (Bryant & LaFromboise,
Interestingly, no studies could be found reporting a positive relation between aspects of ethnic identity and academic outcomes in American Indian adolescent samples.

Thus, there is growing evidence suggesting that the relation between ethnic/racial identity and academic outcomes may not be as simple as originally conceptualized. First, as outlined by Sellers et al. (1998) and others, racial/ethnic identity is not a monolithic construct, and any discussion of it should refer explicitly to the aspect of identity under consideration. Second, aspects of racial/ethnic identity can operate either in a protective/promotive fashion or as risk factors depending on the mechanisms at play. Finally, contextual and individual factors are also likely to shape the direction of the relations between aspects of racial/ethnic identity and academic outcomes (Chavous et al., 2003).

Primary among the reasons that aspects of racial/ethnic identity might place American Indian students at risk for low achievement are negative stereotypes: Cultural stereotypes suggest that African Americans and American Indians are unintelligent and unlikely to excel academically (Steele, 1997; Tan, Kujioka, & Lucht, 1997). Because of these negative stereotypes, African American and American Indian adolescents who have higher levels of ethnic/racial centrality may be vulnerable in the classroom. Indeed, in a study with African American middle school adolescents with prior achievement controlled, endorsement of traditional racial stereotypes was associated with lower self-perceptions of academic competence among adolescents who were high in racial centrality. This association was not observed in adolescents who were low in racial centrality (Okeke, Howard, Kurtz-Costes, & Rowley, 2009).

Because of the importance of ethnicity/race and gender for youth’s understanding of their personal identities, a logical next step for researchers is to develop a means of promoting a
positive association between ethnic/racial and gender identities and academic success. In this study, I sought to create a positive view of the self that is congruent with STEM achievement on the basis of ethnic and gender identities in American Indian adolescents.

Identity-Based Motivation Theory: Understanding the Relationship between Social Identities and Motivation

Tenets of the proposed intervention were grounded in Identity-Based Motivation Theory (IBM) (Oyserman, 2007). This theory was the most appropriate as the primary goal of the study was to explore relations between aspects of ethnic and gender identities and motivation. IBM theory suggests that identities can act as source of motivation for students, as students are more likely to act and engage in thoughts and behaviors that feel congruent to their identities, compared to thoughts and behaviors that do not feel congruent with their identities. Further, the theory suggests that people’s understanding of their physical and social world is likely to be colored by their identities (Oyserman & Destin, 2010).

Three underlying motivational assumptions in IBM theory work together to explain why social identities are sensitive to change from the contextual experiences of the student and why academic achievement must be congruent with the student’s identity. These processes are termed: (1) action-readiness, (2) dynamic construction, and (3) interpretation of difficulty (Oyserman, 2007). Action-readiness is the assumption that identities signal readiness to act and interpret the physical and social world on the basis of the norms, values, and behaviors relevant to an identity. For example, if a girl and a boy endorse the idea that STEM achievement is linked to a male identity, action-readiness of the girl’s female identity would signal the girl to pursue other academic domains that might be more congruent with her identity. Conversely, action-readiness of the boy’s male identity would signal the boy to continue to work hard in STEM classes, as excelling in STEM domains is congruent with a male identity. Thus, identities can
influence actions and behaviors.

It is important to note that which actions are signaled as congruent and what sense to make of situations is dependent on the content of an identity, which is dynamically constructed. Dynamic construction is the assumption that identities, their content, and subsequently the behaviors that are congruent with the identity are determined and constructed within a given context (Oyserman, 2007). For example, if a boy reads a graph suggesting that men are more likely than women to succeed in and earn more in STEM careers, the boy may believe that success in STEM is a component of his male identity. Consequently, he may develop stronger interest in STEM domains and become more engaged in STEM classes.

Interpretation of difficulty is the final assumption of IBM theory (Oyserman, 2007). This assumption suggests that if achievement is considered to be congruent with a salient identity, the individual is likely to assess a difficulty as meaningful, and subsequently will put forth extra effort to overcome the difficulty. Conversely, if achievement is considered incongruent (“not for people like me”), the individual is likely to put forth little extra effort to overcome the difficulty (Oyserman & Destin, 2010). Thus, for achievement to be congruent with an identity, difficulties must be interpreted as meaningful and not impossible to surmount.

IBM theory has implications for understanding how social identities like ethnicity/race and gender could impact a student’s motivation in school. Social identities are often associated with stereotypes (Good, Dweck, & Aronson, 2007). In the United States, stereotypes suggest that some social identities are not congruent with academic achievement. For example, there is a negative stereotype that American Indians students are unintelligent and uneducated (Tan, Fujioka, & Lucht, 1997). Given this stereotype, American Indian students who are reminded of
their identity might view academic achievement as incongruent with their identity, and will subsequently show reduced academic motivation.

Empirical evidence supporting IBM theory has primarily examined academic and health outcomes in adolescents (e.g., Oyserman, Gant, & Ager, 1995; Oyserman, Kemmelmeier, Fryberg, Brosh, & Hart-Johnson, 2003, Oyserman, Fryberg, and Yoder, 2007). With a sample of African American middle school students, Oyserman et al. (1995) primed students’ ethnic/racial identity and had them complete a novel math task. Results revealed that students who believed that academic achievement was congruent with their identity worked harder to complete the task compared to students who believed that academic achievement was not congruent with their identity. In another study, a relation was observed in two samples of African American youth between the endorsement of traditional racial stereotypes about African Americans (suggesting academic achievement is incongruent with African American identity) and negative academic self-concept (Okeke et al., 2009). Relations have also been found between identity congruency and health behaviors (Oyserman et al., 2007). Taken together, these results support IBM theory and the hypothesized association between identities and motivation. Adolescents understand that specific behaviors and norms are expected from certain social identities. If a behavior is not considered to be congruent with one’s ethnicity or gender, the individual is less likely to continue that behavior.

Given these theoretical assumptions, a promising avenue for interventions is to increase congruency between specific social identities and academic success. Ambady and colleagues (2001) investigated how the activation of different identities could impact academic achievement in Asian girls. In a sample of late-elementary and middle school girls when Asian identity was primed before a mathematics test, performance scores were higher compared to those of a
control group. Conversely, when their female identity was primed before a mathematics test, performance was lower compared to scores of a control group (Ambady et al., 2001). Thus, the priming of specific identities that are congruent with achievement may offer some success in promoting academic achievement; however, identities incongruent with academic achievement can quickly be primed again. Interventions focused on changing the content of the identity such that academic achievement is congruent with a given identity might be more durable in promoting academic motivation and achievement. Because American Indians are stereotyped as lazy and uneducated (Tan, Fujioka, & Lucht, 1997), and girls are negatively stereotyped in math and science domains (Kurtz-Costes, Rowley, Harris-Britt, & Woods, 2008), American Indian youth and girls may develop an identity that is incongruent with STEM motivation and achievement. Thus, in the proposed study, I sought to alter the content of racial/ethnic and gender identities to become congruent with science motivation and achievement, and enhance motivational beliefs in American Indian students.

**Role Models: A Mechanism for Creating Identity Congruency**

Whereas students rely on many internal psychological processes to maintain and promote academic motivation, students also rely on external social supports (Wang & Eccles, 2012). Scholars suggest that teachers, families, peers, and mentors all serve as important social supports for students. Social supports can aid students in the pursuit of academic and career goals and maintain positive mental health (Legault, Green-Demers, & Pelletier, 2006). Further, agents of social support also influence students’ identity development (Schachter & Venturea, 2008; Zirkel, 2002). Individuals who provide social support to students may become “identity agents” in students’ lives, providing students with examples of behaviors and cognitions that increase motivation and a positive sense of self. Of course, all students benefit from social support in the
maintenance and promotion of motivation and achievement in the classroom. However, for students in classrooms where their ethnic/racial or gender group is underrepresented, these social supports may be particularly important, as these students are more likely to experience a harsher classroom climate (e.g., feelings of loneliness and isolation and negative stereotypes about their ability) (Syed, Azmitia, & Cooper, 2011).

One particularly effective source of social support is a role model (Hurd, Zimmerman, & Xue, 2009; Yancey, Siegel, & McDaniel, 2002). A role model can be defined as a person who excels in a domain that is important to a given individual (Lockwood & Kunda, 1997). Rooted in social comparison theory, role model theory postulates that role models can serve as a source of inspiration when students make positive upward social comparisons with the role model (Lockwood & Kunda, 1997). Scholars have identified two factors that are important in determining the efficacy of inspiration that role models provide for individuals: (1) the perceived relevance of the role model to the individual and (2) the believed attainability of the role model’s success (Lockwood & Kunda, 1997). Relevance of a role model to the student must first be achieved in order for a social comparison to be made.

A primary determinant of relevance is shared likeness or similarities between the individual and the role model (Lockwood, Jordan, & Kunda, 2002). Indeed, research regarding social comparison has shown that similarity between individuals increases social comparison: The more similar an individual perceives him/herself to be to a role model, the more likely the individual is to engage in an upward social comparison (Lockwood et al., 2002). The idea that increased similarity results in increased social comparison is also supported by intersectionality theory. Intersectionality theory recognizes that individuals hold a constellation of social identities and that the combination of these various identities creates a unique social position for an
individual, which likely colors how they understand and interpret social situations (Settles & Buchanan, 2014). Thus, an individual who is matched to a role model on various social identities is more likely to make social comparisons, as he or she can more readily identify with the role model and can trust that the two have had similar experiences.

Whereas relevance of the role model to the individual is a critical component in the efficacy of inspiration of a role model, attainability is another critical competent. Theory regarding roles models suggests that attainability drives the affective response to the social comparison (Lockwood & Kunda, 1997). Individuals who compare themselves to role models and feel as though the role models’ achievements are not possible for them to accomplish are likely to be discouraged, resulting in a negative upward social comparison. However, individuals who believe they can attain the same success as the role model will be inspired, resulting in a positive upward social comparison (Lockwood & Kunda, 1997).

Although both relevance and attainability are important in the efficacy of role models, educational research regarding role models has primarily focused on relevance, particularly among students who are underrepresented in various academic domains (Morgenroth, Ryan, & Peters, 2015). Perhaps the most well-studied means for making role models more relevant to students has been by matching the role model to the student on various social identities. With underrepresentation of African American, American Indian, and Hispanic individuals across most academic domains and women in STEM domains, scholars have explored whether matching students to role models on ethnicity/race or gender promotes motivation (e.g., Marx & Ko, 2012; Bryant & Zimmerman, 2003; Zirkel, 2002). For example, in a series of studies examining the effect of role models on mitigating stereotype threat among emerging adults, Marx and colleagues (2002, 2009, 2012) demonstrated that exposure to role models who were
similar to the participant on gender or ethnic/racial identities resulted in the narrowing of achievement gaps between gender and ethnic/racial groups. In a study with African Americans adolescents, results revealed that girls who reported having a female role model had higher GPAs, educational attainment, and school expectations than girls who did not have a female role model. This relation was not observed among boys (Bryant & Zimmerman, 2003). Zirkel (2002) asked adolescents to list people they identified as role models in their lives. A majority of the ethnic/racial minority students in the sample did not list a role model who shared both their gender and ethnicity/race. Students were also asked to report several academic outcomes. Results showed that compared to students who listed non-matched role models or no role models at all, students who listed role models of their gender and ethnicity/race reported higher academic performance and more educational achievement goals (Zirkel, 2002). Thus, both theory and empirical evidence indicates that providing students with a role model, especially one who is matched to the student on gender and race/ethnicity, could promote students’ motivation. Thus, I expected that students who were matched with role models on ethnic/racial and gender identities would show greatest increases in various motivational beliefs.

Finally, it is important to consider the effect role models could have on the content of identity and its development. Exposure to positive role models who are from underrepresented ethnic/racial minority groups and/or women may influence the content of students’ identities (i.e. centrality or regard). Indeed, social comparison theory suggests that individuals are likely to make upward social comparisons with other intergroup members who are viewed as prototypical and, as a result, these comparisons often enhance self identity and may result in changes in identity (Hogg, 2000; Lockwood & Pinkus, 2008). For example, a student who is exposed to a role model from his or her racial/ethnic group might experience increases in private and public
regard. As the role model represents a positive reflection of the student’s ethnic group, the student may gain more positive views of his or her ethnic group (increasing in private regard) and may also be more likely to believe that others hold positive views of the student’s ethnic group (increasing public regard).

It is also important to note that content of students’ social identities could predict the student’s identification with the role model. Students might be more likely to identify with the role model of their race/ethnicity if race/ethnicity is highly central to their identity. Therefore, I expected that students who were matched to a role model on either ethnic/racial or gender identity would increase in their levels of centrality, private and public regard. Also, students with higher levels of centrality of a given identity (ethnic or gender) and who were matched with a role model on that identity were expected to report greater increases in motivational beliefs compared to students with lower levels of centrality.

**Self-Affirmation Theory and Intervention: A Means to Diminish Threats to Identity**

Social identity threat – the awareness that one could be viewed negatively on the basis of an identity – and its impact on motivation and achievement has been well studied over the past 20 years (Spencer, Logel, & Davies, 2016). A relatively new field of research has emerged in developing interventions that reduce the negative effects of these threats. These interventions, known as “wise interventions,” are rooted in social-psychological theory and are designed to compromise problematic psychological processes that lead an individual to feel threatened by stereotypes associated with an identity (Walton, 2014). These interventions have been termed as “wise” because, rather than working to remedy the symptoms of these problematic psychological processes, these interventions target the processes themselves. In this way, scholars have developed interventions that not only can have situational or “in-the-moment” effects for
individuals, but also have produced lasting effects and effects that generalize across domains (Walton, 2014). These interventions target specific psychological processes (e.g., stereotype threat and fixed growth mind-set) known to have deleterious effects on motivation and achievement. These interventions are often relatively brief in duration and have been integrated into a host of different real-world settings.

Among the many different kinds of wise interventions that have been designed, a particularly successful method is rooted in self-affirmation theory. At the center of self-affirmation theory rests the notion that individuals are motivated to preserve and maintain self-integrity (Yeager & Walton, 2011). Self-integrity is defined as a global sense of efficacy and the image that one has the ability to control adaptive and moral outcomes in one’s life (Sherman & Cohen, 2006). In simpler terms, individuals strive to view themselves as generally “good” and “adequate” people, with the ability to control their futures. Thus, when an individual enters an environment where this image of self-integrity is challenged, psychological threat ensues (Cohen & Sherman, 2014). Once awareness of a psychological threat has been activated, motivation to reassure the self begins in an attempt to preserve self-integrity (Steele, 1988). Though some research has found that psychological threat can be an adaptive means of change, threat can be very intrusive as individuals must focus on maintaining self-integrity in the short term, at the cost of learning and performing in the long term (Cohen & Sherman, 2014). In threatening situations, cognitive resources that would be used in learning or performance are divided, as individuals work to maintain self-integrity.

Self-affirmations have been proposed as a means of buffering effects of threats on social identities (Cohen & Garcia, 2008). A self-affirmation is an attempt to demonstrate one’s adequacy (Steele, 1988). Of course, major accomplishments (e.g., graduating from high school
or college or getting a job promotion) are obvious sources of adequacy and can aid in the affirming of self-integrity. However, seemingly “small” acts, like receiving a thoughtful note when lonely or thinking about family in time of high stress, can also act as strong forces in the affirmation of self-integrity (Carter et al., 2013; Yeager & Walton, 2011). Over the course of a given day individuals can encounter a number of these “small” affirmations that are relevant to the self, acting as a continuous refreshment of their self-integrity (Cohen & Sherman, 2014). In situations where threats to the self are especially high or self-affirmations are low, intervention is warranted.

One of the most well-studied self-affirmations in empirical research has been a values-affirmation task where individuals write about basic personal values (Cohen & Sherman, 2014). In the classic values-affirmation writing task, individuals are given a list of values and are asked to choose one or a few values that are particularly important to them. To expand the focus of individuals beyond a threat, values from the list are typically very broad, global values and are not directly relevant to the specific domain of threat (Cohen & Sherman, 2014). For example, if the goal is to buffer individuals against threats of addiction, mental health and rationality should not be included in the list (Cohen & Sherman, 2014). After selecting the values that are important to them, individuals are asked to write brief essays explaining why they selected those values and why they are important, or explain a time when those values made an important impact in their lives (Cohen & Sherman, 2014). Thus, a significant strength of this kind of self-affirmation task is that content is derived from the individual and tailored to his or her specific values and identity (Sherman & Hartson, 2011).

Thus, from self-affirmation theory, three important mechanisms work together to create potential for lessening effects of a psychologically threatening situation (Cohen & Sherman,
First, affirmations act as reminders of more global psychosocial resources, broadening the perspective of the individual beyond a specific threat. Second, given the notion that self-affirmations offer a more global, expanded view of the self, threats are likely to have less of an impact on an individual and his or her psychological well-being. Third, affirmations promote orientations of approach, rather than avoidance, to tasks at hand. Affirmed individuals, whose self-integrity is not challenged, are likely to view a threatening challenge as difficult but surmountable. Taken together, these three mechanisms equip individuals with the means needed to diffuse threats to the self (Cohen & Garcia, 2008).

Self-affirmation theory and interventions have many practical applications in a host of real-world settings that often evoke threat. Perhaps not surprisingly, some of the first interventions developed with self-affirmation theory were designed for the classroom (Cohen, Garcia, Apfel, & Master, 2006; Cohen, Garcia, Purdie-Vaughns, Apfel, & Brzustoski, 2009). Many students aspire to view themselves as competent and able students. However, from formal (e.g., grades, standardized tests) and informal evaluations (e.g., peer and romantic relations), the classroom can present an array of continuous threats to students’ self-integrity (Cohen & Sherman, 2014). For students who have social identities that are negatively stereotyped, threats are likely to be especially salient, as these students are likely to worry whether their performance in the classroom is viewed through the lens of a negative stereotype. Academic settings can be places of chronic threat for such individuals (Garcia & Cohen, 2012; Yeager & Walton, 2011).

However, a self-affirmation intervention could have the potential for profound and positive effects on students’ academic trajectories. Indeed, empirical evidence from both the laboratory and the field suggests that self-affirmation interventions targeting students whose social identities are negatively stereotyped in academics can be beneficial in boosting motivation.
and achievement over time (Cohen et al., 2006, 2009; Bowen, Wegmann, & Webber, 2013; Sherman et al., 2013). Among self-affirmation studies with ethnic/racial minority middle school students, Cohen et al. (2006) found that African American students who engaged in a self-affirmation writing exercise were less likely to show GPA declines over the course of a semester than students who did not engage in a self-affirmation exercise. In a two-year follow-up with the Cohen et al. (2006) sample, Cohen et al. (2009) observed maintenance of the buffering effect of the self-affirmation intervention, as students who had engaged in the self-affirmation task had slower declines in GPA than their counterparts in the control condition. In a similar study, African American middle schoolers who participated in a self-affirmation writing task declined less in social studies GPA over the course of one academic year than students who did not participate in a self-affirmation writing task (Bowen et al., 2013). Latino American middle school students who engaged in multiple self-affirmation writing tasks during an academic year had higher GPAs by the end of the academic year than students who did not engage in self-affirmation tasks, and these effects persisted over two additional years (Sherman et al., 2013). Finally, women college students who enrolled in introductory physics and completed a self-affirmation task received higher test scores and earned higher grades at the end of the semester than women who did not complete a self-affirmation task (Miyake et al., 2010).

Thus, it is clear that such interventions can have beneficial effects in promoting motivation and achievement for students whose identities are traditionally negatively stereotyped. Through explicitly asserting the self as someone who is good and capable, students are equipped with a means of thwarting a downward spiral of motivation that is provoked by identity threats.
Current Study

Given the under-achievement and underrepresentation of American Indians and women in STEM domains (National Science Board, 2014), an intervention targeted at promoting STEM motivation in these two social groups is warranted. Adolescence was chosen as it represents a developmental period characterized by advancing social cognition, such that students are beginning to understand their social identities and the stereotypes and threats that are associated with them (Kao, 2000; Oyserman & Fryberg, 2006; Umaña-Taylor et al., 2014). Based on the synthesis of the theoretical frameworks outlined above, I developed an intervention to increase STEM motivation through the disruption of two problematic psychological processes known to thwart motivation and achievement in youth (1) identity incongruence with academic achievement and (2) threats to social identity.

As noted from IBM theory, specific social identities that students hold may not be considered congruent with academic achievement, which is likely to lead to lower motivation. In the context of STEM domains, American Indian and female identities are not considered congruent with STEM achievement. However, role models could act as a mechanism of increasing identity congruency. In providing students with a role model, one who is matched to them on ethnicity/race and/or gender, students may incorporate STEM achievement with their ethnic and/or gender identities. In order to undermine threats to students’ identity and increase identity congruence with STEM motivation, students in the experimental conditions completed a self-affirmation task. Students received a short biography and color photograph of a STEM scientist who matched the students on ethnicity but not gender, gender but not ethnicity, neither ethnicity or gender, or both ethnicity and gender. Students then engaged in a self-affirmation task
by writing about the positive characteristics they shared with the role model. Specific hypotheses are elaborated below.

**Hypotheses**

There were three principal purposes of the study. The first purpose was to investigate the efficacy of a self-affirmation task with role models in the promotion of science motivation among American Indian students. The second purpose was to explore whether matching the scientist role model to the student on gender and ethnicity would produce an additive effect in promoting science motivation and ethnic and gender identity. Finally, the third purpose was to investigate whether ethnic or gender centrality predicted efficacy of the self-affirmation task and whether the manipulation led to changes in racial centrality and/or regard. I anticipated the following:

**Hypothesis 1A: Efficacy of self-affirmation task with role model on promotion of motivational beliefs.** Students in the experimental conditions (i.e. students who participated in a self-affirmation task, affirming themselves with a successful scientist) would report increases in science self-efficacy, science interest, and approach achievement goals (henceforth collectively referred to as *science motivation*) from pre-intervention to post-intervention. Students in the control condition (i.e. students who affirm positive characteristics of a successful scientist with no self-affirmation) would show no change in science motivation.

**Hypothesis 1B: Maintenance of treatment efficacy.** One week post-intervention, students in the experimental conditions would maintain treatment-related gains in motivational beliefs.
**Hypothesis 2A: Additive effects of ethnic and gender matching of the role model in the promotion of girls’ motivational beliefs.** Because of hypothesized gender differences in the additive effects of ethnic and gender matching in the efficacy of the intervention, hypotheses are presented separately for girls and boys. Girls who engaged in the self-affirmation task and who were matched to the scientist on ethnicity and gender were expected to report the greatest increases in science motivation (among girls) from pre-intervention to post-intervention. Girls who were matched to the scientist on just ethnicity or gender were expected to report increases in science motivation, but to a lesser degree than girls who were matched on both ethnicity and gender. Portrayal of a European American female scientist was expected to produce a stronger effect among girls than portrayal of an American Indian male scientist. Finally, girls who self-affirmed with a European American male scientist were expected to report the smallest increase in motivational beliefs. Additive effects of ethnic and gender matching were expected to be maintained one-week post-intervention.

**Hypothesis 2B: Additive effects of ethnic and gender matching of the role model in the promotion of boys’ motivational beliefs.** Like girls, boys who were matched to the scientist on ethnicity and gender were expected to report the greatest increases in science motivation. When matched to the scientist exclusively on gender or ethnicity, I expected that identification with an American Indian woman would produce a stronger effect than identification with a European American man. Finally, boys who were not matched to the scientist on ethnicity or gender were expected to show the smallest treatment effects. Additive effects of ethnic and gender matching were expected to be maintained one-week post-intervention.
Hypothesis 3A: Effects of ethnic matching of the role model on the promotion of ethnic identity. Students who self-affirmed with American Indian scientists were expected to report increased ethnic centrality, private regard, and public regard from pre-intervention to post-intervention, and to maintain those levels one-week later. Control students and those who self-affirmed with European American scientists were not expected to report changes in measures of ethnic identity.

Hypothesis 3B: Effects of gender matching of the role model on the promotion of gender identity. Students who were matched with the scientist on gender were expected to report increases in gender centrality and private regard from pre-intervention to post-intervention, and to maintain those levels at the one-week follow-up. Students who were not matched were not expected to show change in gender identity measures.

Hypothesis 4A: Ethnic centrality as a predictor of self-affirmation task efficacy. Students with higher pre-intervention levels of ethnic centrality who read about an American Indian scientist were expected to report greater increases in science motivation from pre-intervention to post-intervention than students with lower levels ethnic centrality.

Hypothesis 4B: Gender centrality as a predictor of self-affirmation task efficacy. Students with higher levels of gender centrality who were matched with a scientist on gender were expected to report greater increases in motivational beliefs from pre-intervention to post-intervention than students with lower levels gender centrality.
CHAPTER 2: METHODS

Participants

The sample consisted of 212 (110 girls and 102 boys) sixth, seventh, and eighth grade American Indian students from a single American Indian Nation in the Southeastern region of the U.S. \(M_{age} = 12.7\) years, \(SD = .97\). This Nation is federally recognized and has trust land (similar to traditional Indian reservations) that falls in two counties in the state. Thus, students were recruited from the tribal middle school and the two county public middle schools. As citizens of this Nation, students are allowed to enroll in any of these three schools. In terms of ethnic/racial make-up, European Americans represent the majority of students in the two county public schools. However, the second largest ethnic/racial group in both schools is American Indian, comprising 25% and 16% of enrolled students at the public schools. Only youth who are citizens of the Nation are allowed to attend the tribal middle school with the exception of special family circumstances (e.g., citizens may have siblings who are not citizens but may still attend the same school). Thus, 95% of students at the tribal school are American Indian. Students were approximately balanced across the three grades, with 76 students in each of Grades 6 and 7 and 60 participants in Grade 8. Approximately 59.9% or 127 of the participants were recruited from the tribal middle school and the remaining 40.1% of the participants were recruited from the two public county middle schools (School 1 = 44 participants or 20.8% of the total sample and School 2 = 41 participants or 19.3% of the total sample).
Procedure

To gain access to conduct research with this specific population, several hurdles were cleared to ensure the research questions were congruent with the needs of the Nation and that all appropriate parties granted approval for the research to be conducted with the Nation’s citizens. I first met with several school teachers in the community to explain the questions I aimed to answer with the study and sought feedback as to ways they thought the study could be improved. Feedback from the teachers was incorporated into the study design. The Nation has a formal Institutional Review Board (IRB) to review research studies regarding the Nation and its citizens. I met with the Nation’s IRB committee to explain the study, questions that could be answered with study results, and potential benefits for the community. Feedback from the IRB committee was also incorporated in the study design. I then completed applications and gained approval from the IRBs of both the Nation and of the University. Once approved by the Nation’s IRB, the study was presented to the Tribal Council of the Nation, where it received approval. With approvals from both IRB institutions and the Tribal Council I was then able to meet with superintendents from three school districts where students were recruited for the study. Approval was granted from each of the three school district superintendents. I then met with the principal of each of the middle schools to explain the study and seek their approval. All principals gave approval for me to recruit students through their schools.

Parent consent and student assent were obtained for all participants. The study design consisted of three meetings with the students: pre-intervention, intervention, and one week post-intervention. Students completed all surveys at school. At pre-intervention, students completed survey measures of motivational beliefs and ethnic and gender identity.
Students were randomly assigned to one of four experimental conditions or the control condition with gender balanced within each group (i.e. approximately 25 boys and 25 girls were assigned to each of the identity match groups, and approximately 15 boys and 15 girls to the no match condition and control condition). Although assignment to condition was random, it was done within school and grade level so as to have cells balanced on grade, gender, and school. Cell sizes are shown in Tables 1 and 2.

About two-three weeks after the pre-intervention session, the intervention was implemented. Students in each of the four experimental conditions read a biography of a scientist and engaged in a values-affirmation task. In this task, students wrote a short essay using a provided list of traits (e.g., hard-working, curious, successful, etc.) to describe how they share the same traits as the scientist and why the traits are important. The four experimental conditions (1) matched the student and scientist featured in the biography on ethnicity but not gender; (2) matched on gender but not ethnicity; (3) matched on both ethnicity and gender; (4) did not match on ethnicity or gender. In a fifth (control) group, students read a biography of a successful scientist who did not match the student on ethnicity or gender. Students in the control condition described in a short essay why other people might find the traits important. After the intervention, students completed the same questionnaire that was completed at pre-intervention.

One-week post intervention students completed the same questionnaire with measures of motivational beliefs, ethnic identity, and gender identity that was administered in the first two sessions. At the conclusion of each of the first two sessions students received an item from a grab bag (i.e. keychain, bouncy ball, or pencils), and at the conclusion of the post-intervention session, students received a $10 gift card to a local retail or online store of their choice.
Measures and Instruments

All study measures and instruments appear in Appendices A and B, respectively.

Science self-efficacy. Students’ science self-efficacy was measured with six items adapted from Midgley et al.’s (2000) Academic Self-Efficacy Scale. Items from this scale are domain general for assessing general academic self-efficacy; thus, items were changed to specifically assess science self-efficacy adding the word ‘science’ to each item. Items from this measure assesses youth’s beliefs in their ability to master materials and skills if they (1) are given enough time and/or (2) exert enough effort (e.g., Even if the work in science class is hard, I can learn it). The scale was developed with a large sample of ethnically/racially mixed children and adolescents ranging from Grade 3 to Grade 9 and has adequate reliability, $\alpha = .76$ (Midgley et al., 2000). Items are rated on a 7-point Likert-like scale ($1 = \text{strongly disagree}; 7 = \text{strongly agree}$) and were averaged to create a composite score of science self-efficacy, where higher scores indicate higher levels of science self-efficacy. Reliabilities of science self-efficacy for the current study were strong at pre-intervention, intervention, and post-intervention ($\alpha$’s = .85, 90, and .93, respectively).

Interest in science. To assess science interest, students completed an adapted version of the task-value scale from the Motivated Strategies for Learning Questionnaire (Pintrich, Smith, Garcia, & McKeachie, 1993). Scholars who study interest have used this measure as a proxy for individual interest, as it measures both the feeling and value students attribute to science (Linnenbrink-Garcia et al., 2010) (e.g., I enjoy the subject of science). The task value scale was developed with a predominately European American college-aged sample and has strong reliability, $\alpha = .90$ (Pintrich et al., 1993). This measure has also been used with adolescents ranging from Grade 7 to Grade 12 in a primarily Hispanic and Asian American sample.
(Linnenbrink-Garcia et al., 2010). The measure assesses interest with eight items. Original items were not domain-specific; thus, items were edited to be specific to science. Items are rated on a 7-point Likert-like scale (1 = *strongly disagree*; 7 = *strongly agree*) and were averaged to create a composite score of individual interest in science, where higher scores indicated higher levels of science interest. Reliabilities in the current study were strong at pre-intervention, intervention, and post-intervention (α’s = .90, 92, and .93, respectively).

**Approach Achievement Goals in Science.** Youth’s approach achievement goals were measured with an adapted version of Elliot and McGregor’s (2001) 2 x 2 achievement goals measure. This measure assesses the qualities of an individual’s achievement goals, in terms of mastery or performance goals and approach or avoidance goals. The measure is comprised of four subscales, with three items for each subscale. However, only two of the four subscales, mastery-approach (e.g., I desire to completely master the material presented in science class) and performance-approach (e.g., It is important for me to do well compared to others in my science class) were used, as these goal orientations are considered to be the most adaptive and have demonstrated positive relations with academic motivation and achievement (Midgley, Kaplan, & Middleton, 2001). Original items from both subscales were not domain-specific; thus, items were edited to be specific to science. Items are rated on a 7-point Likert-like scale (1 = *strongly disagree*; 7 = *strongly agree*) and were averaged to create a composite score of mastery or performance approach goal orientation in science, with higher scores indicating higher levels of mastery or performance approach goals. Subscales of the measure were originally developed with college-aged students and were reliable (Elliot & McGregor, 2001). Since their development, these subscales have been used in ethnically diverse and adolescent samples and continue to demonstrate adequate to good reliability (Keys, Conley, Duncan, & Domina, 2012;
Witkow & Fuligni, 2007). Reliabilities of mastery approach and performance approach goal orientations in the current study were strong at pre-intervention, intervention, and post-intervention (mastery approach $\alpha$’s = .84, 88, and .91, respectively, and performance approach $\alpha$’s = .80, 86, and .91, respectively).

**Gender identity.** Two adapted subscales from the adolescent version of the Multidimensional Inventory of Black Identity (MIBI-T) assessed gender centrality and regard (Scottham, Sellers, & Nguyen, 2008). Though these subscales were originally developed to measure racial identity, subscales of centrality and private regard are thought to be dimensions that exist among other identities, including gender identity (Rogers, Scott, & Way, 2015). The subscales measure gender centrality (e.g., “I feel close to other [gender in-group]”) and private regard (e.g., “I am happy that I am a [gender in-group].”). Thus, items were adapted by changing all ethnic/racial labels of “Black” to “boy” or “girl.” Because items are gender specific, “girl” and “boy” items were presented on a single page in two sections, and students were instructed to only complete items for their respective gender. Alpha reliabilities for gender centrality were adequate at pre-intervention, intervention, and post-intervention (boys $\alpha$’s = .71, .74, and .83; girls $\alpha$’s = .79, .74, and .84, respectively). However, the gender private regard measure alpha reliabilities were quite low, particularly among boys. Thus, one item was removed from the measure (“I feel good about other [gender in-group]s.”) and reliabilities greatly improved and were deemed adequate to strong (boys $\alpha$’s = .78, .84, and .96; girls $\alpha$’s = .95, .96, and .95).

**Ethnic identity.** Three adapted subscales from the adolescent version of the MIBI-T assessed ethnic identity (Scottham et al., 2008). The original subscales were developed to assess racial identity in African American middle and high school adolescents. Items were adapted by changing all ethnic/racial labels of “Black” to “[Tribe Name] or American Indian.” The
subscales measure three dimensions of ethnic identity: ethnic centrality (e.g., “I have a strong sense of belonging with [Tribe Name] or American Indian people”), private regard (e.g., “I am proud to be [Tribe Name] or American Indian”, and public regard (e.g., “People think that [Tribe Name] or American Indians are as good as people from other races”). Each subscale has three items. Items were rated on 7-point scales (1 = strongly disagree; 7 = strongly agree) and averaged to create composite scores, where higher scores indicated higher levels of the construct. Reliabilities of ethnic centrality, ethnic private regard, and ethnic public regard for the current study were adequate to strong at pre-intervention, intervention, and post-intervention for the current sample (ethnic centrality α’s = .79, 84, and .89, respectively; ethnic private regard α’s = .80, 90, and .88, respectively; ethnic public regard α’s = .79, 82, and .86, respectively).

Biographies and self-affirmation essay task. Four biographies of scientists who have earned a doctorate in a STEM domain were featured, each on a single page with a color photograph of the scientist. Biographies of the scientists were identical with the exception that the American Indian scientists were enrolled citizens of local Native Nation and were born in the primary town on the reservation and the European American scientists were born in a neighboring city close to, but not on the reservation. First names of the scientists were similar across gender with “Lance” as the first name for the male scientists and “Lindsay” as first name of the female scientists. The American Indian scientists were given the last name “Youngbird” and European American scientists were given the last name of “Williams.” The first paragraph outlined the scientists’ initial interest in STEM domains. The second paragraph summarized the education and degrees they have received. The third paragraph described the scientists’ civic service related to promoting STEM interest in youth. The four biographies featured either an American Indian woman or man or a European American woman or man.
After reading the biography, students completed the self-affirmation task, choosing three traits from a word bank of 24 positive traits (e.g., determined, proactive, skillful, etc.) located below the biography, and wrote a short essay explaining how the student shared those traits with the scientist. Instructions for the essay prompt read, “Look at the list of traits below and choose three traits that you feel could describe both you and Dr. Williams. Write those three traits at the top of your essay paper and explain how you and Dr. Williams share those traits.” Students were given a pencil and a blank page of ruled paper to write their essay and were told that they had 15 minutes to write a minimum of three sentences. A research assistant collected the essays and coded them for content to ensure that students successfully completed the task. All essays were coded as complete or followed instruction; thus none were discarded from the study.
CHAPTER 3: RESULTS

Before hypotheses were tested, descriptive statistics and bivariate correlations for study variables were calculated. All participants who completed the pre-intervention wave of the study were retained across the subsequent waves of the study. Thus, data were missing only when participants did not complete a specific measure within a given wave. Data were double entered and true/false checked to ensure accuracy of data entry. Distributions of all variables were examined to assess normality. All analyses were conducted with SPSS Version 23. To ensure that the participants in experimental and control conditions did not differ in the composition of gender, school grade, and school enrollment, chi-square test statistics were estimated. Results confirmed that assignment to condition was not confounded with gender ($\chi^2(4, N = 212) = .73, p = .95$), grade ($\chi^2(8, N = 212) = 1.99, p = .98$), or school ($\chi^2(4, N = 212) = 3.99, p = .41$).

Descriptive Statistics and Zero-Order Correlations

Means and correlations of the study variable at pre-intervention appear in Table 3. Means of study variables at pre-intervention, intervention, and post-intervention across the sample were all above the scale midpoint of 3.5, with a majority of means ranging from 4.5 to 5.5, with the exception of ethnic centrality ($M_s = 5.84, 5.51$, and $5.66$), ethnic private regard ($M = 6.54, 5.81, 6.28$), and boys’ and girls’ private regard ($M_s = 6.68, 6.44, 6.41$ and $6.01, 5.81, 5.95$; respectively), which were more than two points above the scale midpoint. Considerable variability was observed in response scores across all study variables at pre-intervention,
intervention, and post-intervention as scores varied from approximately 1.0 to 7.0, with the exception of boys’ private regard, which only ranged from 2.5 to 7.0 across the three waves.

At pre-intervention, intervention, and post-intervention, small to moderate significant correlations were observed among academic motivation variables (e.g., science self-efficacy and mastery approach goal orientations) and among dimensions of ethnic and gender identity (e.g., ethnic centrality and gender private regard). Small positive correlations were observed between academic motivation variables and dimensions of ethnic and gender identity (e.g., ethnic centrality and science self-efficacy).

**Hypothesis 1A: Efficacy of self-affirmation task with role model on promotion of motivational beliefs.** Students in the experimental conditions (i.e. students who affirm themselves with a successful scientist) were expected to report increases in science self-efficacy, science interest, and approach achievement goals (henceforth collectively referred to as *science motivation*) from pre-intervention to post-intervention. Students in the control condition (i.e. students who affirm positive characteristics of a successful scientist with no self-affirmation) would show no change in science motivation.

**Hypothesis 1B: Maintenance of treatment efficacy.** One week post-intervention, students in the experimental conditions would maintain treatment-related gains in science motivation.

To test Hypotheses 1A and 1B, I conducted four 2(Condition) x 3(Time) repeated-measures analyses of covariance (ANCOVAs). Condition (control and the four experimental conditions) was entered as a between-subjects variable and Time (pre-intervention, post-intervention, and one-week post-intervention) was entered as a within subjects (repeated) variable. Each of the motivational belief measures (i.e. self-efficacy, individual interest, and
master and performance approach goal orientations) were dependent variables and examined independently of each other. Gender, grade, and school were entered as covariates. Hypotheses 1A and 1B would be supported with a significant Condition x Time interaction. Tukey comparison tests were expected to show significant mean increases from pre-intervention to post intervention and from pre-intervention to one-week post-intervention for the experimental conditions and no significant mean changes in the control condition. Results across all four ANCOVAs revealed no significant main effects of Time or Condition x Time interactions, all $F's < 2.0$, $p's > .15$. Thus, Hypotheses 1A and 1B were not supported. On average, students’ scores in science self-efficacy, individual interest, and mastery and performance approach goal orientations did not change over the course of the study, and patterns did not differ across the control and experimental conditions.

**Hypothesis 2A: Additive effects of ethnic and gender matching of the role model in the promotion of girls’ motivational beliefs.** Because of hypothesized gender differences in the additive effects of ethnic and gender matching in the efficacy of the intervention, hypotheses are presented separately for girls and boys. Girls who engaged in the self-affirmation task and who were matched to the scientist on ethnicity and gender were expected to report the greatest increase in science motivation (among girls) from pre-intervention to post-intervention. Girls who were matched to the scientist on just ethnicity or gender were expected to report increases in science motivation, but to a lesser degree than girls who were matched on both ethnicity and gender. Portrayal of a European American female scientist was expected to produce a stronger effect among girls than portrayal of an American Indian male scientist. Finally, girls who self-affirm with a European American male scientist were expected to report the smallest increase in
science motivation. Additive effects of ethnic and gender matching were expected to be maintained to one-week post-intervention.

**Hypothesis 2B: Additive effects of ethnic and gender matching of the role model in the promotion of boys’ motivational beliefs.** Like girls, boys who are matched to the scientist on ethnicity and gender were expected to report the greatest increases in science motivation. When matched to the scientist exclusively on gender or ethnicity, I expected that identification with an American Indian woman would produce a stronger effect than identification with a European American man. Finally, boys who were not matched to the scientist on ethnicity or gender would show the smallest treatment effects. Additive effects of ethnic and gender matching were expected to be maintained to one-week post-intervention.

To test Hypotheses 2A and 2B, I conducted four 5(Condition) x 2(Gender) x 3(Time) repeated-measures ANCOVAs. Condition (control, no match on ethnicity or gender, match on ethnicity, match on gender, and match on ethnicity and gender) and Gender were entered as a between-subjects variable and Time (pre-intervention, post-intervention, and one-week post-intervention) was entered as a within-subjects (repeated) variable. Each motivational belief measure was entered as a dependent variable. Grade and school were covaried. Hypotheses 2A and 2B would be supported with significant Condition x Gender x Time interactions.

Results of the four ANCOVAs revealed no significant effects of Time, Condition x Time, or Condition x Gender x Time, all $F’s < 1.5, p’s > .16$. Thus, Hypothesis 2A and 2B were not supported. On average, students’ scores in science self-efficacy, individual interest, and mastery and performance approach goal orientations did not change over the course of the study as a function of condition assignment for either boys or girls.
Given a $F$ statistic approached significance for performance approach goal orientation, I conducted exploratory analyses and examined the means of each group conditional on gender. Means appeared to indicate that participants who were matched to their role model on both ethnicity and gender increased in their levels of performance approach goal orientations, whereas the means from the other experimental and control groups, appeared to not either not change or decrease. Thus, I conducted an ANCOVA as described above. However, the condition factor was changed, such that the experimental condition where participants were matched to their role model on ethnicity and gender were now being compared to all other experimental and control groups. The effect of Time and the Condition x Gender x Time were not significant $F(2, 204) = .001; p = .92$ and $p = .95$, respectively. However, a significant Condition x Time effect emerged $F(2, 204) = 4.99; p = .008$. A comparison of means at intervention and post-intervention with the confidence intervals of the pre-intervention mean revealed that participants who were matched to their role model on ethnicity and gender significantly increased in performance approach goal orientation scores from pre-intervention ($M = 4.21$) to post-intervention ($M = 4.62$). Whereas the participants from all other conditions significantly decreased in performance approach goal orientation scores from pre-intervention ($M = 4.81$) to intervention ($M = 4.54$).

**Hypothesis 3A: Effects of ethnic matching of the role model on the promotion of ethnic identity.** Students who self-identify with American Indian scientists were expected to report increased ethnic centrality, private regard, and public regard from pre-intervention to post-intervention, and to maintain these levels at the one-week follow-up. Control students and those who self-identify with European American scientists were not expected to report changes in ethnic identity.
**Hypothesis 3B: Effects of gender matching of the role model on the promotion of gender identity.** Students who were matched with the scientist on gender were expected to report increases in gender centrality and private regard from pre-intervention to post-intervention, and to maintain these levels at the one-week follow-up. Students who were not matched were not expected to show change in ethnic identity measures.

To test the effect of matching ethnicity or gender of role model on the promotion of ethnic or gender identity, five ANCOVAs were estimated (one ANCOVA for each of the three ethnic identity dimensions and one ANCOVA for each of the two gender identity dimensions). Thus, a 5(Condition) x 2(Gender) x 3(Time) ANCOVA was estimated for each variable. Condition (four experimental conditions and control condition) and Gender (girls and boys) were entered as between-subjects variables and Time (pre-intervention, post-intervention, and one-week post-intervention) was entered as a within subjects (repeated) variables. Grade and school enrollment were entered as covariates. Hypotheses would be supported by significant Condition x Gender x Time interactions.

Results from the three ethnic identity ANCOVAs (ethnic centrality, ethnic private regard, and ethnic public regard) revealed one significant main effect of Time for ethnic public regard, \( F(2, 198) = 3.38; p = .04 \). The main effect of Time was not significant for ethnic centrality and ethnic private regard time, \( F(2, 198) = 1.29 \) and \( 1.70; p = .28 \) and .19. A comparison of means at intervention and post-intervention with the confidence intervals of the pre-intervention mean revealed that participants, no matter the condition, decreased in ethnic public regard scores from pre-intervention \( (M = 5.24) \) to intervention \( (M = 4.90) \). However, none of the Condition x Time interactions nor the Condition x Gender x Time interactions were significant, \( F's < 2.0, p's > .05 \).
Thus, Hypothesis 3A was not supported. On average, students’ ethnic centrality, ethnic private regard, and ethnic public regard did not change as a function of experimental condition.

Results of the ANCOVAs examining gender centrality and gender private regard revealed no significant effects of Time, Condition x Time, or Condition x Gender x Time, all F’s < 2.0, p’s > .10. Thus, Hypothesis 3B was not supported. On average, students’ gender centrality and gender private regard did not change across the three sessions.

**Hypothesis 4A: Ethnic centrality as a predictor of self-affirmation task efficacy.**

Students with higher pre-intervention levels of ethnic centrality who read about an American Indian scientist were expected to report greater increases in science motivation from pre-intervention to post-intervention than students with lower levels ethnic centrality.

**Hypothesis 4B: Gender centrality as a predictor of self-affirmation task efficacy.**

Students with higher levels of gender centrality who were matched with a scientist on gender were expected to experience greater promotion of motivational beliefs, from pre-intervention to post-intervention, compared to students with lower levels of pre-intervention gender centrality.

To test Hypothesis 4A multiple regression analyses were conducted to measure the predictive ability of ethnic centrality on change in science motivation from pre-intervention to post-intervention. Experimental condition was dummy-coded such that students in the three conditions with no ethnicity match (i.e., gender match to role model, but no ethnicity match; neither ethnic nor gender match; control condition) were assigned the label of zero; students who matched the role model on ethnicity but not gender were assigned the label of one, and students with an ethnicity and gender match were assigned the label of two. In the calculation of the
interaction term, ethnic centrality and ethnic-match condition were mean-centered. Pre-intervention ethnic centrality scores, ethnic-match condition, gender, a pre-intervention centrality by ethnic-match condition interaction, and student’s grade level, school enrollment, and science motivation pre-intervention scores were entered in the analyses as predictors of intervention and post-intervention scores of each of the science motivation measures. It was expected that the pre-intervention ethnic centrality by ethnic-match condition interaction would be significant, and probing of that interaction would show a significant relation between condition and post-intervention motivation among students who were high in ethnic centrality at pre-intervention. The relations between ethnic match condition and post-intervention motivation variables were expected to be nonsignificant or of lesser magnitude among students who reported low ethnic centrality at pre-intervention.

The multiple regression equations predicting the four science motivation variables were significant for both intervention and pre-intervention scores (see Tables 5, 6, 7, and 8 for model values). However, although the equations were significant, none of the ethnic centrality x ethnic-match condition interactions significantly predicted science self-efficacy, science interest, or mastery or performance approach goal orientations at intervention. In equations examining the one week follow-up scores, the ethnic centrality x ethnic-match condition interaction was marginally significant in predicting interest in science and science mastery approach goal orientations ($\beta$’s = .11 and .12, $p$’s = .08 and .10) and significantly predicted science performance approach goal orientation ($\beta$ = .23, $p$ = .005). However, in probing the interactions, results revealed that the control condition was the only group for which ethnic centrality significantly predicted science interest and mastery and performance approach goal orientations.
at one-week post-intervention. Thus, results from the multiple regression models did not support Hypothesis 4A.

Similar to the analyses testing Hypothesis 4A, Hypothesis 4B was tested with a series of multiple regression analyses. The analyses measured whether change in science motivation from pre-intervention to intervention and post-intervention was moderated by students’ gender centrality. Pre-intervention gender centrality scores, gender match condition, gender, a pre-intervention gender centrality by gender-match condition interaction, school grade and school enrollment were entered in the analyses as predictors of post-intervention scores of each of the science motivation measures. The gender-match condition variable was dummy-coded, such that students in all no gender match were aggregated and assigned the label of zero (i.e., ethnic match but no gender match to role model; neither ethnicity nor gender was matched; control condition); students with a gender only match were assigned the label of one; and students with a gender and ethnicity match to the role model were assigned the label of two. In the calculation of the interaction term, gender centrality and gender-match condition were mean-centered. It was expected that the pre-intervention gender centrality x gender-match condition interaction term would be significant. In probing the interaction, I expected a significant positive beta predicting post-intervention motivation from gender-match condition among students with high gender centrality at pre-intervention, whereas the relation between gender-match condition and post-intervention science motivation would be nonsignificant or of lesser magnitude among students who had low gender centrality at pre-intervention.

The regression equations were significant for intervention and post-intervention across the four science motivation measures (see Tables 9, 10, 11, and 12). However, none of the pre-
intervention gender centrality x gender-match condition interactions was significant. Thus, results from the regression analyses did not support Hypothesis 4B.
CHAPTER 4: DISCUSSION

The current project used a synthesis of social and developmental psychological theories to develop an intervention to promote science motivation and ethnic/racial and gender identity among American Indian middle school adolescents. Results suggested that the intervention was not successful with one exception: Adolescents who were matched with a role model on both ethnicity and gender increased in performance approach goal orientations from pre-intervention to one-week post-intervention. In the following sections, I briefly review the results of the study and offer potential explanations regarding why most hypotheses were not supported. To conclude, I discuss limitations of the study and present directions for future research in this area.

The Effect of the Self-Affirmation Intervention

The primary purpose of the intervention was to increase students’ science motivation—in particular, their science self-efficacy, science interest, and mastery and performance goal orientations in science via reading a biography about a scientist and completing of a self-affirmation task. In Hypothesis 1, I predicted that adolescents who engaged in the self-affirmation task would report increased science motivation. Neither adolescents who engaged nor those who did not engage in the self-affirmation task increased in science motivation either at intervention or one-week post-intervention. Thus, Hypothesis 1 was not supported.

Other empirical evidence regarding self-affirmation interventions is relatively mixed in success of improving academic outcomes in adolescents. Cohen et al. (2006) employed a multi-session values affirmation intervention with African American and European American seventh
grade students. Students were randomly assigned to an affirmation or control condition. Those who were assigned to the affirmation condition engaged in three to five affirmation writing exercises (affirming the self positively) over the course of an academic year. African American students, but not European American students, who engaged in the affirmation condition had significantly improved their GPAs compared to African Americans in the control conditions (Cohen et al., 2006). Longitudinal effects of the intervention were observed three years post-intervention: Affirmed African Americans continued to improve their GPAs over their non-affirmed African American counterparts (Cohen et al., 2009). European American students showed no benefits of the self-affirmation. Sherman et al. (2013) conducted a study that was methodologically similar to that of Cohen et al. (2006) with White and Hispanic/Latino American sixth, seventh, and eighth grade students. Results revealed that Hispanic/Latino American students who engaged in the affirmation writing had higher GPAs than their non-affirmed Hispanic/Latino American counterparts by the end of the first year. Effects of the intervention endured two years post-intervention, as affirmed Hispanic/Latino American students continued to earn higher GPAs than non-affirmed Hispanic/Latino American students (Sherman et al., 2013). However, once again, European Americans did not benefit from the intervention, and other researchers who have aimed to replicate the intervention benefits found by Cohen et al., (2006) and Sherman et al., (2013) with other adolescent samples and have had mixed/marginal success (Borman, Grigg, & Hanselman, 2016; Bratter, Rowley, & Chukray, 2016; de Jong, Jellesma, Koomen, & de Jong, 2016; Dee, 2016; Hanselman, Rozek, Grigg, & Borman, 2016).

Three key methodological differences between the current study and prior successful affirmation interventions with adolescents could explain why no effect of intervention was
observed in the current study. The first two differences are the frequency of affirmations and the timing of testing for intervention effects. Of published affirmation interventions that were successful in improving academic outcomes for adolescents, each have had at least two affirmation sessions (usually toward the beginning of the academic year) for participants in the experimental groups, and effects of intervention were observed over the course of an academic year, typically by grading quarter or semester (Bowen et al., 2013; Bratter et al., 2016; Cohen et al., 2006; Dee, 2016; Hanselman et al., 2016; Sherman et al., 2013). In the current study, adolescents had only one self-affirmation session, and the effects of intervention were tested immediately after the intervention and one-week post-intervention. Thus, results from the current study provide support for the notion that self-affirmations tasks, in isolation, are likely not beneficial for promoting academic motivation in the short term. Further, results are not inconsistent with the possibility that the effect of self-affirmations may be subtle and gradual, unfolding over time (especially in conjunction with continued sessions of self-affirmations).

The third difference that might explain why no effect of intervention was observed in the current study could be the choice of intervention outcomes (i.e., science self-efficacy, science individual interest, and mastery and performance approach goal orientations in science). To date, much of the education intervention research employing self-affirmation tasks has focused on academic achievement as the outcome of interest. It is possible that no effect was observed in the intervention because of selection of motivational measures. Self-efficacy, individual interest, and mastery and performance approach goal orientations measure motivational beliefs. However, perhaps the intervention was not effective in changing these beliefs, but may have led to change in other facets of motivational beliefs or behavior. For example, students who engaged in the self-affirmation condition, reading about the effort employed by a scientist to reach his or her
professional goals, might have an increased belief in the importance of effort. Such students could be more motivated in the future to put effort into their science homework and tests. Future research aiming to increase motivation via self-affirmation studies could consider using a broad array of motivation measures to assess what forms or kinds of motivation such interventions may affect.

Taken together, it is likely that these three methodological differences; (1) single frequency self-affirmation, (2) immediate tests of intervention effects, and (3) different measures of outcome variables jointly contributed to explain why no effect of intervention was observed. It should be noted that self-affirmation intervention studies are sensitive to subtle methodological and contextual changes, as these changes may disrupt the targeted underlying psychological processes (Yeager & Walton, 2011). Thus, perhaps the changes outlined above were too divergent from previously successful self-affirmation studies. Future research would benefit from better understanding how the efficacy and fidelity of self-affirmation interventions may be affected by various methodological differences in study designs and contextual differences in the environment.

**The Effect of Role Model Matching on Self-Affirmation Efficacy**

For Hypotheses 2 and 3, more nuanced analyses of the intervention efficacy were examined to understand the potential effect of reading about a scientist who matched the students on both ethnicity and gender, only gender, only ethnicity, or on neither ethnicity nor gender. Results provided little support for Hypotheses 2 and 3, as none of the outcome variables changed, on average, among students in any of the experimental conditions. Ad hoc probing showed increases in performance goal orientation among students who were matched to their
role model on both ethnicity and gender, whereas students in the other conditions reported decreased mastery motivation.

In general, results suggest that reading a brief text about a successful scientist who had the same gender and ethnicity as the student was insufficient to change students’ science motivation and their ethnic or gender identity. Based on role model theory and research (Bryant & Zimmerman, 2003; Lockwood & Kunda, 1997; Marx & Ko, 2012; Zirkel, 2002), I had expected that matching the role model to the student on each of the social identities would independently enhance treatment effects. However, the current study differs from much of the role model literature, as students in this study were assigned a role model. In most of the prior role model research, students are asked to list role models in their lives. After a list is generated, more descriptive demographic information is typically gathered about the role model to ensure that a role model who matches the youth on ethnicity and/or gender is listed (Bryant & Zimmerman, 2003; Hurd et al., 2009; Yancey et al., 2002; Zirkel, 2002). Perhaps it was an unrealistic assumption that students would view the scientist they had read about in the intervention as a role model. A manipulation check assessing perceived similarity and attainability could have been added to the study to ensure that students viewed the scientists featured in the biography as role models. Indeed, this practice was used in an empirical study that employed the use of a “novel” role model assigned to participants in an adult sample (Marx & Ko, 2012).

Another possible explanation for lack of findings may stem from the length and content of the biographies. In general, the biographies were short, only containing three paragraphs of approximately five sentences per paragraph. Even the youngest students in the sample (i.e. 6th graders) were able to read through the biographies in less than 10 minutes. In these biographies,
students read about how the scientists came to be interested in science, the degrees they earned, the scientists’ current employment, and their science-related service. It is possible that the information in the biographies was not relevant enough for the students to be able to identify or associate themselves with the scientist. Increasing the quantity of content in the biographies and ensuring that content was personally relevant to the adolescent might create a stronger role model effect, especially use of information that highlighted the ethnic and gender identities of the scientists. An example of creating more general relevance would be to explain that the scientists went to the same middle school as the students. An example of creating more specific relevance to the students on the basis of a social identity would be to explain a time when the scientist was in middle school and someone told the scientist that s/he could not do well in science because the student was a girl or American Indian (or both). However, despite the negative feedback, the scientist persisted and earned their degrees in science.

One significant intervention effect was observed for students who were matched to the scientist on ethnicity and gender: Those students reported increased performance goals in science after the intervention. In contrast, mean performance goals of other groups decreased after treatment. This result may be indicative that matched role models are an effective mechanism for change in specific kinds of outcomes. Out of four science motivation variables, performance approach goal orientation could be considered a form of extrinsic motivation, whereas the other three variables (self-efficacy, interest, and mastery approach goal orientations) are forms of intrinsic motivation. Individuals who endorse performance approach goal orientations in school aim to demonstrate their competence through academic achievement as shown through exam and course grades. Other studies examining the effects of matched role models have found that students who reported matched role models were more likely to have higher GPAs (Bryant &
Zimmerman, 2003, Zirkel, 2002). Role model theory suggests that an individual who identifies another person as a role model is likely already intrinsically motivated/interested in the domain in which that role model excels. However, the skills, milestones, and accomplishments that the role model has already achieved is what differentiates the individual from the role model (Morgenroth et al., 2015). This difference between the role model and individual could act as a mechanism for increases in extrinsic motivation, as the individuals seeks to emulate the role model by achieving the same skills, milestones, and accomplishments as the role model. Thus, perhaps role models and role model matching may be particularly effective in boosting more extrinsic motivation, like performance approach goal orientations or general achievement.

Indeed, empirical research from the role model literature often uses an individual’s performance or achievement as a measure of role model effectiveness (e.g., Hoyt, Burnette, & Innella, 2012; Latu, Schmid Mast, Lammers, & Bombari, 2013, O’Brien, Hitti, Shaffer, Van Camp, Henry, & Gilbert, 2016).

Alternatively, this significant result could be spurious. Many analyses were conducted in assessment of the intervention efficacy; thus, at least one significant effect might to emerge due to chance. Further, examination of group means from pre-intervention to one-week post-intervention showed that group means were regressing to an overall sample mean (i.e., performance approach goal orientation means at pre-intervention and post-intervention for those who were matched to the scientist were $Ms = 4.21$ and 4.62, respectively, and those in all other experimental conditions and the control condition were $Ms = 4.81$ and 4.54, respectively). Thus, the interpretation of this result must be cautious and not overstated.
Centrality as a Predictor of Intervention of Efficacy

In Hypothesis 4 I expected that ethnic and gender centrality would significantly predict the efficacy of the intervention, such that the students with higher levels of centrality in the respective centrality-match conditions would report greater increases in science motivation, compared to students with lower levels of centrality. However, ethnic and gender centrality were not significant predictors of intervention efficacy and results did not support Hypothesis 4. Perhaps the most obvious factor in explaining why ethnic and gender centrality were not significant predictors is that there was no effect of treatment for any of the science motivation measures. With very little observed change from pre-intervention to intervention and post-intervention in science motivation scores, it is not surprising that ethnic and gender centrality did not significantly predict intervention efficacy.

However, even if a treatment effect had been observed in the experimental conditions, it could be the case that ethnic centrality (as well as other dimensions of ethnic identity) are too rudimentary during early adolescence to have moderated treatment effects. Ethnic identity development theory suggests that nuanced dimensions of ethnic identity such as ethnic centrality and ethnic private and public regard are only beginning to develop in late childhood and early adolescence (Umaña-Taylor et al., 2014). Indeed, a study of individual differences in racial centrality of African American youth showed that the stability of racial centrality increased from early to middle adolescence (Hoffman, Kurtz-Costes, Rowley, & Adams, 2017). Thus, given its nascent form, perhaps it is not surprising that centrality did not significantly predict treatment efficacy in the intervention.
Limitations and Directions for Future Research

The study had several limitations that might inform future interventions to boost students’ motivation and social identities that are congruent with academic success. First, there appeared to be a novelty and/or experimenter effect in the mean scores of the key study variables across the three sessions of the study. Relatively consistently, pre-intervention scores across all groups were the highest of the three sessions. Motivation scores at intervention and post-intervention were typically lower than pre-intervention scores and were more similar to each other across conditions. It is likely that many of the students had never participated in a psychology research study before participating in the current study, and seeing some of these measures for the first time might have resulted in higher endorsement. Further, especially at the first session, students may have anticipated that the experimenter would want the students to have higher endorsement of the various measures. To circumvent this issue in future studies, it would be helpful to offer two or three pre-intervention sessions across several weeks. Scores across the pre-intervention sessions could then be averaged to create a more accurate measure of baseline mean levels of various measures.

An assumption underlying the study design was that the scientists featured in the biographies would be considered role models for the students. However, much of the role model research with children and adolescents requires participants to identify their role models, who are therefore personally known to them. This method ensures that an individual can serve as a role model for the participant. However, in the current study, students were assigned a scientist role model and it is not known whether or not these scientists were viewed as role models for the students. Certainly, for those students who were interested in and who enjoy science, it is likely that these scientists would serve as a role model. However, for students who were not interested
in or enjoyed science, it is not clear if and how the scientists could serve as role models for these students. Thus, in future role model research where role models are assigned to the participant, it would be important to use a manipulation check to ensure that role models serve their purpose. As previously mentioned, scholars have identified the perceived relevance of the role model to the individual and the believed attainability of the role model’s success as important factors (Lockwood & Kunda, 1997). Therefore, in future research, study designs where participants are matched to a role model should include questions that ask the extent to which participants believe that role model is relevant to them and the extent to which the role model’s success is attainable.

Finally, it is important to consider that the sample represents a specific population, even within the larger American Indian and Alaskan Native population. It is not clear if and how results would be different among other Native Nations or ethnic/racial minority groups in the United States. To date, there are 567 federally recognized Native Nations in the United States. Of these Nations, only 46 Nations, or approximately 8%, are located east of the Mississippi River. The Nation represented in this study is one of those 46 federally recognized Native Nations east of the Mississippi River. That Nation has a unique history compared to many of the Native Nations in the western parts of the United States. Histories for these Nations in particular include forced assimilation (including attendance at Indian boarding schools) and The Indian Removal Act of 1830. Negative effects of these historical traumas have been documented (Brave Heart, 2003) and are known to influence the content and development of ethnic identity of American Indian youth (Brown, Dickerson, & D’Amico, 2016). Thus, the historical trauma experienced by this Nation likely shapes its citizens’ ethnic identity, views about education, general worldviews, and perhaps, even their response to the current intervention. With such ties to historical trauma,
perhaps young citizens are skeptical of academia and higher education as a means for a future career and lifestyle. Thus, students from the current sample may be less responsive to the intervention than students from other Nations in the western United States. Conversely, because of the forced assimilation and loss of Native culture due to assimilation, young citizens from this Nation may be more likely to view academia and higher education as means for success in their future and thus may be more responsive to the intervention compared to students from other Nations.

Despite the limitations listed above, results of the current study provide valuable information regarding the methodological design and implementation of self-affirmation intervention studies. Results suggest that the fidelity of self-affirmation interventions are relatively fragile and sensitive to methodological and contextual changes. Future research will benefit from a more nuanced understanding of which methodological factors and contextual conditions in self-affirmation interventions are and are not successful in boosting students’ academic motivation and achievement. Results of the current study provide preliminary evidence that a single session self-affirmation study may not be sufficient to create intervention effects. Further, immediate measurement of intervention effects may not be the optimal timing to assess intervention efficacy. With persistent ethnic/racial and gender science achievement gaps in in the United States, scholars aiming to close those gaps should continue to refine self-affirmation theory and interventions to better understand when and under what circumstances self-affirmation can lead to educational parity.
Table 1
*School Enrollment by Gender and Experimental Condition (N = 212)*

<table>
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<th></th>
<th>Tribal School</th>
<th>Public Schools</th>
<th>Total</th>
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<tbody>
<tr>
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<tr>
<td>Match on Ethnicity and Gender</td>
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<td>25</td>
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<tr>
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<td>10</td>
<td>24</td>
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<tr>
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<td>6</td>
<td>24</td>
</tr>
<tr>
<td>No match on Ethnicity or Gender</td>
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<td>5</td>
<td>19</td>
</tr>
<tr>
<td>Control</td>
<td>12</td>
<td>6</td>
<td>18</td>
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<tr>
<td><strong>Total</strong></td>
<td>73</td>
<td>36</td>
<td>110</td>
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<tr>
<td><strong>Boys</strong></td>
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<td>Match on Ethnicity and Gender</td>
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<td>Match on Ethnicity</td>
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<tr>
<td>No match on Ethnicity or Gender</td>
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<td>4</td>
<td>14</td>
</tr>
<tr>
<td>Control</td>
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<td>6</td>
<td>15</td>
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<tr>
<td><strong>Total</strong></td>
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<td>48</td>
<td>102</td>
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<tr>
<td><strong>Total</strong></td>
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<td>Grade 6</td>
<td>Grade 7</td>
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<tr>
<td><strong>Girls</strong></td>
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<tr>
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<tr>
<td>Match on Gender</td>
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</tr>
<tr>
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<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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*Note: *p<.05, **p<.01*
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Table 5

*Multiple Regression Predicting Science Self-Efficacy from Pre-Intervention Ethnic Centrality and Experimental Condition (N = 212)*

<table>
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<td>.16</td>
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*Note. Ethnic Centrality and Ethnic Group Match were centered at their means.*

*p < .05, **p < .01*
Table 6

*Multiple Regression Predicting Science Individual Interest from Pre-Intervention Ethnic Centrality and Experimental Condition (N = 212)*

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<td>.16</td>
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<td>.07</td>
<td>.13</td>
<td>.11</td>
<td>.06</td>
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*Note. Ethnic Centrality and Ethnic Group Match were centered at their means.*

*p < .05, **p < .01*
Table 7

*Multiple Regression Predicting Mastery Approach Goal Orientations in Science from Pre-Intervention Ethnic Centrality and Experimental Condition (N = 212)*

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<td>Ethnic Group Match</td>
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<td>Student School</td>
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*Note.* Ethnic Centrality and Ethnic Group Match were centered at their means.

*p < .05, **p < .01*
Table 8

Multiple Regression Predicting Performance Approach Goal Orientations in Science from Pre-Intervention Ethnic Centrality and Experimental Condition (N = 212)

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<td>Ethnic Centrality at Pre-Intervention</td>
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<td>.19</td>
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<td>Ethnic Centrality x Ethnic Group Match</td>
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<td>Student Grade</td>
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<td>Student School</td>
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<tr>
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*Note. Ethnic Centrality and Ethnic Group Match were centered at their means.

*p < .05, **p < .01
Table 9

Multiple Regression Predicting Science Self-Efficacy from Pre-Intervention Gender Centrality and Experimental Condition (N = 212)

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<td>-.05</td>
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<td>-.02</td>
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Note. Gender Centrality and Gender Group Match were centered at their means.

*p < .05, **p < .01
Table 10

*Multiple Regression Predicting Individual Interest in Science from Pre-Intervention Gender Centrality and Experimental Condition (N = 212)*

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<td>.08</td>
</tr>
<tr>
<td>Gender Centrality at Pre-Intervention</td>
<td>-.06</td>
<td>.12</td>
</tr>
<tr>
<td>Gender Centrality x Gender Group Match</td>
<td>.03</td>
<td>.05</td>
</tr>
<tr>
<td>Student Grade</td>
<td>-.09</td>
<td>.08</td>
</tr>
<tr>
<td>School</td>
<td>.03</td>
<td>.08</td>
</tr>
<tr>
<td>$R^2$</td>
<td>.53</td>
<td></td>
</tr>
<tr>
<td>$F$</td>
<td>41.15</td>
<td></td>
</tr>
</tbody>
</table>

*Note. Gender Centrality and Gender Group Match were centered at their means.*

*p < .05, **p < .01*
Table 11

*Multiple Regression Predicting Mastery Approach Goal Orientation from Pre-Intervention Gender Centrality and Experimental Condition (N = 212)*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Intervention</th>
<th></th>
<th>One-Week Post Intervention</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE B</td>
<td>β</td>
<td>B</td>
</tr>
<tr>
<td>Mastery Approach Goals in Science at Pre-Intervention</td>
<td>.71</td>
<td>.05</td>
<td>.69**</td>
<td>.65</td>
</tr>
<tr>
<td>Gender Group Match</td>
<td>-.05</td>
<td>.08</td>
<td>-.03</td>
<td>.02</td>
</tr>
<tr>
<td>Gender Centrality at Pre-Intervention</td>
<td>-.14</td>
<td>.12</td>
<td>-.16</td>
<td>-.05</td>
</tr>
<tr>
<td>Gender Centrality x Gender Group Match</td>
<td>.06</td>
<td>.05</td>
<td>.16</td>
<td>.05</td>
</tr>
<tr>
<td>Student Grade</td>
<td>-.04</td>
<td>.09</td>
<td>-.02</td>
<td>-.11</td>
</tr>
<tr>
<td>Student School</td>
<td>-.12</td>
<td>.09</td>
<td>-.07</td>
<td>.01</td>
</tr>
<tr>
<td>R²</td>
<td>.46</td>
<td></td>
<td></td>
<td>.40</td>
</tr>
<tr>
<td>F</td>
<td>30.86</td>
<td></td>
<td></td>
<td>24.70</td>
</tr>
</tbody>
</table>

*Note. Gender Centrality and Gender Group Match were centered at their means.*

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

*Multiple Regression Predicting Performance Goal Orientation in Science from Pre-Intervention Gender Centrality and Experimental Condition (N = 212)*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Intervention</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>One-Week Post Intervention</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE B</td>
<td>β</td>
<td>B</td>
<td>SE B’</td>
<td>β</td>
<td>B</td>
<td>SE B’</td>
<td>β</td>
</tr>
<tr>
<td>Performance Approach Goals in Science at Pre-Intervention</td>
<td>.71</td>
<td>.05</td>
<td>.69**</td>
<td>.63</td>
<td>.06</td>
<td>.63**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender Group Match</td>
<td>-.12</td>
<td>.10</td>
<td>-.07</td>
<td>-.26</td>
<td>.10</td>
<td>-.14*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender Centrality at Pre-Intervention</td>
<td>-.11</td>
<td>.14</td>
<td>-.12</td>
<td>-.00</td>
<td>.15</td>
<td>-.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender Centrality x Gender Group Match</td>
<td>.08</td>
<td>.06</td>
<td>.20</td>
<td>.04</td>
<td>.06</td>
<td>.09</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student Grade</td>
<td>-.02</td>
<td>.10</td>
<td>-.01</td>
<td>-.04</td>
<td>.10</td>
<td>-.02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student School</td>
<td>-.22</td>
<td>.10</td>
<td>-.11*</td>
<td>-.10</td>
<td>.11</td>
<td>-.06</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R^2$</td>
<td>.45</td>
<td></td>
<td></td>
<td>.40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$F$</td>
<td>29.51</td>
<td></td>
<td></td>
<td>24.70</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Gender Centrality and Gender Group Match were centered at their means.

*p < .05, **p < .01*
APPENDIX A: ITEMS OF STUDY MEASURES

Science Self-Efficacy

I’m certain I can master the skills/standards taught in science class this year.

I can do even the hardest work in science class if I try.

If I have enough time, I can do a good job on all of my work for science class.

I can do almost all of the work for my science class if I don’t give up.

Even if the work in science class is hard, I can learn it.

I’m certain I can figure out how to the most difficult science problems.

Science Individual Interest

Science is practical for me to know.

Science helps me in my daily life outside of school.

I like science.

Science is exciting to me.

It is important to me to be a person who reasons scientifically.

I enjoy the subject of science.

Thinking scientifically is an important part of who I am.

I enjoy doing science experiments.

Approach Goal Orientations for Science

Performance Approach Goal Orientations

It is important for me to do better than other students in science class.

It is important for me to do well compared to others in my science class.

My goal in science class is to get a better grade than most of the other students.

Mastery Approach Goal Orientations
It is important for me to understand the content of my science class thoroughly as possible.
I want to learn as much as possible from science class.
I desire to completely master the material presented in science class.

**Gender Identity**

*Gender Centrality*
If I were to describe myself to someone, one of the first things that I would say is that I am a [gender in-group].
I feel close to other [gender in-group]s.
I have a strong sense of belonging with [gender in-group]s.

*Private Regard*
I am happy that I am a [gender in-group].
I am proud to be a [gender in-group].

**Ethnic Identity**

*Ethnic Centrality*
If I were to describe myself to someone, one of the first things that I would say is that I am [Tribe Name] or American Indian.
I feel close to other [Tribe Name] or American Indian people.
I have a strong sense of belonging with [Tribe Name] or American Indian people.

*Private Regard*
I am happy that I am [Tribe Name] or American Indian.
I am proud to be [Tribe Name] or American Indian.
I feel good about [Tribe Name] or American Indian people.
Public Regard

Most people think that [Tribe Name]s or American Indians are as smart as people from other races.

People think that [Tribe Name] or American Indians are as good as people from other races.

People from other races think that [Tribe Name] or American Indians have made important contributions.
APPENDIX B: BIOGRAPHIES

Please carefully read the paragraph about Dr. Lindsey Youngbird

Dr. Lindsey Youngbird is an enrolled member of the Eastern Band of Cherokee Indians. She was born in Cherokee, NC. She was very bright and hard working from a young age. As a young teenager, she was interested in learning how animals and plants changed to be able to live in certain places. She also wanted to learn how she could help protect them. Because of her interests, Dr. Youngbird wanted to go to school to learn more about plants and animals.

When she was 18, Lindsey went to college at Western Carolina University. She graduated four years later with a Bachelor’s degree in Biology. Lindsey then went to graduate school at the University of North Carolina (UNC). At UNC, she earned her Master’s and Doctoral (Ph.D.) degrees in Biosystems Engineering.

Dr. Youngbird is now a biologist for the U.S. Fish and Wildlife Service. Her job is to protect fish and other wild animals. She volunteers at Bioscience Alliance. At Bioscience Alliance, she helps young people learn about jobs in science, technology, engineering and mathematics.

Look at the list of words below and choose three words that could describe both you and Dr. Youngbird. Write those three words at the top of your essay paper and explain how you and Dr. Youngbird are alike.

Adventurous  Determined  Kind  Skillful
Brave  Flexible  Knowledgeable  Smart
Capable  Generous  Optimistic  Successful
Curious  Hard working  Organized  Willing
Dedicated  Interesting  Self-confident  Wise
Please carefully read the paragraph about Dr. Lance Youngbird

Dr. Lance Youngbird is an enrolled member of the Eastern Band of Cherokee Indians. He was born in Cherokee, NC. He was very bright and hard working from a young age. As a young teenager, he was interested in learning how animals and plants changed to be able to live in certain places. He also wanted to learn how he could help protect them. Because of his interests, Dr. Youngbird wanted to go to school to learn more about plants and animals.

When he was 18, Lance went to college at Western Carolina University. He graduated four years later with a Bachelor’s degree in Biology. Lance then went to graduate school at the University of North Carolina (UNC). At UNC, he earned his Master’s and Doctoral (Ph.D.) degrees in Biosystems Engineering.

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- Capable
- Curious
- Dedicated
- Determined
- Flexible
- Generous
- Hard working
- Interesting
- Kind
- Knowledgeable
- Optimistic
- Organized
- Self-confident
- Skillful
- Smart
- Successful
- Willing
- Wise
Please carefully read the paragraph about Dr. Lindsey Williams

Dr. Lindsey Williams was born in Sylva, NC. She was very bright and hard working from a young age. As a young teenager, she was interested in learning how animals and plants changed to be able to live in certain places. She also wanted to learn how she could help protect them. Because of her interests, Dr. Williams wanted to go to school to learn more about plants and animals.

When she was 18, Lindsey went to college at Western Carolina University. She graduated four years later with a Bachelor’s degree in Biology. Lindsey then went to graduate school at the University of North Carolina (UNC). At UNC, she earned her Master’s and Doctoral (Ph.D.) degrees in Biosystems Engineering.

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Dedicated  Kind  Smart
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REFERENCES


Sanders, M. G. (1997). Overcoming obstacles: Academic achievement as a response to racism


