Female High School Students' Science, Technology, Engineering and Mathematics Intentions: The Effects of Stereotype Threat

by

Yirgalem Alemu Keery

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Supervisor: Prof Kitty Dumont

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DECLARATION

I, Yirgalem Alemu (student number 49034251), declare that *Female High School Students' Science, Technology, Engineering, and Mathematics Intentions: The Effects of Stereotype Threat* is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references. I further declare that I have not previously submitted this work, or part of it, for examination at UNISA or at any other higher education institution for another qualification.

Name: Yirgalem Alemu Date: 28 January 2019

Signature: ________________

ABSTRACT

The central objective of the present research was to provide a better understanding of stereotype threat and its underlying effects on female high school students' intention to major in Science, Technology, Engineering and Mathematics (STEM) fields. Specifically, the study investigated the intervening effects of mathematics/science self-efficacy and the conditional effects of perceived social support with regards to the implications of stereotype threat. For this reason, three studies were conducted. Participants were female (Study 1 – 3) and male (Study 1) high school students from Harer and Dire Dawa Regions, located in the Eastern part of Ethiopia. Study 1 provided evidence that both female and male participants were well aware of the existence of the negative stereotype about females' mathematics/science ability. Participants reported that the Ethiopian society attributes less mathematics/science ability to females than to males. Although female participants were well aware of the existence of the negative stereotype about females' mathematics and science ability, they did not endorse it. Study 2 showed experimentally that stereotype threat reduces indeed females' intention to major in STEM fields. Moreover, Study 2 revealed that mathematics/science self-efficacy mediated the relationship between stereotype threat and females' intention to major in STEM fields. Study 3 addressed the role of social support. The results revealed that female participants who felt socially supported in their intention to major in a STEM field were found to be resistant to the negative effects of stereotype threat. In other words, it is the interaction between stereotype threat and the lack of social support that reduces females' intention to major in STEM fields. The findings of the present study are discussed in relation to stereotype threat theory and related literature as well as in relation to potential educational interventions relevant for the Ethiopian context.

SUMMARY

The issue of females' underrepresentation in Science, Technology, Engineering and Mathematics (STEM) fields is a well-documented phenomenon. In most developed countries including the USA, females make up less than a quarter of the STEM workforce. Research also indicates that the underrepresentation of females in the STEM workforce is worst on the African continent (UNESCO, 2009).

The present study focused on mediation and moderation variables influencing the impact of stereotype threat effects on female high school students' intention to major in STEM fields. The use of moderation and mediation models can lead to a deeper and more comprehensive understanding of the conditions under which stereotype threat causes performance decrement and the process and/or mechanism of stereotype threat effects. Because of theoretical and empirical significances, the present study considered mathematics/science self-efficacy as mediator and perceived social support as moderator variables of stereotype threat effects.

In order to determine whether stereotype threat influences females' intention to major in STEM fields, it was important to elaborate first whether the negative gender stereotype about females' mathematics and science ability is shared within the Ethiopian society and whether female students endorse this negative stereotype (Study 1). The results of Study 1 revealed that the negative gender stereotype about females' mathematics and science ability is indeed shared within the Ethiopian society. However, the results of Study 1 also suggested that female students do not endorse this stereotype. On the other hand, the results of Study 2 showed that experimentally induced stereotype threat reduced indeed female high school students' intention to major in STEM fields. Furthermore, Study 2 revealed that the negative effect of stereotype threat on STEM intention was partially mediated by mathematics/science self-efficacy. In other

words, female high school students' mathematics/science self-efficacy was reduced due to the activated stereotype threat, which in turn interfered with their intention to major in STEM fields.

Study 3 showed that the negative relationship between stereotype threat and STEM intention is conditional upon perceived social support. More specifically, the results suggested that stereotype threat influences negatively only those female students' intention to study a STEM field that reported low social support from significant others (e.g., parents and teachers) in their mathematics/science learning. On the other hand, participants who perceived high social support in their mathematics/science learning were not at all affected by stereotype threat. These results imply that the negative effects of stereotype threat are conditional upon social context.

In conclusion, the present study which was informed by the Ethiopian government plan to increase the enrolment of students in science and technology fields in order to transform Ethiopia into a middle-income country by 2025 (Federal Democratic Republic of Ethiopia, MoE, 2010), proposes that both personal factors (such as reduced self-efficacy) and a threatening social environment (such as stereotype threats) reduce female students' intention to major in STEM fields. However, both self-efficacy and a threatening social environment are dynamic rather than fixed constructs which means that support programmes might provide appropriate interventions to mitigate the negative effects of these factors.

INTRODUCTION

In today's world, there is a growing demand for people in science and technology as world economies rely increasingly on innovations in Science, Technology, Engineering and Mathematics (Catsambis, 2005). The importance of Science, Technology, Engineering and Mathematics (STEM) for the whole world and the unique role of girls and women has been described by the former UNESCO Director-General, Frederico Major, as follow:

> *In a world increasingly shaped by science and technology, scientific and technological literacy is a universal requirement […]. It is vital to improve scientific and technological literacy among women and girls, whose unique educational function within the family makes them such a major determinant of the attitude of present and future generations* (cited in Hoffmann-Barthes, Nair & Malpede, 1997, p. 6).

Currently, countries are giving due attention to STEM education in order to bring about socio-economic changes and improve the quality of people's lives. Developed countries such as the USA stress the importance of science and technology if its industries and the nation itself aim to maintain their lead. According to the American National Academy of Sciences (2007), there is a national need for more workers trained in STEM fields to maintain the economic supremacy of the USA. Hence, the government of the USA is expected to increase the supply of generations of youth from all backgrounds who aspire to and eventually work in STEM domains (National Academy of Sciences, 2010).

It is estimated that developing countries on the African continent need at least 200 scientists per one million individuals for effective industrial development (Hoffmann-Barthes et al., 1997). Thus, the Ethiopian government considers the expansion of science and technology as a key factor for poverty reduction. The Ethiopian Federal Ministry of Education stresses the issue by explicitly stating that “Achieving the vision of transforming Ethiopia into a middle-income country in 2025 demands transformation of the economy through the application of science and technology as instruments to create wealth” (Federal Democratic Republic of Ethiopia, MoE, 2010, p. 9). Accordingly, it was decided to enroll 70 percent of university students in science and technology fields from 2008 (Federal Democratic Republic of Ethiopia, MoE, 2010). This decision created a unique and challenging situation whereby science and mathematics secondary education has been put into the spotlight.

Involvement in STEM domains is also assumed to increase employment opportunities and to narrow the wage gap between men and women (Wang & Degol, 2013; Beede, Julian, Langdon, McKittrick, Khan, & Doms, 2011; Federal Democratic Republic of Ethiopia, MoE, 2010; National Academy of Sciences, 2010; Hoffmann-Barthes et al., 1997). In terms of employment opportunities, in 2012 there were approximately 7.4 million STEM positions available in the USA. This number was expected to grow up to 8.65 million by 2018 (Wang & Degol, 2013). That STEM employment also plays a pivotal role in reducing the gender wage gap was suggested by Beede et al. (2011), who reported that women in STEM jobs earned 33 percent more in the United States’ workforce than comparable women in non-STEM jobs. This figure is considerably higher than the STEM premium for men (which was 25 percent). This trend suggests that recruiting more women into the STEM workforce is likely to decrease the gender wage gap which corresponds with the demands for economic gender equity.

In spite of the high demand of STEM graduates, the number of female students who enroll and graduate in these fields is in general much less than required (Wang & Degol, 2013; Beede et al., 2011; FME, 2010; National Academy of Sciences, 2010). Despite making up almost half of the overall workforce in the USA, women represent less than a quarter of the STEM workforce (Beede et al., 2011). They are also underrepresented in academic faculties (National Academy of Sciences, 2010; Ceci, Williams & Barnett, 2009; Halpern, Benbow, Geary, Gur, Hyde, & Gernsbache, 2007). For instance, at the top of US universities, the proportion of women full professors in mathematics-intensive fields ranges from 3% to 15% (Science and Engineering Indicators, 2005; cited in Ceci et al., 2009). Women are also the minority in STEM fields in most Western European countries (Grevholm, 2002; Lihong, 2009). In most OECD countries, university-level graduation rates for women and men are equal or women exceed men. However, the proportion of women among university graduates in mathematics-intensive fields is on average only 30 percent (Lihong, 2009; Haahr, Nielsen, Hansen, & Jacobsen, 2005).

In Africa, the underrepresentation of women and girls in STEM fields is even worse (Hoffmann-Barthes et al., 1997; UNESCO, 2009). Although females constitute more than half of the population on the African continent, their rate of participation in science and technology is considered to be the lowest of all regions in the world (UNESCO, 2009). In Zambia, for example, although the participation of females in science has continuously increased since 1985, they represent only 15 to 16 percent of students in physics and chemistry (Hoffmann-Barthes et al., 1997). The participation of females in physics and chemistry is also low in Uganda and Kenya with most of them opting for biological sciences, avoiding pure sciences (Hoffmann-Barthes et al., 1997). At Ethiopian Universities, less than a quarter of female students are enrolled in science and technology fields (Federal Democratic Republic of Ethiopia, MoE, 2011). The underrepresentation of females in science and technology deprives the African continent of a substantial input (UNESCO, 2009; Hoffmann-Barthes et al., 1997).

As much as researchers do agree about women's underrepresentation in STEM fields, as much do they disagree about the underlying causes. It is known that arithmetic abilities are an essential entry skill for scientific and technical occupations (Catsambis, 2005; Steele, Levin, & Blacksmith, 2005; Bussey & Bandura, 1999). Thus, the underrepresentation of females in STEM-related careers has often been attributed to their poor performance in mathematics and science subjects (Huguet & Regner, 2009; Wiest, 2008; Haahr et al., 2005). Some researchers argued that biological determinants are responsible for gender differences in academic performance and in turn for the underrepresentation of women in STEM fields (Benbow & Stanley, 1983). Other researchers directed their attention to socio-cultural factors including cultural norms, a division of labour, social structure, gender inequality and others that contribute to gender differences in mathematics and science performance and differences in career choices between males and females (Eagly & Wood, 1999; Baker & Jones, 1993). Psychological research stressed in recent years the role of stereotypes related to females' mathematics/science abilities and their implications for academic performance. Thus, the phenomenon of stereotype threat received a great amount of attention as a potential contributor to the underperformance of women and girls in STEM domains (Saucerman & Vasquez, 2014; Tomasetto, Alparone, & Cadinu, 2011; Taylor & Walton, 2011).

While most of the outlined research stressed females' underperformance in mathematics and science as a reason for the underrepresentation of females in the STEM domains, the present research proposes that motivational factors are also at play, that is to say, the intention females might have (or not) to choose STEM fields when entering university. Based on the premise that negative stereotype activation reduces females' academic performance, the present research argues that negative stereotype activations equally reduces females' intention to major in STEM fields. More specifically, this research project aimed at extending our understanding about the interplay between negative stereotype activations and females' intention to major in STEM fields by exploring the intervening effects of self-related beliefs as well as the conditional effects of social context in this interplay.

The results of this research contribute not only to the discussions and discourses related to stereotype threat research and other academic fields such as social and educational psychology but also to the ongoing efforts of the Ethiopia government to transform Ethiopia into a middle-income country through the increase of STEM graduates in general and the increase of female STEM graduates in particular.

Organization of the Thesis

The thesis consists of three major parts. The first part which is referred to as the literature review discusses the various existing explanations addressing females’ underrepresentation in the STEM fields and proposes the stereotype threat approach as an appropriate framework. Accordingly, theoretical and empirical review of the literature on stereotype threat and factors that mediate and moderate stereotype threat effects are outlined and discussed. Regarding stereotype threat literature, contents like conditions necessary for stereotype threat to occur, stereotype threat manipulation (implicit and explicit), short-term and long-term implications of stereotype threat within the context of STEM, factors that mediate and moderate stereotype threat effects, and related ideas are included. Finally, the research context and the interplay between stereotype threat, mathematics/science self-efficacy, perceived social support and intention to major in STEM fields are explained which also informed the proposed hypotheses of the present research.

The second part of the thesis reports three studies that addressed the relationships between stereotype threat, mathematics/science self-efficacy, perceived social support and intention to major in STEM fields. Study 1 explored the awareness and endorsement of the negative stereotype of females' mathematics/science ability among Ethiopian female and male high school students using a cross-sectional survey design. Study 2 tested experimentally the effect of stereotype threat on females' intention to study STEM fields by exploring the role of self-efficacy within this relationship. Study 3 studied also experimentally the role of social support in mitigating the negative effect of stereotype threat. Research design, participants, procedures, measurements, results, and discussions are outlined for each study.

The final part of the thesis contains the general discussion. This section starts with summarizing the general aims of the present research followed by discussions of the findings of the research in relation to previous studies in the area. Next, the contributions of the research to stereotype threat literature are discussed. Specifically, this section discusses how the results of the present research contribute to stereotype threat theory by extending the negative consequences of stereotype threat to motivational processes (i.e., intention). Moreover, this section discusses the roles of authority figures (i.e., parents and teachers) in boosting students' socio-emotional skills including feeling safe and resisting negative pressure in the STEM environment. Then, the limitations of the study with regard to participants, design, measurements as well as the approach employed to manipulate stereotype threat are discussed. Based on the outlined limitations, recommendations for future research are proposed. Finally, the general discussion section of the thesis discusses some guidance for evidence-based intervention programs for the Ethiopian context to improve the representation of female students in STEM disciplines. To this end, interventions are recommended on three levels: curriculum, extra-curriculum and organizational levels.

LITERATURE REVIEW

In this section, the theoretical and empirical review of the literature on areas pertinent to the present research addressing females' intention to major in STEM fields, stereotype threat, self-efficacy theory, and perceived social support are outlined and discussed.

Explanations for Females' Underrepresentation in STEM fields

Females' underrepresentation in STEM fields in both education and workforce is a well-documented phenomenon (Wang & Degol, 2013; Federal Democratic Republic of Ethiopia, MoE, 2010; National Academy of Sciences, 2010; Lihong, 2009; Ceci et at., 2009; Halpern et al., 2007; Grevholm, 2002). Although scholars and policymakers agree upon the role of females' underperforming in mathematics and science as one of the reasons for their underrepresentation in STEM fields, they tend to disagree about the underlying causes.

Some researchers blame biological determinants for gender differences in academic performance (Benbow & Stanley, 1983). Biological factors such as the development of the brain structure and levels of androgen and testosterone hormones in the body are assumed to be responsible for females' weaker performance in mathematics and science (Kimura, 2002; Nuttall, Casey & Pezaris, 2005; Fletcher, 2006). Kimura (2002) emphasizes the possible influence of the brain structure on the cognitive abilities of students as in boys being good at spatial relationships and girls being good at verbal fluency. These gender differences in cognitive abilities have been demonstrated in various studies. For instance, Hedges and Nowell (1995) examined gender differences in mental test scores over time. They used six studies conducted from 1962 to 1992 with adolescents and young adults who were assumed to be representative of the USA population. The results of the studies revealed that males performed better in mathematics and science while females excelled in reading and writing. The results also revealed that males outnumbered females by a ratio of seven to one in the top one percent on tests of mathematics and spatial reasoning. However, for associative memory performance, reading comprehension, and perceptual speed, more males than females scored in the bottom 10 percent of the national distribution and fewer males scored in the top five to 10 percent. Another important finding of the studies refers, according to Hedges and Nowell (1995), to the gender difference in the variance of mathematics and science scores that was larger in males than in females. Hedges and Nowell (1995) concluded that these gender differences are of concern because ability and achievement in mathematics and science are essential to excel in scientific and technological occupations.

Although various researchers argue that biology plays a significant role in the achievement gap between males and females as indicated above, there are others who attribute the achievement gap to socio-cultural factors. This framework examines broader contextual influences on cognitive ability formation and performance including the effects of societal gender stratification (Baker & Jones, 1993), and customary rules that govern cognition and behaviour in groups and societies (Bicchieri, & Muldoon; 2014, Eagly & Wood, 1999).

The gender stratification hypothesis (Baker & Jones, 1993) argues that females' negative attitudes towards and poorer achievement in mathematics are the results of societal gender stratification. This stratification creates inequality of opportunities between the genders which in turn produces gender differences in performance. In most cultures, more educational and occupational opportunities are given to males than females (Dumas, 2011). Parents, teachers, and friends encourage males more and tell them that "mathematics is the domain of performance that they should take seriously" (Baker & Jones, 1993, p. 92). To summarize, the gender stratification hypothesis proposes that the more societal stratification based on gender, the more inequality of opportunities between the genders favouring males. Thus, females will be more likely to develop negative attitudes and perform relatively worse on mathematics tests than their male counterparts.

To investigate the relationship between mathematics performance and gender inequality, Guiso, Monte, Sapienza, and Zingales, (2008) analyzed the Program for International Student Assessment (PISA) among high school students in 40 countries. The results showed that the size of the gender gap in mathematics performance varies between countries and that these differences can be explained by the country's measure of gender equality index. According to these results, an increase in gender equality showed a diminishing gender gap in performance. In more gender equal societies, females' underperformance diminished to a great extent. More importantly, in these societies females equally perform as males in mathematics. In some gender equal societies like Norway and Iceland, secondary school females even outperformed their male counterparts in both science and mathematics (Lihong, 2009; Haahr et al., 2005).

The social role theory (Eagly & Wood, 1999) is another relevant approach that aims at explaining the underlying causes of gender differences in behaviour. The theory proposes that society's gendered division of labour fosters the development of gender differences in behaviour. This is done by affording different restrictions and opportunities to males and females on the basis of their social roles. Accordingly, if females are expected to care for younger siblings or prepare meals rather than going to school, their access to formal schooling may be limited (Eagly & Wood, 1999).

Although Eagly and Wood (1999) did not analyze gender differences specifically in mathematics performance, it is obvious that social role theory can be applied in the context of mathematics and science education. That is, if the cultural roles of females do not include abilities in mathematics and science, they may face structural obstacles as in lack of formal access to mathematics and science education. Even if they have access to mathematics and science education, they still might face social obstacles such as lack of support and encouragement to succeed in these areas. Such structural and social impediments hinder females' mathematical development. Guiso et al. (2008) also suggested that indicators of females' roles in society impact on mathematics attitude and performance. In other words, in a more divisive social structure regarding to gender, the gender gap in mathematics would be greater in favouring males.

Both gender stratification and division of social roles are facilitated through the process of socialization by parents, media, teachers, and others. In turn, these agents of socialization are influenced by social structure, because they internalize it and pass it on to the new generation consciously or unconsciously. In other words, societal gender stratification and role assignment influence parents' and teachers' expectations and treatment of children along the gender lines. One differential treatment of parents is manifested through the type of toys they choose for their sons and daughters. Boys are often provided with toy vehicles, guns, and sports equipment; while girls are provided with kitchen sets, dress-up toys and other domestic items (Bussey & Bandura, 1999). These toys send messages that dictate the roles each gender should play in the future; in that boys are prepared for carrying responsibilities outside of the home such as to be mechanical engineers, whereas girls are prepared for homemaking and childcare.

The other treatment difference of parents refers to the type of support and encouragement that they give their daughters and sons. Parents tend to comment more often and more positively on their sons' mathematics and science performance than on their daughters' mathematics and science performance. Such implicit acts, according to Bussey and Bandura (1999), are influential towards females' negative mathematics attitudes, which at a later stage will negatively affect their mathematics and science achievement and mathematics and science-related careers. It has been shown that students' reports of their parents' expectations are significant factors influencing their higher mathematics and science grades (Kaufman & Yin, 2009). Generally, parents socialize their children by communicating their values with respect to school (i.e., doing well in math class), and intending for their children to adopt these values and beliefs (Spera, 2005). Hence, parental beliefs about their child's mathematics ability and the value they put on mathematics generally influence their own behaviour as well as the motivation and later career choices of their children (Catsambis, 2005).

Educators play their own roles in the socialization of children. For example, teachers consciously or unconsciously reinforce gender stratification through the examples they give in the classroom that for instance depict males as scientists and females as secretaries. Moreover, teachers expect different performance levels from males and females. Most teachers expect higher math-related performance from males than from females (Clark, 2015; Shapiro & Williams, 2012; Bianco, Harris, Garrison-Wade & Leech, 2011; Catsambis, 2005). Such differences in expectation are directly related to different treatment and achievement outcomes (Cho, 2013; Hattie, 2009; Kaufman & Yin, 2009). For instance, Moss-Racusin, Dovidio, Brescoll, Graham and Handelsman (2012) indicated subtle biased treatment of female university students in the science disciplines by the faculty of both genders. This bias was associated with less support for female students, which is likely to contribute to the gender disparity in STEM fields.

Media also shape females' expectation and performance in mathematics and science through portrayals of women and girls in movies, news reports, and advertisement. For instance, brandings on females' clothing such as "ALLERGIC TO ALGEBRA" (Dumas, 2011, p. 1) can be seen as rather unsupportive of females' mathematics preference and performance. Gradually, females tend to internalize the messages they receive from different agents of socialization and thus believe that females are not expected to be good in the mathematics and science environment or to pursue a career in the sciences and engineering. Generally, biased treatment reduces encouragement and poor support from parents, teachers, and media contribute to the female underperformance in mathematics/science subjects.

To conclude, proponents of socio-cultural factors as explanations for gender difference in mathematics/science performance argue that factors such as unequal opportunity (i.e., in access, treatment, expectation, encouragement) to mathematics/science learning favouring males, and gendered division of labour (i.e., relating men to engineering and women to nursing profession) negatively affect female students' mathematics/science performance in the classroom. This performance difference might translate into differences in career choices in that males are more likely to major in mathematics and pursue mathematics-intensive careers such as engineering and physics. Thus, socio-cultural explanations argue that as the gender inequality and gendered division of labour reduces, the performance gap between the genders reduces too.

In summary, biological and socio-cultural explanations for the underperformance of females in mathematics and sciences or underrepresentation in the STEM domains are not conclusive. Ceci et al. (2009, p. 218) concluded that “biological evidence is contradictory and inconclusive; evidences for socio-cultural factors are inconsistent and contradictory.” These limitations of the biological and socio-cultural models to explain females’ underperformance in mathematics and science, which in turn contributes to the underrepresentation of females in STEM domains, gave way to the rise of another perspective, namely the stereotype threat approach.

The Stereotype Threat Approach

The phenomenon of stereotype threat received in recent years a great amount of attention and can be considered as a potential contributor to the underperformance of females in the STEM domain. Steele and Aronson (1995) first introduced the concept of stereotype threat. According to them, stereotype threat is a situational phenomenon that occurs when people belonging to minority groups suffer from a performance deficit when the negative stereotype concerning their in-group becomes salient. When a negative stereotype about a minority group is salient, people fear that their performance may be evaluated in light of the negative stereotype about their social group (Steele & Aronson, 1995). Under these conditions, fear of confirming the negative stereotype poses a threat to targets of the stereotype, thereby undermining their performance (Steele & Aronson, 1995).

To demonstrate this phenomenon Steele and Aronson (1995; Experiment 1) assigned African American and White college students that took a difficult test using items from the Graduate Record Examination (GRE) verbal exam to one of two conditions. In the stereotype threat condition, the test was introduced as a diagnostic of intellectual abilities. This was intended to make the racial stereotype about intellectual ability relevant to African American participants. In the non-stereotype threat condition, the test was described as a laboratory problem-solving task that was non-diagnostic of ability. This description aimed at making the racial stereotype about ability irrelevant to African American participants' performance. The performance was compared in the two conditions after statistically controlling for self-reported Scholastic Aptitude Test (SAT) scores. The results revealed that African American participants performed less well than their White counterparts in the stereotype threat condition, whereas in the non-threat condition no group differences were found. Steele and Aronson (1995) attributed the performance differences in the stereotype threat condition to the evaluation pressures created by the possibility of confirming the negative stereotype that African Americans lack academic ability.

The primary hypothesis of stereotype threat theory is performance interference (Spencer, Steele, & Quinn, 1999; Steele, 1997; Steele & Aronson, 1995). The theory states that stereotyped individuals perform worse on an evaluative task in a stereotype-threatening context than they would in a non-threatening context (Spencer et al., 1999; Steele, 1997; Steele & Aronson, 1995). Most subsequent researchers replicated and extended the stereotype threat effect on performance in cognitive ability tests of stereotyped groups (Flore & Wicherts, 2015; Armenta, 2010; Murphy, Steele, & Gross, 2007; Kiefer & Sekaquaptewa, 2006; Spencer et al., 1999; Steele, 1997; Steele & Aronson, 1995). For example, Spencer et al. (1999) observed that females' performance on a difficult math test decreased after they were told that the test had previously revealed gender differences in performance. Likewise, Krendl, Richeson, Kelley and Heatherton (2008) used neuroimaging to identify neural structures associated with females' underperformance on math tasks under conditions of stereotype threat. Their finding depicted heightened activation in brain regions associated with social and emotional processing among females who were reminded of gender stereotypes about mathematics ability. The negative effects of stereotype threat on performance have also been shown for children and adolescents (Flore & Wicherts, 2015). Analyzing 15 years of stereotype threat literature with children or adolescents as test-takers, Flore and Wicherts (2015) concluded that girls who were exposed to stereotype threat scored on average lower on mathematics, science and spatial skills compared to girls who were not exposed to such threat.

Whereas many studies replicated the original work of Steele and Aronson (1995) in different contexts as indicated above, other researchers have questioned the validity of stereotype threat theory and its effects (Ganley, Mingle, Ryan, Ryan, Vasilyeva, & Perry, 2013; Stoet & Geary, 2012). For instance, in exhaustive studies of stereotype threat with 931 high school students, Ganley et al. (2013) found no empirical evidence for stereotype threat effects. They suggested that “these results raise the possibility that stereotype threat may not be the cause of gender differences in mathematics performance prior to college” (Ganley et al., 2013, p. 1995). Similarly, in a meta-analysis of stereotype threat effects, only 30% of unconfounded experiments replicated the original theory of stereotype threat (Stoet & Geary, 2012). Some researchers argue that the literature has inflated and exaggerated the importance of stereotype threat as possible explanation for under-representation of females in some domains including STEM (Appel & Weber, 2017; Flore & Wicherts 2015; Ganley et al., 2013).

In other words, there is wide range of publication bias in the literature regarding the effects of stereotype threat. One common sign of publication bias is that researchers do not publish findings that are contrary to the theory. Studies that provide contrary results are often dismissed, forgotten, not presented at conferences, or formally written down which in turn affects non-significant results (Appel & Weber, 2017). This practice is likely to produce a meta-analytical bias in reporting stereotype threat effects. The other instance of publication bias is including studies with small sample sizes which results in biased stereotype threat effects. For example, in Flore and Wicherts’ (2015) meta-analysis, 39 out of the 47 studies have a total sample size smaller than 100. Flore and Wicherts (2015) suggest that studies with large sample sizes provide more accurate and better results of stereotype threat effects than small sample size that dominate the current stereotype threat literature.

To conclude, most debates in the stereotype threat literature are not about the existence or absence of stereotype threat effects; they are about the exaggeration and inflation of the importance of stereotype threat effects (Appel & Weber, 2017; Flore & Wicherts, 2015). This inflation tendency may not only discourage researchers from investigating psychological processes influencing stereotype threat effects that may be involved in gender differences in mathematics and science related career choices; it may also be suggestive of the existence of an homogenous concept of stereotype threat.

Following Steele and Aronson (1995), different conceptualizations of stereotype threat were proposed (see overview by Shapiro & Neuberg, 2007). Some of these conceptualizations include whether the implications of confirming the stereotypes are in another's (i.e., not necessarily a belief or expectation about one’s self) or in one’s own eyes (i.e., confirming stereotypes as a self-characteristic, see Shapiro & Neuberg, 2007). In other words, some researchers focus on the concerns the stereotyped group might have about how the group will be viewed and treated by others. Other researchers emphasize the concerns the stereotyped group might have about actually possessing the stereotypic attribute (Shapiro & Neuberg, 2007). These differences in the conceptualizations are reflected in the way stereotype threat is defined. For example, stereotype threat is defined as concern and anxiety over confirming, as a self-characteristic, a negative stereotype about one’s group (Steele, 1997). This definition emphasizes confirming negative stereotype as self-characteristics. On the other hand, stereotype threat is defined to occur when “a person is afraid of the implications of confirming the stereotypes in another’s eyes: real-time threat of being judged and treated poorly in settings where a negative stereotype about one’s group applies” (Steele et al., 2002, p. 385); and it is defined as “the decrement in test performance that results when members of some groups fear that their test performance will confirm a negative stereotype of their group” (Mayer & Hanges, 2003, p. 208).

Other researchers consider both conceptualizations of stereotype threat in their definitions. For instance, Schmader (2002) characterized stereotype threat as “a psychological predicament in which individuals are inhibited from performing to their potential by the recognition that possible failure could confirm a negative stereotype that applies to their in-group and, by extension, to themselves” (p. 194). Similarly, Koenig and Eagly (2005) defined stereotype threat as “a state of self-evaluative threat, whereby anxiety about confirming a negative stereotype in others’ eyes, or in one’s own, produces behaviour that is consistent with and confirms the stereotype” (p. 489). No matter how researchers differ in their conceptualization of stereotype threat as indicated above, most of them support the idea that the presence of stereotype threat inhibits performance when stereotyped groups are reminded of their in-group’s weaknesses.

Agreement exists also that stereotype threat is characterized as a situational threat (Steele, 1997). That is, it is not a trait or a stable characteristic or personality factor. It has the potential to occur in any situation in which negative stereotypes about one’s group are perceived to apply (Chung, Ehrhart, Hattrup, & Solamon, 2010). Thus, minority group membership or relatively low status is not prerequisite for the experience of stereotype threat (Shapiro & Neuberg, 2007). Even White males, a group not typically thought of to be stereotypically stigmatized, can experience performance decrements in math when the stereotype of Asians' superior quantitative ability is made salient (Aronson et al., 1999).

There are certain conditions necessary for stereotype threat to happen. First, there must be a known negative stereotype about a social group in a particular field (Nadler & Clark, 2011; Delisle, Guay, Senécal, & Larose, 2009; Steele, 2003). That is, people must be aware of the relevant stereotype in order to perceive the risks associated with stereotype-consistent performance. Martinot and Desert (2007) even propose to distinguish between stereotype awareness and stereotype endorsement. For instance, gender stereotype awareness refers to knowledge of what people in general think about abilities of a typical man and typical woman; whereas endorsement of stereotype refers to people's own personal beliefs about their abilities (Martinot & Desert, 2007).

Previous research indicated that the mere awareness of being negatively stereotyped was a sufficient condition for stereotype threat to occur (Spencer et al.,1999; Steele, 1997; McKown & Weinstein, 2003). For instance, Spencer et al. (1999, Study 2) informed female participants that the test they were about to take showed gender difference in the past. However, participants were not explicitly informed how women or men performed. Thus, the conclusion was left to the participants. The results showed that female participants underperformed significantly in relation to male participants. On the other hand, female participants performed at the same level as male participants under the condition that they were not informed about gender differences. These studies suggest that people need to be aware of the negative stereotype in order to be threatened by this particular stereotype. For the present research context it was, therefore, necessary that participants (i.e., female high school students) are aware of the negative gender stereotype about females' mathematics/science ability in order that stereotype threat can be considered as an influencing factor.

Although people need to be aware of a negative stereotype for stereotype threat to occur, they do not have to endorse the stereotype. In other words, stereotype endorsement is not a necessary condition for stereotype threat to occur (Quinn & Spencer, 2001; Steele, 1999). Simply the awareness that the negative stereotype is prevalent in society is sufficient to trigger stereotype threat and to cause stereotype susceptibility (Nadler & Clark, 2011; McKown & Weinstein, 2003; Spencer et al., 1999; Steele, 1997). For instance, Huguet and Regner (2009) showed that stereotype threat can occur among females who actually deny the negative gender stereotype. These findings could be taken as support that stereotype endorsement is not a necessary condition for stereotype threat to occur.

Another condition for stereotype threat to occur is that the task to be performed has to be relevant to the feared stereotype. In other words, the individual must be faced with a task that reveals the stereotype (e.g., cognitive ability test for African Americans or math test for women; see Chung et al., 2010; Delisl et al., 2009; Mayer & Hanges, 2003; Steele, 1997; Steele & Aronson, 1995). To put it differently, stereotype threat is unlikely to be evoked on verbal tests for women or on athletics test for African Americans for which they are not negatively stereotyped.

Moreover, stereotype threat research proposes that the activation of a stereotype induces threat given that the negative stereotype has been internalized over a long time and that it is ever-present; even if dormant. Stereotype threat inducing mechanisms vary from one setting to the other. In some settings, asking participants to indicate, for instance, their race prior to taking the test alone is enough to induce stereotype threat (Steele & Aronson, 1995). In other contexts, being out-numbered in an environment where group stereotypes might apply induces threat (Murphy et al., 2007).

Stereotype Threat Inducement

In their meta-analysis on stereotype threat research, Nguyen and Ryan (2008, p. 1316) identified three types of cues that are likely to induce stereotype threat. The first type of cue is blatant. In this mechanism, according to Nguyen and Ryan (2008), the message involving a stereotype about a group's inferiority in cognitive ability and/or performance is explicitly conveyed to the test takers prior to their taking a cognitive ability test. The group-based negative stereotype becomes salient in the test takers via a conscious mechanism. For example, stating that Whites tend to perform better than Blacks or that men tend to score higher than women can be considered as blatant cues (Aronson et al., 1999; Krendl et al., 2008).

The second type refers to moderately explicit stereotype threat activating cues (Nguyen & Ryan, 2008). For example, stating that men and women perform generally differently on standardized math tests (Spencer et al., 1999, Study 2) represent such a cue. When Spencer et al. (1999) later informally asked about the participants' interpretation of the situation, all participants assumed that men did better than women. The third type of stereotype threat activating cues is called "indirect and subtle" (Nguyen & Ryan, 2008, p. 1316). This cue does not refer to group differences in cognitive ability but rather reminds people about their group memberships. Examples are to ask participants prior to tests about their race or gender; or race or gender is primed by other means (e.g., a pretest questionnaire, a pretest task, a testing environment cue).

How people respond to these blatant, moderately explicit or indirect cues depends on their stereotype susceptibility. For instance, in a sample of female undergraduate students enrolled in an introductory statistics course, Franceschini, Galli, Chiesi, and Primi (2014) found that only female students who hold a strong implicit gender-mathematics stereotype were susceptible to the stereotype manipulation. In particular, they showed lower mathematics self-efficacy levels and lower mathematics performances in the threat condition. Students who reported low levels of implicit gender–mathematics stereotype did not show a different level of mathematics self-efficacy and performance (Franceschini et al., 2014). Similarly, Ambady, Shih, Kim, and Pittinsky (2001) examined the effects of positive and negative stereotypes on the cognitive performance of children in three age groups: lower elementary school, upper elementary school, and middle school. The result revealed that implicit activation of negative stereotypes significantly impeded performance and implicit activation of positive stereotypes boosted performance. On the contrary, in their meta-analysis Nadler and Clark (2011) found no difference in stereotype susceptibility when stereotype threat was manipulated directly or indirectly.

Research studying the implications of stereotype threat developed and applied different kinds of stereotype threat manipulations. For instance, in the study of Murphy et a. (2007), female undergraduates majoring in mathematics, science and engineering, that had high interest, ability, and confidence, and that highly identified with these domains, watched a video which presented either an unbalanced ratio of men to women (i.e., more men than women) or a balanced ratio within a mathematics, science and engineering conference situation. The result revealed that women who viewed the gender-unbalanced video reported a lower sense of belonging and less desire to participate in such a conference than women who viewed the gender-balanced video. Men were unaffected by this situational cue. This indicates that even subtle situational cues can trigger stereotype threat.

Several other studies have also shown that not only being out-numbered but also the mere presence of men in settings where group stereotypes might apply decreases females' performance expectations and their actual performance (Flore & Wicherts, 2015; Delisle et al., 2009; Davies, Spencer, & Steele, 2005; Inzlicht & Ben-Zeev, 2000). In these cases, men act as a situational cue that serves to create a threatening environment for women.

Shapiro and Neuberg (2007) summarized different stereotype threat manipulation mechanisms used by different researchers since the introduction of the stereotype threat concept. Manipulation mechanisms include asking participants about their identification with a group prior to a stereotype-relevant performance (e.g., Steele & Aronson, 1995), explicitly reminding participants of the negative stereotypes about their group (Spencer et al., 1999), making participants token members of their groups (e.g., Inzlicht & Ben-Zeev, 2000), having participants complete a questionnaire regarding common stereotypes of their group (e.g., Shih, Ambady, Richeson, Fujita, & Gray, 2002), having participants answer questions about the effects of negative stereotypes on them (e.g., Josephs, Newman, Brown, & Beer, 2003), and labeling participants' performance as diagnostic of their standing on a negatively stereotyped trait or ability (e.g., Marx, Stapel & Muller, 2005). Nevertheless, many studies on stereotype threat employ combinations of the above listed manipulations.

Stereotype Threat Intervening Factors

Because of its complex nature, stereotype threat effects are not only elicited under different conditions but also through different intervening mechanisms (Shapiro & Neuberg, 2007). Previous research identified different factors that intervene the effects of stereotype threat. Anxiety is one of the factors that mediate the relationship between stereotype threat and performance (Spencer et al., 1999, Experiment 3, Inzlicht & Ben-Zeev, 2003, and Brodish &

Devine, 2009). In other words, minority members experience anxiety due to their fear of confirming with the existing stereotype which in turn interferes with their task performance. However, other studies failed to replicate the mediating effects of anxiety (Schmader, Johns & Barquissau, 2004; Bonnot & Crozet, 2007; Aronson et al., 1999). The rather inconsistent results were attributed to the timing of assessing (i.e., before or after the test) and the method of measuring anxiety (i.e., self-report or physiological measures) (Shapiro & Neuberg, 2007; Mayer & Hanges, 2003). For instance, after reviewing various studies addressing anxiety as a possible mediator, Shapiro and Neuberg (2007) concluded that self-reported anxiety measures (as opposed to physiological measures) might not be appropriate for detecting the mediation effects of anxiety in the relationship between stereotype threat and performance.

Evaluation apprehension is another factor that has been shown to mediate the effects of stereotype threat on test performance (Aronson et al., 1999). According to Aronson et al. (1999), people under stereotype threat may show great concern for how other people are evaluating them and thus feelings of self-consciousness might increase. As a result, they may exercise excessive caution when performing the task. However, Spencer et al. (1999, Experiment 3) could not replicate the indirect effect of stereotype threat on test performance through evaluation apprehension.

Likewise, stereotype threat is assumed to reduce the working memory, which in turn leads to performance decrement (Schmader et al., 2004; Bonnot & Crozet, 2007). However, according to Krendl et al. (2008) stereotype threat does not affect the working memory. Their neuro-imaging study revealed that neural regions that support working memory were not more active after the threat induction than before. Krendl et al. (2008) proposed that stereotype threat rather increases activities in brain regions that are responsible for social and emotional processing. Their conclusion was that stereotype threat might direct people's attention toward the negative social and emotional consequences of confirming negative stereotypes about their group, thereby increasing performance anxiety rather than reducing the working memory.

Effort is considered as another mechanism which has been proposed as potential explanation for how stereotype threat effects influence performance outcomes (Shapiro & Neuberg, 2007; Smith, 2004). There are two hypotheses with regard to the role of effort. First, stereotype-threatened individuals show less effort than their non-threatened counterparts thus leading to poor performance. The second hypothesis (originally proposed by Steele and Aronson, 1995) is that stereotype-threatened individuals show more effort but try too hard which leads to poor performance (see also Shapiro & Neuberg, 2007; Smith, 2004).

The ability to formulate problem-solving strategies and performance expectancies has also been proposed as mechanism intervening in the stereotype threat effects. For example, Quinn and Spencer (2001) found that the ability to formulate problem-solving strategies under high stereotype-threat conditions mediated the effects of stereotype threat. That is, when stereotype threat was high, women were less able to formulate problem-solving strategies than when stereotype threat was reduced which contributed to performance reduction in standardized math tests. Sekaquaptewa and Thompson (2003), on the other hand, showed that performance expectancy under stereotype-threat conditions mediated the effects of stereotype threat, in that stereotype threat decreases performance expectancies, which in turn resulted in lower performance.

Self-efficacy is also considered to mediate the effects of stereotype threat. For instance, Hansen and Wanke (2009, Experiment 2) demonstrated that participants that were primed with a stereotype of professors (and thus judged by participants as intelligent) performed significantly better in a general knowledge test than participants that were primed with the stereotype of cleaning ladies (and thus negatively stereotyped for their intelligence). This performance difference was mediated by self-efficacy. That is, positive priming with the stereotype of professors improved participants' self-efficacy beliefs which in turn resulted in better performance in a general knowledge test. Similarly, using a self-report measure of stereotype threat, Chung et al. (2010) showed the mediating effect of self-efficacy in the relationship between stereotype threat and test performance. It seems important to mention the study of Spencer, Steele and Quinn (1999), which tested first the mediation effect of self-efficacy on the relationship between stereotype threat and performance. Although they could not detect a statistically significant indirect effect from stereotype threat on performance through self-efficacy; they did not rule out its existence (Spencer et al., 1999, p. 20).

Self-efficacy and Stereotype Threat

According to Bandura (1997), self-efficacy refers to subjective judgments of one's capabilities to organize and execute courses of action to attain designated goals. It is a belief about what a person can do (Zimmerman & Cleary, 2006). Self-efficacy perceptions are usually domain and task-specific constructs (Bandura, 1986; Zimmerman & Cleary, 2006). Some forms of self-efficacy include career self-efficacy, academic self-efficacy, social self-efficacy, and exercise self-efficacy (Pajares, 2002; Bandura, 1986; Zimmerman & Cleary, 2006).

The domain for the current research is academic self-efficacy with particular reference to science and mathematics. Academic self-efficacy is the belief that students have in their ability to perform academic tasks and it is a measure of the degree to which individuals feel confident in their ability to succeed, understand, and perform at an appropriate level (Pajares, 2002).

Mathematics and science self-efficacy refers to students' beliefs in their ability to learn successfully what is taught in math/science class (Liu & Koirala, 2009).

Self-efficacy is a component of a larger theoretical framework known as social cognitive theory (Bandura, 1986, 1997). According to the theory, individuals are viewed as self-organizing, proactive, self-reflecting, and self-regulating (Bandura, 1986, 1997). Human thought and action are considered as the product of a dynamic interplay of personal, behavioural, and environmental influences. For example, to be successful in an academic context, students are expected to correct their inappropriate self-beliefs (i.e., cognitive level), improve their self-regulatory practices (i.e., behavioural level), and change their relationships within the school and classroom environments that undermine their academic success (i.e., environmental level).

From the perspective of social cognitive theory, individuals are viewed as proactive and self-regulating rather than as reactive and controlled by biological or environmental forces (Pajares, 2006). Likewise, individuals are understood to possess self-beliefs that enable them to exercise a measure of control over their thoughts, feelings, and actions. Thus, the underlying premise is that cognitions (i.e., beliefs) determine affective (i.e., emotional) and somatic (i.e., physiological) states and behaviour. The word "social" also signifies the interaction of the person with the environment.

Efficacy beliefs influence human behaviour in various ways. In his seminal article *Self-efficacy: toward a unifying theory of behavioural change*, Bandura (1977, p. 191) asserts that "Psychological procedures, whatever their form, alter the level and strength of self-efficacy". Self-efficacy influences the choices people make, the effort people will expend on an activity, thought patterns, and their emotional reactions (Bandura, 1997). Furthermore, students' academic self-efficacy reduces stress, lowers vulnerability to depression, improves memory, and predicts students' future academic and career choice (Pajares, 2000; Bandura, 1994).

Self-efficacy beliefs also influence causal attributions. Bandura (1994) argued that people, who regard themselves as highly efficacious, attribute their failures to insufficient effort, whereas those who regard themselves as inefficacious attribute their failures to low ability. One could, therefore, argue that a female student, who has a strong self-efficacy belief in mathematics and science, attributes poor performance in these subjects to lack of effort. The solution to this lack of effort is simply to increase the effort in the next time. On the other hand, a female student who has a weak self-efficacy belief in mathematics and science might attribute poor performance in these subjects to lack of ability. "I cannot do math and science" would be the possible scenario. The solution to this attribution is avoidance of or dis-identification with these domains.

Various studies focused on self-efficacy in relation to stereotype threat. In most of these studies, the relationship appears to be inverse, in that lower expectation about performance and academic self-efficacy were inherent parts of stereotype threat (Cadaret, Hartung, Subich, Weigold, 2017; Hardin & Longhurst, 2016; Spencer et al., 1999). Research indicates that girls who have parents who hold a negative stereotype about girls' abilities in mathematics not only performed worse on a math test under the stereotype threat condition but they also reported lower self-efficacy and confidence in their abilities to perform in math-related activities (Tomasetto et al., 2011). Schmader et al. (2004) also found that female students who were more likely to endorse a negative stereotype not only performed poorly in mathematics compared to male students but also reported lower mathematics self-efficacy. Thus, there is evidence that the activation of stereotype threat lowers the self-efficacy of members of stereotyped groups.

Research has found that stereotype threat can impair women's self-efficacy across various domains including leadership self-efficacy (Burnette, Hoyt, & Pollack, 2010; Hoyt & Blascovich, 2007), entrepreneurial self- efficacy (Pollack, Burnette, & Hoyt, 2012), and STEM/science-related careers (Cadaret et al., 2017; Hardin & Longhurst, 2016; Cadinu, Maass, Rosabianca, & Kiesner, 2005; Woodcock, Hernandez, Estrada, & Schultz, 2012). For instance, Hardin and Longhurst (2016) found that over the course of a semester females perceived greater barriers which resulted in lower self-efficacy and lower interest in the STEM domain. Cadinu et al. (2005) also showed that when negative stereotypes were activated, females were more likely to report that a math exercise was too difficult and that they were not good at mathematics.

The negative relationship between stereotype threat and self-efficacy was also demonstrated in non-academic environments. For example, female participants were primed with the gender leadership stereotype (Burnette et al., 2010). Results revealed that female participants reported lower self-evaluation after stereotype threat when they had low self-efficacy and believed leadership ability to be fixed. On the other hand, female participants with high efficacy displayed reactance to stereotype threat (Burnette et al., 2010; Hoyt & Blascovich, 2007). In a similar vein, females who were told that entrepreneurial ability is primarily driven by masculine traits (threat condition) and who believed that entrepreneurial ability is fixed revealed reduced entrepreneurial self-efficacy (Pollack et al., 2012).

To summarize, stereotype threat has implications not only for the actual behaviour but also for self-related beliefs such as self-efficacy, which is important for individuals' self-regulation in that they influence performance and the choices people make. However, underperformance under stereotype threat is not only intervened by individuals' perceptions and judgments about themselves (i.e., self-related beliefs) but also conditional upon beliefs about and the identification with the stereotypes group.

For instance, Aronson et al. (1999) showed in their study that students who placed high importance to mathematics were more affected by stereotype threat compared to students who placed less importance to the mathematics domain. Researchers also identified the role of implicit gender-mathematics stereotyping in moderating the effect of stereotype threat. In their experimental study, Kiefer and Sekaquaptewa (2006) examined the effects of implicit gender-mathematics stereotyping on female participants' mathematics performance under strong and reduced stereotype threat conditions. The results revealed that implicit gender-mathematics stereotyping moderated stereotype threat effects on female participants' mathematics performance. Female participants who implicitly associated women more than men with mathematics benefited most from the reduction of stereotype salience. Conversely, females who showed implicit gender-mathematics stereotyping (i.e., that associate men more with mathematics and science and women more with arts and humanities) scored even lower in reduced threat condition. Thus, math performance under stereotype threat seems to be moderated by implicit gender-mathematics stereotyping.

The role of identification with the stereotyped group was stressed by Armenta (2010) who showed that when ethnicity was made salient, highly ethnically identified Asian Americans (i.e., positively stereotyped with regards to mathematics) performed better whereas highly ethnically identified Latinos (i.e., negatively stereotyped with regards to mathematics) performed worse in stereotype threat condition. The math performance of participants who did not strongly identify with their respective ethnic group was not significantly affected by the presence of stereotype threat cues (Armenta, 2010). Thus, whether the activation of a positive or negative stereotype boosted or threatened the math performance depended on the degree participants identified with the respective ethnic group. However, individuals do not only identify with different social groups, but they also receive support from those different groups.

Social Support and Stereotype Threat

Social support is an important element in individuals' lives. An important aspect of social cognitive theory is the assumption that an individual's social milieu is a primary determinant of his or her functioning, attitudes, and beliefs (Bandura, 1986). Halpern et al. (2007) argue that humans are born with innate abilities, such as the ability to learn a language. However, the language they learn depends largely on their environment and learning experiences. In other words, abilities are developed in supportive social environments.

Empirical evidences in educational and health studies revealed the positive impact of social support in human functioning. Social support contributes to academic performance of school-children (Kress, Norris, Schoenholz, Elias, & Seigle, 2004). There are also considerable literature supporting the positive impact of social support on the psychological functioning of individuals. For instance, social support reduced the occurrence of depressive and problem symptoms among high-risk children (Appleyard, Egeland & Sroufe, 2007). Similarly, high levels of social support were significantly related to fewer reports of anxiety and behavioural problems (Barrera, Chung & Fleming, 2004).

Social support encompasses the provision of both material and emotional support from members of one's social network (London, Rosenthal, Levy, & Lobel, 2011; Yasin & Dzulkifli, 2011). Social support is defined as a form of assistance that includes verbal encouragement, appraisal of different situations, effective coping strategies, and emotional support to mathematics and science learning (Yasin & Dzulkifli, 2011). Such support comes from different sources including parents, teachers and peers.

Parental support can be in the form of helping and motivating students in doing their homework as well as active participation in school-home cooperation activities. Studies indicate that students' perception of their family's support influences their school achievement including mathematics (Simpkins, Price & Garcia, 2015; Catsambis, 2005; Haahr et al., 2005). Parental support as encouragement can also have a strong influence on both preferences to participate in learning experiences and engagement during such learning (Sha, Schunn, Bathgate & Ben-Eliyahu, 2016; Simpkins et al., 2015). The positive influence of parental support is not limited to educational experiences of students. It also contributes to their psychological adjustment to new learning environments. In their cross-sectional study, Holahan et al. (1995, cited in Yasin & Dzulkifli, 2011) found that first-year students with higher levels of perceived parental support scored higher on well-being and happiness, they were less depressed and showed less anxiety than those with lower levels of perceived parental support. The implications of parents' lack of support were addressed by Tomasetto et al. (2011) by showing that for instance, mothers' gender-stereotypical beliefs moderated high school girls' math performance. Performance of girls whose mothers strongly endorsed the gender stereotype about mathematics decreased stronger under stereotype threat.

Teachers support is another important factor in students' academic achievements, especially in mathematics and science. For example, Jacobs et al. (1998, cited in Steele et al., 2005) found that when females pursue fields that require mathematics, they often do so because of interested teachers. Similar results were found by Zeldin and Pajares (2000) who showed that women who were successful in mathematics and science careers perceived their teachers as being supportive of their mathematics pursuits.

The influences of adults like parents and teachers diminish markedly during adolescence and are often replaced by the influence of peers. Harris (1995), for example, concluded that peer affiliations become increasingly more influential on shaping attitudes than parents' and teachers' influence. When adolescents are greatly influenced by their peers, they may avoid the pursuit of mathematics if their salient peer group regards it negatively for any reason (Steele et al., 2005). The forms of support vary between parents and peers. Peer support is concerned with the degree of importance they place on academic success and the extent to which they support achievement among their friends (Yasin & Dzulkifli, 2011). Peer influence also varies between the genders. Beal (1994, as cited in Steele et al., 2005) found that if females cannot find peer support for taking mathematics, they often change their major courses of study.

Various studies showed that adolescents who perceive their parents, teachers and/or peers as supportive achieve far better results in school than those who do not perceive such support (London et al., 2011; Ahmed, Minnaer, Van der Werf & Kuyper, 2010; Dzulkifli & Yasin, 2009). Simple verbal judgments and expressions of faith in people's capabilities raise their self-related beliefs that they have what it takes to succeed (Bussey & Bandura, 1999; Pajares, 2002). Students who perceive they are highly valued and well regarded by others will often exhibit high self-esteem as part of their overall self-concept (Hoover-Dempsey, Bassler, & Burow, 1995). Yet, the effect of social support does not seem to be equally distributed between the genders. A recent study by Mishkin, Wangrowicz, Dori, and Dori (2016) indicated that females are significantly more influenced by other people than males. Other studies revealed that social support promoted females' academic achievement in general and their career choice in particular (Catambis, 2005; Mruk, 2006; Kaufman & Yin, 2009).

Stereotype threat theory also places a good deal of attention to environmental determinants of human functioning. According to the theory, the social circumstances confronting the person contribute a lot to the underperformance of minority groups (Aronson et al., 1999). Thus, the negative effect of stereotype threat is likely to diminish in a supportive social environment than in an unsupportive environment.

The relationship between stereotype threat and social support can be described as inverse. Stereotype threat literature suggests that exposure to the situations of stereotype threat causes emotional distress and anxiety that diminishes performance (Halpern et al., 2007; Spencer et al., 1999). On the other hand, social support from significant others makes individuals feel less threatened but more protected and secured (Hartman & Hartman, 2008; London et al., 2011). Other than creating a secure environment, social support is also assumed to enhance the coping strategies of individuals exposed to stressful situations (London et al., 2011). However, in order to display its stress buffering effect, the supportive environment needs to be stronger than the threatening environment. If the reverse is true, people are likely to avoid engagement and activities in the threatening environment (Bandura, 1995).

One common element between stereotype threat and social support is that both come from the environment, rather than from some shortcomings or virtues inside the person (Steele, 1999). Social cognitive theory (Bandura, 1986) assumes that an individual's social environment is a primary determinant of his or her functioning, attitudes, and beliefs. In the context of mathematics/science learning, the social environment of the classroom can be threatening or non- threatening. If the interaction between students and teachers and between students themselves is supportive and non-stereotypic, mathematics/science classroom environment would potentially be non-threatening. In this context, students are likely to enjoy the classroom and develop a positive attitude, diligence, and confidence in what they are learning as suggested by social cognitive theory. Conversely, if the interaction is consistent with a negative stereotype, mathematics/science classroom environment would be threatening for students (Inzlicht & Good, 2006). This can have an adverse effect on students' learning and performance in these subjects or on their future career intention to major in fields related to these subjects. Therefore, the environmental nature of stereotype threat and social support implies that there is a possibility of changing performance and behavioural intention by changing the social context.

Summarizing, it can be concluded that the stereotype threat approach provides insights in females' underperformance in mathematics/science by demonstrating the implications of negative stereotype activations not only for the actual performance but also for self-related beliefs which are likewise assumed to influence females' underperformance in mathematics/ science. Underperformance in math-intensive fields because of stereotype threat can be assumed to have long-term effects on STEM related decisions. For instance, repeated underperformance due to stereotype threat might not only reduce females' aspirations and desires to pursue STEM related majors (Nye, Su, Rounds & Drasgow, 2012; Davies et al., 2005) but also result in changing their majors or their disengagement (Nye, et al., 2012; Nussbaum & Steele, 2007; Steele, James, & Barnett, 2002). Moreover, repeated experiences of stereotype threat may eventually lead females to dis-identify from STEM domains (Smith, Brown, Thoman & Deemer, 2015; Steele, 1997; Steele & Aronson, 1995) by applying different compensatory strategies. These compensatory strategies, according to Shapiro and Neuberg (2007), include avoidance and devaluation which might explain that females prefer careers outside the STEM fields.

However, recent research also showed that the gender gap with regards to mathematics/ science performances has been closing (Burke, 1989; Martinot & Desert, 2007; Caplan & Caplan, 2005; Catsambis, 2005; Raty & Kasanen, 2007; Zheng, 2010) in that female performance on math tests became like that of males. For instance, Mittelberg, Rozner, and Forgasz (2011) examined math performance between Arab and Jewish primary school students and found no gender difference among Jewish students. On the contrary, a significant performance difference favouring girls was found among Arab students. Similarly, Lihong (2009) demonstrated that girls in Norwegian secondary schools outperformed in both science and mathematics their male counterparts. A similar trend was found for Iceland where boys' performance was weaker not only in reading skills but also in mathematics and science (Haahr et al., 2005). Even though evidence indicate that the gender gap in mathematics and science performance and achievement is decreasing in recent years (Ceci et al., 2014; Zheng, 2010; Ceci et al., 2009), it has not transformed into an increasing number of female STEM students (Riegle-Crumb, Moore, & Ramos-Wada, 2011; Ceci et al., 2009). To the contrary, women who are proficient in math-intensive fields are more likely to choose careers outside of STEM or leave STEM careers as they advance (Ceci et al., 2009; Hartman & Hartman, 2009).

The latter suggests that the underrepresentation of females in STEM fields is caused by other factors. The present research argues that besides performance also self-regulation are at play, that is to say, the intention females might have (or not) to choose STEM fields when entering university. Consequently, the present research argues that negative stereotype activations equally influence females' intention to major in STEM fields and that this interplay is equally influenced by self-efficacy and social support.

Stereotype Threat and Intention

Intention is one of the self-regulation processes that directly influence behaviour. The theory of planned behaviour (Ajzen, 1991) emphasizes the role of behavioural intention, which is assumed to capture the motivational factors that influence actual behaviour. The theory defines behavioural intention as the central component affecting behaviour (Ajzen, 1991). Intentions are indications of how hard people are willing to try, and how much of an effort they are planning to apply to perform the behaviour (Ajzen, 1991). Social cognitive theory (Bandura, 1997) also posits that forming near goals (i.e., intention) is a necessary condition of behaviour. Moreover, behavioural intentions reflect people's decisions to act in a particular way (Armitage, 2008).

Research supports that intention is an important predictor of behaviour. For example, Luszczynska, Mazurkiewicz, Ziegelmann and Schwarzer (2007) showed that intention is a direct predictor of physical activity (e.g., jogging or running behaviour). That is, individuals with strong intentions execute jogging or running more often than those who do not have such intentions. The influence of intention on behaviour is also demonstrated in the academic environment. Armitage (2008) showed for instance that even after controlling for the effects of important predictors of academic achievement (i.e., attitude, subjective norm and perceived control), intention appeared to be a sole predictor of academic achievement.

Research on stereotype threat already suggests that underperformance is not the only consequence of stereotype threat. For example, stereotype threat decreases interest in persisting in sciences (Nye et al., 2012; Nussbaum & Steele, 2007), entrepreneurial intentions (Pollack et al., 2012; Gupta & Bhawe, 2007), and other stereotype-relevant activities like leadership (Burnette et al., 2010; Davies et al., 2005). Yet, little research has examined how stereotype threat may actually affect intention.

Because we focus on self-regulation (i.e., intention), one could assume that self-related beliefs such as self-efficacy play an important role to self-regulate. Previous studies indicate the positive influence of self-efficacy on science learning, STEM intention, and career choices of individuals (Cadaret et al., 2017; Woodcock et al., 2012). For instance, self-efficacy mediated the relationship between parental support on mathematics/science and career decision making of Mexican American high school students (Hernandez, Estrada, & Schultz, 2012). Moreover, self-efficacy has also been postulated as a predictor of persistence intentions and actual persistence in entering engineering careers (Cadaret et al., 2017; Woodcock et al., 2012).

Because we aimed at explaining females' intention to major in STEM fields, social support can be assumed to play an equally important role. A supportive environment might be likely to re-direct females' attention towards the positive consequences of disconfirming negative stereotype about their in-group. Support can reduce the perceived stressfulness of an event or experience, thus having a stress-buffering effect (Cohen & Wills, 1985, cited in London et al., 2011). Consequently, perceived social support might provide females with means of coping with the challenges they face within the STEM environment. For example, close friends and parents may provide informational support about how to handle challenging situations in the STEM environment. Perceiving that one has a social support network, particularly when it relates to a nontraditional career choice can boost confidence and endurance when faced with possible barriers to success (Sha et al., 2016; Simpkins et al., 2015; London et al., 2011). Based on the same logic one could argue that perceived social support represents a condition influencing inter-individual differences in the vulnerability to effects of stereotype threat on females' intention to major in STEM fields.

As the present research focuses on how stereotype threat might affect females' intention to major in STEM fields, we considered it as most appropriate to examine female students who are still at high school and who still decide on their future careers. Moreover, various studies have indicated that high school is a pivotal point in the STEM pipeline (Ceci, Ginther, Kahn, & Williams, 2014; Legewie & DiPrete, 2011; Aschbacher, Li, & Roth, 2010). For example, Morgan, Gelbgeiser, and Weeden (2013) found that gender differences in occupational plans expressed by high school seniors are strong predictor of actual gender differences in college STEM majors. Similarly, in their analysis of middle-school through college phase of the educational life course, Legewie and DiPrete (2011) showed that the high school years played an important role in shaping gendered orientations toward science and engineering. Considering the studies above, Ceci et al. (2014) concluded that high school expectations of future college majors alone are enough to explain 28.1% of the gender gap in science and engineering bachelors. These studies clearly indicate that barriers to women's full participation in mathematics intensive academic science fields are rooted in the pre-college (i.e., high school) rather than in the college context.

Based on the assumption that stereotype threat has not only implications for performance but also for motivation, the present research project aims to explore the interplay between negative stereotype activations and females' intention to major in STEM fields by exploring the role of self-related beliefs as well as social support. To extend our understanding about this interplay seems not only to be relevant for theoretical purposes but also for the societal context within which the present studies were conducted; namely for the societal context of Ethiopia.

THE CURRENT RESEARCH AND ITS CONTEXTS

The following paragraphs provide an overview about school and science education in current Ethiopia, the so-called 70 percent policy and its implementation.

Ethiopia, with its 105 million people is after Nigeria the second most populous country on the African Continent (CIA World Factbook, 2018). Although Ethiopia is a country with an ”old” history, it is a young country regarding its citizens. The median age is 17.9 years with 40 percent of its population younger than 15 years. However, less than half of its population (49.1%) aged between 15 and older can read and write; with a gender gap favouring males (57.2%) over females (41.1%) (CIA World Factbook, 2018).

According to the latest information provided by the Ethiopian Ministry of Education (2015/16), there are 34,867 primary schools (1-8 Grade), 3,156 secondary schools (9-12 Grade) and around 50 government-owned universities in the country. Student enrolment at each level of education has been increasing from year to year. Net enrolment at primary schools (students aged from 7-14 years old enrolled in grade 1 to 8) ranges at 18,383,944 (100.25 % of which 96.17% constitute females). These numbers appear to be technically impossible as stressed by the Ministry of Education (Federal Democratic Republic of Ethiopia, MoE, 2017). However, they arise due to imprecise population information and challenges in estimating students' age at the point of entry because of the lack of uniform birth registration in Ethiopia.

Similarly, net enrolment at secondary schools (students aged 15-18 years enrolled in grade 9-12) stands at 8,336,375 (with a rather slight difference between males and females according to the gender parity index of 0.93). The latter means that for one male student, there is 0.93 female student enrolled in the secondary education system.

University students enrolled in undergraduate degree programs increased from 447,693 in 2010/11 to 778,766 in 2015/16. The number of female university students is also increasing. For example, female university students' enrolment in first-degree programs increased from 120, 978 (27%) in 2010/11 to 265,851 (34.13%) in 2015/16.

Although the numbers of educational institutions and students' enrolment have been significantly increasing over the last decade, school facilities and infrastructure remain poor in the country. For instance, among the schools in the country, only 24 percent of primary schools and 70 percent of secondary schools have electricity available. Nearly 60 percent of primary schools do not have access to water. In fact, only 10 percent of secondary schools have all the required infrastructure such as water, sanitation and hand washing facilities that are needed to protect children's health (Federal Democratic Republic of Ethiopia, MoE, 2017).

Moreover, only nine percent of primary schools and 20 percent of secondary schools have access to video equipment. Textbooks are also scarce. The textbook-student ratio stands at 3.83 in primary schools. Pupil-class and pupil-teacher ratios at primary schools are 55 and 46, respectively. This means that on average around 55 pupils are enrolled in a single class and one teacher serves 46 students. It is commonly known that lower pupil-teacher ratio creates "better opportunity for contact between the teacher and pupils and for the teacher to provide support to students individually and hence a better teaching/learning process, thereby improving the quality of education" (Federal Democratic Republic of Ethiopia, MoE, 2017, p. 61). Similarly, large class size, lack of school facilities and other infrastructures may contribute to grade repetition and dropout from school, which are rather startling in Ethiopia. The dropout rate for primary schools increased over the last years with a rate of 7.8 percent, 9.9 percent and 10.12 percent in

2013/14, in 2014/15 and in 2015/16, respectively. Following the recent trends, dropout rates at this level of education are slightly higher in males compared to females.

In Ethiopia, gender disparity favouring males increases with the level of education. For example, in 2015/16 a total of 47.4 percent of Grade 1-8 students and 48.9 percent of Grade 9-12 were females. In the same year, the percentage of female students in university undergraduate programs reached only 34.13 percent. This number decreases even further as the academic ladder goes up. For instance, among 51,521 postgraduate students (i.e., both masters and PhD students), females' representation was only 23.1 percent. If only PhD students are considered, the percentage of female candidates reduces to 10.3 (Federal Democratic Republic of Ethiopia, MoE, 2017). This trend clearly demonstrates that as the education ladder goes up, the representation of females in the system dramatically goes down.

It is, however, important to note that science education has a rather short history in the Ethiopian context. When modern education was introduced in 1908, its main aim was to produce citizens who are able to communicate with the international community. As a result, foreign language education was given more emphasis than science education (Alemseged, 2004). However, with the opening of the first higher education institutions in 1950, science became a major component of the Ethiopia education curriculum (Zewde, 2002; cited in Semela, 2010).

Since the opening of science faculties at universities, the Ethiopian government emphasized science and technology in its policies and development strategies. For instance, the education and training policy of the Federal Democratic Republic of Ethiopia (1994) stipulated that science and technology shall be one of the central aims of the education system. Moreover, in 2008 the Ethiopian Ministry of Education introduced what is commonly known as 70-30 policy whereby 70 percent of overall university enrolment should be in STEM-related fields, with the remaining 30 percent being enrolled in social sciences. Similarly, the first Growth and Transformation Plan (GTP) of the government of Ethiopia (2010) reflects the determination of the government to expand science and technology. For instance, the strategic document clearly and boldly states that the government will strengthen the expansion of higher education with a "big push in science and technology" (p. 11), capacity building will be undertaken to improve performance, especially of "science and technology institutes and departments" (p. 50), and ensure higher education expansion and enrolment that "prioritizes science and technology" (p. 51). Furthermore, the Ministry of Science and Technology (MoST*)* issued the Science, Technology and Innovation Policy (STIP) in 2012 to increase the number of STEM workforce. All these policies are aimed at producing more graduates and at increasing the workforce in STEM fields to secure sustainable development in the country. Nevertheless, the country's STEM preparedness and the workforce is still very low.

Recent data from the Ethiopian Ministry of Education (2017) indicates that STEM enrolment in Ethiopian higher education institutions does not meet the set targets and the gender gap is still very large. For example, in the 2015/16 academic year, nearly eight hundred thousand (778,766) students were enrolled in undergraduate programs at both private and government higher education institutions. Of this number, 27.5 percent were enrolled in Engineering and Technology fields. The share of female students enrolled in these areas stands at 7.4 percent of the total university enrolment. Similarly, the College of Natural and Computational Sciences enrolled 10.8 percent of the overall national enrolment. Female participation in these fields constitutes 3.4 percent of the national undergraduate enrolment. As it can be seen from the above data, the percentage of female students’ enrolment in undergraduate STEM fields is around 10.8

percent (7.4 % in Engineering and Technology and 3.4 % in Natural and Computational Sciences).

In the same academic year (2015/16), a total of 51,521 students enrolled in the postgraduate program of which females constitute 23.1 percent. Looking at the distribution of enrolments across the different colleges, Engineering and Technology enrolled 15 percent of the students and the other 13.9 percent were enrolled in the College of Natural and Computational Sciences. Female participation in the overall postgraduate STEM fields stands at 5.8 percent (3.9 % in the College of Engineering and Technology and 1.9 % in Natural and Computational Sciences (see Federal Democratic Republic of Ethiopia, MoE, 2017). In both undergraduate and postgraduate programs, the participation of female students in STEM fields is much less than envisioned by the 70:30 policy of the government.

The Ethiopian STEM labour market reflects the science and technology enrolment rates in the country's universities. The number of women in science and technology related positions is very low. Gender patterns by types of employment reveal that work associated with men and masculinity is often out of reach for women (Beyene, 2015). The report of the national labour force survey of the Ethiopian Central Statistical Agency (Federal Democratic Republic of Ethiopia, CSA, 2014) reflects this fact. According to the survey, women make up 55 percent of nursing and midwifery associated professionals, 40 percent of elementary school professionals, 16 percent science and engineering, fewer than 10 percent of professionals in the field of information technologies, and nine percent of higher education professionals (CSA, 2014). Moreover, women constitute 6.7 percent of PhD degree holders at Ethiopian universities. More than half of these women belong to two colleges: the college of social science and humanities (1.9%) and agriculture and life sciences (1.8%). The number of women with a PhD in science and engineering is less than one percent (0.34%) of the total university faculty (Federal Democratic Republic of Ethiopia, MoE, 2017). Most of the times, even if the professions are similar; the level they are working at shows great gender disparity. For example, although women constitute 55 percent of nursing and midwifery associated health professions, they constitute only 40 percent of medical doctors. Similarly, women constitute 40 percent of elementary school teachers but only 13 percent of university faculty (Beyene, 2015).

Besides the Ethiopian government's attempts to increase the participation of women in STEM fields in university enrolment and the labour market, the target has not yet been achieved. As indicated earlier, the enrolment at universities and the workforce in the labour market reflect traditional gender role stereotype. Ethiopia is a patriarchal society where girls are brought up to specialize in indoor activities like cooking, washing clothes, fetching water, and caring for children (Beyene, 2015). Such culturally constructed stereotypes need effective interventions in order to reshape the values and assumptions of their members and to facilitate actual transformation.

To summarize, the Ethiopian government has made remarkable achievements in increasing access to education and decreasing gender disparity. The government has also given due emphasis to science and technology education in order to make Ethiopia a middle-income country by 2025. Accordingly, different policies were passed and strategies were adapted to enhance the enrolment and graduation of students; particularly of females in STEM fields. Despite these efforts, the representation of females in STEM fields is still low. Though females make 34.14 percent of the total undergraduate enrolment in 2015/16, they only represent 10.8 percent of the STEM-related disciplines.

Consequently, to extend our understanding of female high school students' intention to major in STEM fields is particularly important in the context such as Ethiopia. As mentioned above, the Ethiopian government has put high school mathematics and science education in the spotlight by implementing the so-called 70: 30 strategy. According to the Ethiopian education and training policy (1994), the structure of secondary education consists of two levels: the first level refers to secondary education (grade 9 and 10) and the second level refers to preparatory secondary education (grade 11 and 12). The purpose of the former is to enable students to identify their interests for further education and for their occupational careers. Thus, we focused in the present research on female students enrolled in the first level of secondary education.

As outlined above gender inequality in science and engineering fields has remained a critical challenge in the Ethiopian education system. This makes it imperative to question the barriers of the representation of females in science and engineering. The present research argues that culturally and socially shared stereotypes about females' education and performance can be considered to be one of the reasons for the low involvement of females in STEM fields. Negative stereotypes in the context of STEM fields include females being portrayed as less talented and less successful in mathematics and science, whereas males are believed to be more talented in these fields of study (Ertl, Luttenberger & Paechter, 2017). Because such shared beliefs among people are pertinent for stereotype threat to occur, the first aim of the present research was to determine whether high school students perceive that the Ethiopian society holds a negative stereotype about females' mathematics/science ability (Study 1). Moreover, Study 1 aimed at exploring whether academic achievement influences female intention to major in STEM fields and whether this interplay is intervened by self-efficacy and conditional upon social support.

The second aim of the present research was to test experimentally whether stereotype threat influences females' intention to major in STEM fields (Study 2 and 3). Because stereotype threat is generated by a combination of individual and environmental characteristics, the present research further aimed at examining how self-efficacy as individual characteristic (Study 2 and 3), and perceived social support as environmental characteristic (Study 3) intervene and interact with the implications of stereotype threat on STEM intention of female high school students, respectively.

More specifically, we proposed the following two hypotheses for the present research.

H1: Stereotype threat activation weakens females' intention to major in STEM fields indirectly through mathematics/science self-efficacy.

H2: Perceived social support to mathematics/science learning from significant others moderates both the direct effect of stereotype threat on STEM intentions and the indirect effect of stereotype threat on STEM intentions through mathematics/science self-efficacy.

The proposed hypotheses are depicted in Figure 1 stating: (1) that stereotype threat to occur requires awareness of the negative stereotype about females' mathematics/science ability; (2) that the negative effect of stereotype threat can be described as direct and indirect effect, in that stereotype threat influences STEM intentions directly and indirectly through self-efficacy; and (3) that the direct and indirect effects of stereotype threat are conditional upon social support.

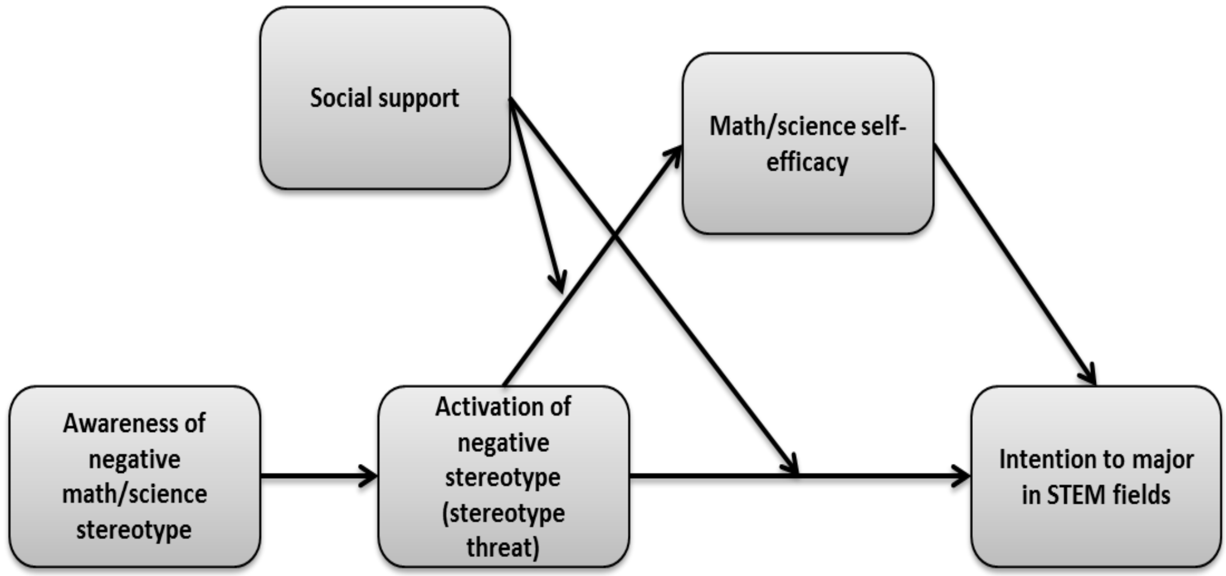

Figure 1: Conceptual framework of the research

Three studies were conducted to test the proposed hypotheses. The purpose of Study 1 was to examine the degree to which participants are aware of the existence of negative gender stereotype related to females' mathematics and science ability in the society, and the degree they endorse this negative stereotype. The degree of awareness of the negative gender stereotype with regards to females' mathematics and science ability determined the direction of the activation of this negative stereotype for Study 2 and 3. Moreover, Study 1 aimed to provide descriptive information about the relationships between mathematics/science achievement, mathematics/ science self-efficacy, intention to major in STEM fields and social support. More specifically, we explored whether the relationship between previous mathematics/science achievements and intention to major in STEM fields is intervened by mathematics/science self-efficacy and whether this interplay is conditional upon social support.

Study 2 tested experimentally Hypothesis 1, which stated that the activation of a negative gender stereotype with regards to females' mathematics and science ability weakens directly female students' intention to major in STEM fields and indirectly female students' intention to major in STEM fields through mathematics/science self-efficacy.

Study 3 tested experimentally Hypothesis 2, which stated that the direct relationships between stereotype threat and intention to major in STEM fields and the indirect relationship through mathematics/science self-efficacy is conditional upon perceived social support.

STUDY 1

The first aim of Study 1 was to examine participants' awareness of the existence of the negative gender stereotype with regard to females' mathematics and science ability and whether participants endorse this stereotype. Secondly, the first study aimed at exploring the interplay between mathematics/science achievement, perceived social support, mathematics/science self-efficacy and intention to major in STEM fields. More specifically, we aimed to explore whether self-reported previous mathematics/science achievement influences the intention to major in STEM fields through mathematics/science self-efficacy and whether this interplay is conditional upon social support. The two main research questions were the following:

1. Are participants aware of the existence of negative gender stereotype regarding females' mathematics and science ability in society and are they endorsing this stereotype?
2. Is the relationship between previous mathematics/science achievements and intention to major in STEM fields intervened by mathematics/science self-efficacy and is this interplay conditional upon social support?

Research Design and Participants

The study employed a cross-sectional survey design. The participants of the study were 211 Grade 9 and Grade 10 students from a High School in Harer District, Ethiopia. The gender ratio was well balanced in the study with 106 female and 105 male participants. The average age of the participants was 15.89 years ranging from 14 to 17.

Measurements

Self-reported mathematics/science achievement. Participants were presented with a list of subjects (i.e., English, Chemistry, Mathematics, Geography, Biology, History, and Physics) and asked to report their average score in these subjects achieved during the previous semester. Other than science subjects (i.e., Mathematics, Physics, Chemistry and Biology), that is to say, the social science subjects (i.e., English, Geography and History) were excluded from further analysis. Scores of the various science subjects were averaged and thus could range from zero (lowest) to 100 (highest). Participants who have higher scores in the science subjects were assumed to have better mathematics/science ability.

Perceived social support measure assessed different forms of social support students receive from significant others to enhance their mathematics/science education. The measure consisted of three sub-scales, namely perceived parental support, perceived teacher support and perceived peer support. *Perceived parental support* measures the perceived level of parental praise and encouragement that Bandura (1977, 1997) called verbal persuasion. The scale consisted of the following eight items: “My parents encourage me to learn math and science as much as I can”; “My parents think that I can do well at math and science”, “My parents think that being good at math and science is useful for my future”, “My parents get involved when I solve math and science problems”, “My parents help me with my math and science homework”, “My parents encourage me to do well in math and science”, “I would talk to my parents about a career that uses math and science”, and “My parents are happy with my math and science progress” ($\alpha = .78$).

Perceived teacher support was measured using the Student-Teacher Relations Scale by Kelly (2002). The original scale consists of 20 items that measure the participants’ level of satisfaction with their relationship with high school teachers. The scale consists of four sub-scales: the perceived level of satisfaction with teachers; the perceived level of support received from teachers; participants’ perception of teachers’ expectation of their educational achievement;

and the extent of positive contact between teachers and participants. The sub-scale assessing the perceived level of support received from teachers appeared to be most relevant for the present study and was consequently used: “My math and science teacher/s provided me with academic assistance when I needed it”, “My teacher/s praised me when I worked hard at math and science subjects”, “My teacher/s helped my math and science grades improve”, “My math and science teachers take a personal interest in me”, “My math and science teachers are friendly to me”, “My math and science teachers consider my feelings”, “My math and science teachers give me extra help when I need it”, and “My teacher/s encouraged me to perform to the best of my abilities in math and science subjects” ($\alpha = .82$).

Perceived peer support was measured by five items proposed by Vekiri and Chronaki (2008) who reported a Cronbach’s alpha coefficient of .67 in their study addressing peer support in using computers. The items were modified for the present study: "My friends and I like to help each other on math/science courses", "My friends are interested in math and science subjects", "When my friends and I get together, we enjoy doing math and science problems", "My friends and I enjoy talking about math and science" and "My friends are important to get good grades in math and science" ($\alpha =.83$). The answer format presented to the participants ranged from 1 (*totally disagree*) to 5 (*totally agree*).

Gender stereotype awareness refers to participants’ awareness of people’s beliefs regarding males’ and females’ mathematics and science ability. Participants were asked about their awareness of people’s beliefs regarding males’ and females’ mathematics and science ability and performance. Two items were used to measure gender stereotype awareness: “How well do people think females do in mathematics and science?” and “How well do people think males do in mathematics and science?” (Martinot & Dessert, 2007). Participants were presented with a five-point answer format ranging from 1 (*Not good at all*) to 5 (*Very good*). Based on these measures, the gender stereotype awareness index for mathematics/science ability was generated. The calculation was conducted as proposed by Martinot and Dessert (2007). The participants' ratings of people's beliefs about males' math/science ability were subtracted from the counterpart ratings for females' math/science ability. Thus, a positive difference score indicates that females are perceived by society as better in mathematics/science than males, while a negative difference score indicates that males are perceived by society as better in mathematics/science than females.

Gender stereotype endorsement refers to participants' own personal beliefs regarding males' and females' mathematics and science ability. Two items were used to measure endorsement: "As for you, how well do you think females do in math/science"? And "As for you, how well do you think males do in math/science"? (Martinot & Dessert, 2007). Participants were presented with a five-point answer format ranging from 1 (*Not good at all*) to 5 (*Very good*). The calculations and the ratings were identical to the previous measure. The participants' ratings of their own personal beliefs about males' math/science ability were subtracted from the counterpart ratings for females' math/science ability. Thus, a positive difference score indicates that participants do not personally endorse the belief that males show better mathematics/science ability than females, while a negative difference score indicates that participants do endorse this gender stereotype.

Mathematics/science self-efficacy was assessed using the measure developed by Liu and Koirala (2009) which was designed to assess students' beliefs in their ability to learn successfully is the content taught in mathematics science class. Liu and Koirala (2009) who tested the scale on a large sample of high school students (N = 11726) reported an excellent

Cronbach's alpha of .93. The following items were included using an answer format ranging from 1 (*not at all true)* to 5 (*very true of me*): "I am sure that I can learn everything taught in my math/science class", "I am sure that I can do even the hardest work in my mathematics/science class", "Even if a new topic in math/science is hard, I am sure that I can learn it", "I am sure that I can figure out the answers to problems my teachers give me in math/science class" and "I am confident I can do an excellent job on my math/science assignments" ($\alpha = .85$).

The measure of *intention to major in STEM fields* as the dependent variable was developed for the present study and consisted of three items that assessed participants' intention to major in STEM fields when they join university. The items were: "How likely are you to major in technology and engineering fields when you join university"? "How likely are you to major in social science or Language and Art fields when you join university"? (reversed), and "How likely are you to major in natural science fields like mathematics and physics when you join university"? ($\alpha = .81$). A five-point answer format was used ranging from 1 (*very unlikely*) to 5 (*very likely*). High scores for the combined variable indicate a high intention to major in STEM fields.

Procedure

Ethical clearance for the study was obtained from the Department of Psychology at the University of South Africa. Furthermore, an official request by Haramaya University (Ethiopia) was made to the concerned school for collaboration. The principal of the school allocated six out of ten classes which were used for the data collection. The data collection was organized during class hours with the support of five research assistants. The aim and nature of the study and the method of completing the questionnaire were explained to the participants. Verbal informed consent was obtained from each participant before the completion of the questionnaires.

Fortunately, there were no students who refused to participate in the study. All identifying information was removed from the questionnaire to maintain anonymity and confidentiality of participants. Participants needed around 40 minutes to answer the questionnaire. No incentives were given to the participants.

Prior to the data collection of Study 1, all measures were translated into the local language (Amaregna). This was done with the help of lecturers from the language department of Haramaya University. First, the English version was translated into Amaregna which was back translated into English. Both translations were done by two different language lecturers. Finally, a third lecturer was presented with the two versions and asked to evaluate the degree of their matching. This lecturer confirmed that the two versions were similar. Moreover, since these measures had never been applied within the Ethiopian context, it was necessary to conduct a pilot study.

A pilot study was administered to 60 students who were assumed to be similar to participants of the main study. The participants of the pilot test were not included in Study 1. In this pilot study, the perceived peer support scale, the perceived teacher support scale, the mathematics/science self-efficacy measures and the measure assessing future intentions to major in STEM field showed appropriate internal consistency with $\alpha > .70$. However, the perceived parental support scale had Cronbach alpha coefficient of .65, which was below the acceptable level of .70 (Field, 2005). To improve the reliability of the perceived parental support scale, the item “My parents do not have any feelings to my mathematics and science subjects progress” that was originally negatively phrased was converted into positive statements “My parents are happy with my mathematics and science progress”. Moreover, the original item “My parents think advanced mathematics will be a waste of time for me” showed a poor corrected item-total correlation (.158). This was likely to reduce the reliability of the scale. Consequently, this item was omitted from the scale in Study 1.

Furthermore, brief discussions were held with some participants of the pilot study to learn more about their experiences to respond to the questionnaire, the clarity of the instructions, ways of responding and other issues. The participants confirmed that the questionnaire was clear in all aspects. Generally, the feedback of the pilot study was very valuable.

Results

Preliminary Analysis

Table 1 depicts the means and standard deviations for the relevant variables reported for male and female participants separately. Independent-samples t-tests revealed statistically significant differences between female and male participants for mathematics/science achievement, $t\ (205) = 2.44$, $p < .05$, parental support, $t\ (195.65) = -2.47$, $p < .05$, and teacher support, $t\ (209) = -2.50$, $p < .05$; in that male participants reported significantly higher scores of previous mathematics/ science achievements when compared with female participants; whereas female participants reported significantly more support from parents and teachers when compared with male participants. Female and male participants did not differ in the variables peer support, mathematics/science self-efficacy, and intention to major in STEM fields, $t_s\ (207\text{-}209) > -1.3 < 0.285$.

The intercorrelations in Table 1 indicate that intention to major in STEM fields was significantly positively related to math/science achievement and math/science self-efficacy in both female and male participants. Gender stereotype awareness did not correlate with any of the other variables in both males and females. Noteworthy, male participants seem to endorse the gender stereotype the less they achieve in mathematics and science. Social support differed in female and male participants with regards to intention to major in STEM fields when joining university, in that, parents seem to play a role in females' whereas peers play role in males' intention to major in STEM fields. Social support, irrespective of parents, teachers or peers is related to math/science self-efficacy in both females and males.

Table 1. Means, standard deviations, and intercorrelations, Study 1

		1	2	3	4	5	6	7	8
Females	M	62.06	3.97	3.49	3.79	-0.62	0.12	3.56	3.31
	SD	8.17	0.68	0.88	0.92	1.40	0.96	0.75	0.97
	Min	38.25	2	1.35	1	-4	-3	1.5	1.33
	Max	90	5	5	5	4	3	5	5
Males	M	65.08	3.70	3.19	3.53	-0.70	-0.07	3.59	3.31
	SD	10.7	0.88	0.87	1.08	1.32	1.20	0.84	1.04
	Min	47.5	1.43	1.38	1	-4	-3	1	1
	Max	92.75	5	4.75	5	3	4	5	5
1 Math/science achievement		-	.20*	.02	.36**	-.16	-.05	.27**	.29**
2 Parental		.08	-	.34***	.31***	.02	.13	.40***	.26**

support								
3 Teacher support	.06	.49***	-	.33***	.11	-.12	.30**	.18†
4 Peer support	.23*	.24*	.39***	-	.01	-.04	.35***	.12
5 Gender stereotype awareness	-.12	.018	.117	-.119	-	-.04	.15	.04
6 Gender stereotype endorsement	-.24*	.17	-.02	-.15	.17	-	-.08	.03
7 Math/science self-efficacy	.18	.44***	.40***	.45***	.03	.17	-	.21*
8 Intention to major in STEM	.22*	.14	.25*	.40***	-.16	-.00	.40***	-

Note: *** Correlation is significant at the .001 level (2-tailed); ** Correlation is significant at the .01 level (2-tailed); * Correlation is significant at the.05 level (2-tailed); † Correlation is marginally significant at the .10 level (2-tailed). The upper part of the table reports the correlations coefficients of the female sample; while the lower part of the table reports the correlations coefficients of the male sample.

Main Analysis

The first research question asked whether participants were aware of the existence of a negative gender stereotype regarding females' mathematics and science ability in society and whether they endorse this stereotype. The scores of the gender stereotype awareness were negative in both female and male participants suggesting that female and male participants assume that males are perceived by society as better in mathematics/science than females (see Table 1). This interpretation is supported by the results of the one-sample t-tests which showed that the scores of both females (M = -0.62, SD = 1.40), t (104) = - 4.59, $p < .001$, and males (M = -0.7, SD = 1.40), t (103) = - 5.38, $p < .001$, were significantly different from zero.

The scores of the gender stereotype endorsement were rather ambiguous with regards to the sizes and the directions (see Table 1). However, the one-sample t-tests revealed that neither females' (M = 0.12, SD = 0.96), t (105) = 1.311, $p > .05$, nor males' (M = -0.07, SD = 1.20), t (104) = -0.647, $p > .05$, scores significantly differed from zero, which means that neither female nor male participants think that males or females have different mathematics/science ability. Moreover, female and male participants did not differ with regard to both awareness, t (207) = -0.388, $p > .05$, and endorsement, t (209) = -1.32, $p > .05$. These results suggest that both, female and male participants perceive that society believes in gender differences with regards to mathematics/science ability in that males are assumed to have more ability than females. The results further suggest that neither female nor male participants actually endorse this stereotype.

The second question addressed the interplay between previous math/science achievement, perceived social support, math/science self-efficacy and intentions to major in STEM fields. More specifically, we explored whether self-reported previous math/science achievement influences the intention to major in STEM fields through math/science self-efficacy and whether this interplay is conditional of social support (see Figure 2). We tested these two assumptions separately for female and male participants using ordinary least squares regressions by applying the bootstrapping method with 10000 iterations in *Process* (Hayes, 2009, 2013). In the first step, we estimated the specific indirect effect of math/science self-efficacy in the relationship between math/science achievement and intention (#Model 4 testing indirect effects, Hayes, 2013), and in the second step, we tested whether the direct effect of math/science achievement on intention and its indirect effect through math/science self-efficacy are conditional upon social support (#Model 8 testing moderated mediation; Hayes, 2013). The results are reported separately for female and male participants.

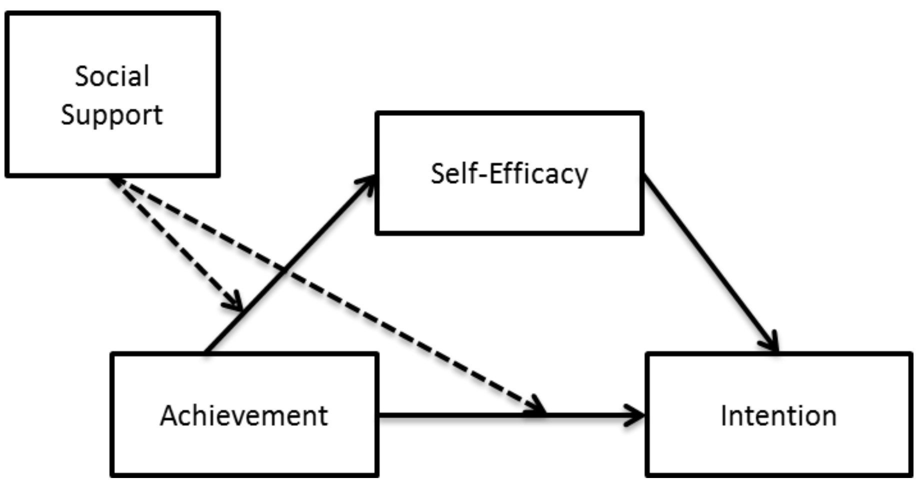

Figure 2. Mediation model and moderated mediation model, Study 1

Female participants

The model testing the specific indirect effect of math/science self-efficacy in the relationship between math/science achievement and intention was statistically significant for female participants, R^2 = .1091, F(2, 102) = 6.2486, p < .01. The estimate of the specific indirect effect did however not support our assumption, b = .0050, *Boot SE* = 0.0035, 95% *Boot* CI [-.0005, .0141]. This result suggests that the influence of math/science achievement on the intention to major in STEM fields is not intervened by math/science self-efficacy. Table 2 reports the estimates and the direct, indirect and total effects. The results indicate first that intention to major in STEM fields is only directly influenced by math/science achievement and not through math/science self-efficacy. Noteworthy is that math/science self-efficacy did not have a statistically significant main effect on intention.

In the second step, we re-estimated the previous model three times by including either parental support, teacher support or peer support as a conditional variable (using Model 8, see Hayes, 2013). In the first model, we included parental support and controlled for teacher support and peer support as covariates. The model assuming parental support to moderate the relationships from math/science achievement on intention on the one hand, and its influence through math/science self-efficacy on the other (controlling for teacher support and peer support) was statistically significant, R^2 = .1661, F(6, 98) = 3.2539, p < .01. As the estimates in Table 3 show, neither the interaction term predicting self-efficacy nor the interaction term predicting intention was statistically significant. These results imply that parental support does not moderate in female participants the relationships among math/science achievement, math/science self-efficacy and intention to major in STEM fields.

The second model included teacher support and controlled for parental support and peer support as covariates. The model assuming teacher support to moderate the relationships from math/science achievement on intention on the one hand, and its influence through math/science self-efficacy on the other (controlling for parental support and peer support) was statistically significant, $R^2 = .1677$, $F(6, 98) = 3.2912$, $p < .01$. The estimates are reported in Table 4. Again, neither the interaction term predicting self-efficacy nor the interaction term predicting intention was statistically significant. These results suggest that teacher support does not moderate in female participants the relationships among math/science achievement, math/science self-efficacy and intention to major in STEM fields.

Thirdly, we included peer support into the model and controlled for parental support and teacher support. The model reached statistical significance, $R^2 = .1606$, F (6, 98) = 3.1242, $p < .01$. Similar to the previous models, neither the interaction term predicting self-efficacy nor the interaction term predicting intention was statistically significant (see Table 5).

Summarizing we can conclude that female participants' intention to major in STEM fields is influenced by their previous mathematics/science achievements. The results of the present study suggest that this relationship is not intervened by self-efficacy and it is not conditional upon any social support, irrespective if the support comes from parents, teachers or peers.

Male participants

The model testing the specific indirect effect of math/science self-efficacy in the relationship between math/science achievement and intention was also statistically significant in male participants, $R^2 = .2072$, $F(2, 99) = 12.93.75$, $p < .001$. The estimate of the specific indirect effect supported our assumption, $b = .0081$, *Boot SE* = 0.0039, 95% *Boot* CI [.0015, .0170]. This result suggests that the influence of math/science achievement on the intention to major in STEM fields is indeed intervened by math/science self-efficacy. The estimates, as well as the direct, indirect and total effects, are summarized in Table 2. The results suggest that intention to major in STEM fields is indirectly influenced by math/science achievement through math/science self-efficacy in male participants.

Similar to the female participants, we re-estimated the intervening model three times by including either parental support, teacher support or peer support as a conditional variable (using Model 8, see Hayes, 2013). In the first model, we included parental support and controlled for teacher support and peer support as covariates. The model was statistically significant, R^2 = .2621, F (6, 95) = 5.6229, p < .001. The estimates in Table 3 show that neither the interaction term predicting self-efficacy nor the interaction term predicting intention was statistically significant; which suggests that the relationships among math/science achievement, math/science self-efficacy and intention to major in STEM fields is not conditional on parental support.

The second and third model included teacher support and peers support respectively by controlling for the remaining supports. Both, the model assuming teacher support, R^2 = .2642, F (6, 98) = 5.6852, p < .001, and the model assuming peer support, R^2 = .2756, F (6, 98) = 6.0236, p < .001, to moderate the relationships among math/science achievement, math/science self-efficacy and intention were statistically significant. The estimates are reported in Table 4 and 5. The interaction term predicting self-efficacy and the interaction term predicting intention were neither statistically significant in the teacher support model nor in the peer support model. These results suggest that teacher support and peer support do not moderate in male participants the relationships among math/science achievement, math/science self-efficacy and intention to major in STEM fields.

In summary, we can conclude that male participants' intention to major in STEM fields is influenced by their previous mathematics/science achievement through mathematics/science self-efficacy. However, these relationships are not conditional upon any social support, irrespective if the support comes from parents, teachers or peers.

Table 2. Special intervening effect models for female and male participants (#Model 4, Hayes, 2013), Study 1

		Outcome: Self-efficacy					
		Beta	SE	*t*	*p*	LLCI	ULCI
Females	Constant	2.08	0.54	3.87	<.001	1.01	3.14
	Math/Science Achievement	0.02	0.01	2.82	.0057	0.01	0.04
Males	Constant	2.53	0.58	4.37	<.001	1.53	1.84
	Math/Science Achievement	0.02	0.01	1.84	.0680	-0.001	0.03
		Outcome: Intention to major in STEM fields					
		Beta	SE	*t*	*p*	LLCI	ULCI
Females	Constant	0.70	0.75	0.94	.35	-0.78	2.18
	Math/Science Achievement	0.03	0.01	2.60	.01	0.01	0.05
	Self-efficacy	0.21	0.13	1.61	.11	-0.05	0.46

Males	Constant	0.50	0.71	0.71	.48	-0.90	1.90
	Math/Science Achievement	0.02	0.01	1.59	.11	-0.003	0.04
	Self-efficacy	0.50	0.11	4.46	<.001	0.28	0.72
Total, direct and indirect effects							
Total Effect		*Effect*	*SE*	*t*	*p*	LLCI	ULCI
	Females	0.04	0.01	3.13	.002	0.013	0.06
	Males	0.02	0.01	2.24	.03	0.003	0.06
Direct Effect (Achievement on Intention)		*Effect*	*SE*	*t*	*p*	LLCI	ULCI
	Females	0.03	0.01	2.60	.01	0.01	0.05
	Males	0.02	0.01	1.59	.15	-0.004	0.04
Indirect Effect (Achievement on Intention via Self-Efficacy)		*Effect*	*Boot SE*		Boot LLCI	Boot ULCI	
	Females	0.005	0.004		-0.0003	0.01	
	Males	0.01	0.004		0.002	0.02	

Table 3. Conditional effects of parental support for female and male participants (#Model 8, Hayes, 2013), Study 1

		Outcome: Self-efficacy					
		Beta	SE	*t*	*p*	LLCI	ULCI
Females	Constant	-4.45	3.19	-1.39	.17	-10.78	3.12
	Math/Science Achievement	0.10	0.05	1.83	.07	-0.01	0.20
	Parental support	1.53	0.77	2.00	.05	0.01	3.05
	Teacher support	0.11	0.08	1.34	.17	-0.05	0.26
	Peer support	0.15	0.08	1.88	.06	-0.01	0.31
	Achievement x Parental support	-0.02	0.01	-1.62	.11	-0.04	0.005
Males	Constant	2.96	2.35	1.26	.21	-1.71	7.63
	Math/Science Achievement	-0.03	0.04	-0.74	.46	-0.10	0.05
	Parental support	-0.03	0.60	-0.44	.66	-1.46	0.93
	Teacher support	0.09	0.10	0.90	.37	-0.11	0.29
	Peer support	0.26	0.07	3.61	<.001	0.12	0.41
	Achievement x Parental support	0.01	0.01	0.94	.35	-0.01	0.03

		Outcome: Intention to major in STEM fields					
		Beta	SE	*t*	*p*	LLCI	ULCI
Females	Constant	-6.03	4.63	-1.30	.20	-15.23	3.15
	Math/Science Achievement	0.13	0.08	1.72	.09	-0.02	0.28
	Self-efficacy	0.09	0.14	0.61	.54	-0.20	3.37
	Parental support	1.66	1.12	1.48	.14	-0.56	3.88
	Teacher support	0.17	0.11	1.44	.15	-0.06	0.39
	Peer support	-0.13	0.12	-1.12	.26	-0.36	0.10
	Achievement x Parental support	-0.02	0.02	-1.30	.20	-0.06	0.01
Males	Constant	2.87	3.11	0.92	.36	-3.29	9.04
	Math/Science Achievement	-0.03	0.05	-0.52	.60	-0.12	0.07
	Self-efficacy	0.38	0.14	2.87	.005	0.12	0.65
	Parental support	-0.73	0.79	-0.92	.36	-2.29	0.84
	Teacher support	0.07	0.13	0.56	.58	-0.19	0.34

	Peer support	0.22	0.10	2.18	.03	0.02	0.43
	Achievement x Parental support	0.01	0.01	0.80	.43	-0.02	0.03
Conditional Direct and Indirect effects							
Conditional Direct Effects (Achievement on Intention)							
Parental Support		*Effect*	*SE*	*t*	*p*	LLCI	ULCI
Females	1 SD below Mean	0.05	0.02	2.68	.01	0.01	0.09
	Mean	0.04	0.01	2.99	.003	0.02	0.06
	1 SD above the Mean	0.02	0.02	1.50	.14	-0.01	0.05
Males	1 SD below Mean	0.003	0.02	0.17	.86	-0.03	0.04
	Mean	0.01	0.01	1.13	.26	-0.01	0.03
	1 SD above the Mean	0.02	0.01	1.44	.15	-0.01	0.05
Conditional Indirect Effect							

(Achievement on Intention through Self-Efficacy)					
	Parental Support	*Effect*	*Boot SE*	Boot LLCI	Boot ULCI
Females	1 SD below Mean	0.003	0.01	-0.004	0.02
	Mean	0.001	0.003	-0.003	0.01
	1 SD above the Mean	0.00	0.002	-0.002	0.01
Males	1 SD below Mean	-0.001	0.004	-0.01	0.01
	Mean	0.002	0.003	-0.003	0.01
	1 SD above the Mean	0.01	0.01	-0.002	0.02

Table 4. Conditional effects of teacher support for female and male participants (#Model 8, Hayes, 2013), Study 1

		Outcome: Self-efficacy					
		Beta	SE	*t*	*p*	LLCI	ULCI
Females	Constant	-0.58	2.18	-0.27	.79	-4.90	3.74
	Math/Science Achievement	0.03	0.03	0.92	.36	-0.04	0.10
	Parental support	0.30	0.10	2.95	.004	0.10	0.50
	Teacher support	0.04	0.60	0.74	.46	-0.75	1.63
	Peer support	0.17	0.08	2.09	.04	0.01	0.33
	Achievement x Teacher support	-0.01	0.01	-0.58	.56	-0.02	0.13
Males	Constant	3.73	1.95	1.95	.06	-0.14	7.60
	Math/Science Achievement	-0.04	0.03	-1.29	.20	-0.10	0.02
	Parental support	0.27	0.09	2.94	.004	0.09	0.46
	Teacher support	-0.08	0.58	-1.37	.18	-0.95	0.36
	Peer support	0.26	0.07	3.64	<.001	0.12	0.41
	Achievement x Teacher support	0.01	0.01	1.57	.12	-0.003	0.03

		Outcome: Intention to major in STEM fields					
		Beta	SE	*t*	*p*	LLCI	ULCI
Females	Constant	-4.19	3.08	-1.36	.18	-10.31	1.93
	Math/Science Achievement	0.10	0.05	2.01	.05	0.001	0.19
	Self-efficacy	0.01	0.14	0.75	.45	-0.18	0.39
	Parental support	0.21	0.15	1.34	.18	-0.09	0.50
	Teacher support	1.31	0.85	1.53	.13	-0.39	3.00
	Peer support	-0.01	0.12	-1.00	.32	-0.35	0.11
	Achievement x Teacher support	-0.02	0.01	-1.37	.17	-0.04	0.01
Males	Constant	2.87	2.62	1.09	.28	-2.33	8.07
	Math/Science Achievement	-0.03	0.03	-0.61	.54	-0.10	0.05
	Self-efficacy	0.37	0.14	2.78	.01	0.11	0.64
	Parental support	-0.12	0.13	-0.92	.36	-0.37	0.14
	Teacher support	-0.64	0.77	-0.83	.41	-2.18	0.89

		Effect	SE	t	p	LLCI	ULCI
	Peer support	0.22	0.10	2.18	.03	0.02	0.42
	Achievement x Teacher support	0.01	0.01	0.96	.34	-0.01	0.04
Direct and Indirect effects							
Conditional Direct Effects (Achievement on Intention)							
Teacher Support		*Effect*	*SE*	*t*	*p*	LLCI	ULCI
Females	1 SD below Mean	0.05	0.02	2.87	.01	0.02	0.09
	Mean	0.04	0.01	2.86	.01	0.01	0.06
	1 SD above the Mean	0.02	0.029	1.18	.24	-0.01	0.05
Males	1 SD below Mean	0.002	0.02	0.14	.89	-0.03	0.03
	Mean	0.01	0.01	1.23	.22	-0.01	0.03
	1 SD above the Mean	0.02	0.02	1.54	.13	-0.01	0.05
Conditional Indirect Effect							

(Achievement on Intention through Self-Efficacy)					
	Teacher Support	*Effect*	*Boot SE*	Boot LLCI	Boot ULCI
Females	1 SD below Mean	0.02	0.003	-0.003	0.01
	Mean	0.001	0.002	-0.002	0.01
	1 SD above the Mean	0.001	0.002	-0.002	0.01
Males	1 SD below Mean	-0.002	0.01	-0.02	0.01
	Mean	0.003	0.003	-0.003	0.01
	1 SD above the Mean	0.01	0.01	-0.00	0.02

Table 5. Conditional effects of peer support for female and male participants (#Model 8, Hayes, 2013), Study 1

		Outcome: Self-efficacy					
		Beta	SE	*t*	*p*	LLCI	ULCI
Females	Constant	2.17	1.73	1.25	.22	-1.27	5.60
	Math/Science Achievement	-0.01	0.03	-0.47	.64	-0.07	0.04
	Parental support	0.31	0.10	3.04	.003	0.11	0.51
	Teacher support	0.08	0.08	1.04	.30	-0.08	0.24
	Peer support	-0.21	0.42	-0.51	.61	-1.04	0.61
	Achievement x Peer support	0.01	0.01	0.94	.35	-0.01	0.02
Males	Constant	1.03	1.58	0.65	.52	-2.12	4.17
	Math/Science Achievement	0.003	0.03	0.14	.89	-0.05	0.05
	Parental support	0.30	0.09	3.17	.002	0.11	0.48
	Teacher support	0.11	0.10	1.06	.29	-0.09	0.31
	Peer support	0.19	0.45	0.41	.68	-0.71	1.08
	Achievement x Peer support	0.001	0.01	0.15	.88	-0.01	0.02

	Outcome: Intention to major in STEM fields						
		Beta	SE	*t*	*p*	LLCI	ULCI
Females	Constant	2.27	2.49	0.91	.37	-2.68	7.22
	Math/Science Achievement	-0.01	0.04	-0.16	.88	-0.09	0.08
	Self-efficacy	0.12	0.14	0.73	.47	-0.18	0.39
	Parental support	0.22	0.15	1.48	.14	-0.08	0.52
	Teacher support	0.13	0.12	1.13	.26	-0.10	0.36
	Peer support	-0.07	0.59	-1.19	.24	-1.89	0.47
	Achievement x Peer support	0.01	0.01	1.01	.31	-0.01	0.03
Males	Constant	-2.51	2.05	-1.22	.22	-6.59	1.56
	Math/Science Achievement	0.06	0.03	1.8665	.07	-0.004	0.12
	Self-efficacy	0.40	0.1319	3.0109	.003	0.14	0.66
	Parental support	-0.111	0.13	-0.88	.38	-0.36	0.14
	Teacher support	0.07	0.13	0.57	.58	-0.18	0.33

	Peer support	1.10	0.58	1.89	.06	-0.05	2.26
	Achievement x Peer support	-0.01	0.01	-1.56	.12	-0.03	0.004
		Direct and indirect effects					
Conditional Direct Effects (Achievement on Intention)							
Peer Support		*Effect*	*SE*	*t*	*p*	LLCI	ULCI
Females	1 SD below Mean	0.02	0.02	1.38	.17	-0.01	0.05
	Mean	0.03	0.01	2.58	.01	0.01	0.06
	1 SD above the Mean	0.04	0.01	2.84	.006	0.01	0.07
Males	1 SD below Mean	0.03	0.01	1.96	.05	-0.00	0.05
	Mean	0.01	0.01	1.07	.29	-0.01	0.03
	1 SD above the Mean	-0.004	0.02	-0.30	.77	-0.03	0.03
Conditional Indirect Effect							

(Achievement on Intention through Self-Efficacy)					
	Peer Support	*Effect*	*Boot SE*	Boot LLCI	Boot ULCI
Females	1 SD below Mean	0.001	0.004	-0.004	0.01
	Mean	0.001	0.003	-0.002	0.01
	1 SD above the Mean	0.002	0.003	-0.001	0.01
Males	1 SD below Mean	0.002	0.007	-0.01	0.01
	Mean	0.003	0.004	-0.003	0.01
	1 SD above the Mean	0.003	0.003	-0.002	0.01

Discussion

The main purpose of Study 1 was to explore whether participants were aware of the existence of negative gender stereotype regarding females' mathematics and science ability in society and whether they endorse this stereotype. Moreover, the first study aimed at providing some insights about the interplay between mathematics/science achievement, social support of parents, teachers and peers, mathematics/science self-efficacy and future intention to major in STEM fields.

The results of Study 1 suggest that societal negative stereotypes that imply females' inferior ability to mathematics and science subjects seem indeed to exist according to our participants. Both female and male participants were well aware of the existence of this negative stereotype in that society attributes less mathematics/science ability to females and more mathematics/science ability to males. However, female and male participants seemed not to endorse this negative stereotype. The results further imply that female participants' intention to major in STEM fields is only explained by previous mathematics/science achievements; whereas male participants' intention to major in STEM fields is explained by the interplay between previous mathematics/science achievements and mathematics/science self-efficacy. Social support, however, did not play a role in the interplay between previous achievement, self-efficacy and intention to major in STEM fields in both female and male participants.

The results of Study 1 have three main implications for the present research: first and most importantly, female students were well aware of the existence of negative stereotype about females' mathematics and science ability in the society, yet they did not endorse this belief. Previous research on stereotype threat indicated that the mere awareness of being negatively stereotyped was a sufficient condition for stereotype threat to occur (Spencer et al., 1999; Steele, 1997; McKown & Weinstein, 2003). Research findings on stereotype threat indicate that the stereotype does not have to be endorsed by the targeted individual to experience stereotype threat (Quinn & Spencer, 2001; Steele, 1999; Huguet & Regne, 2009; Nadler & Clark, 2011). It is sufficient that they are aware of its existence. Thus, lack of endorsement does not safeguard females from experiencing stereotype threat. Consequently, our assumption that stereotype threat (based on the negative stereotype regarding females' mathematics/science ability) might be at play in reducing females' intention to major in STEM fields can be considered as appropriate. This assumption will be tested in Study 2 and 3.

Secondly, for both females and males it was shown that mathematics/science achievement positively influences the intention to major in STEM fields. Theory and previous research on the implications of academic achievement defined and demonstrated that it is indeed an important factor influencing future behaviour (Flashman, 2012). The results of Study 1 further supported previous findings in that self-efficacy plays a pivotal role in mediating the relationship between academic achievement and future behaviour (Pajares, 2000; Bandura, 1994). However, the important role of self-efficacy was only found in male participants; in that male participants in their intentions to major in STEM fields are not only influenced by previous academic achievements but also by the related changes in the self-efficacy. Although academic achievement influenced self-efficacy in female participants, the latter did however not influence on a statistically significant level future behaviour which contradicts previous findings that showed that academic self-efficacy predicts students' future academic and career choice (Catambis, 2005; Pajares, 2000; Bandura, 1994). We could only speculate why we found the implications of self-efficacy on intentions to major in STEM fields in male but not in female participants. However, we considered possible interferences of the measurements, that is to say, that the measure of self-efficacy might have been influenced by the previous measures such as social support and gender stereotype awareness and endorsement. Consequently, we assessed mathematics/science self-efficacy as one of the first measures in Study 2 and 3 which applied a more controlled research design.

Thirdly, the results of Study 1 imply that social support, irrespective whether it is perceived to come from parents, teachers or peers, did not influence any of the assumed relationships between academic achievement, self-efficacy and intention. These results were rather surprising because social support has been shown to be relevant in students' self-efficacy (Bussey & Bandura, 1999; Pajares, 2002), academic achievement (Ahmed et al., 2010; Dzulkifli & Yasin, 2009) and intended future behaviours (Kaufman & Yin, 2009; Mruk, 2006). Again, we are only able to speculate the reasons for these findings. We considered again the possibility that the assessment of social support in a correlative research design might be influenced by previous measures. Consequently, we assessed social support in Study 3 as a true moderator (or situational) variable, that is to say, we assessed it independently from the other principal variables.

The outlined implications for the future studies refer also to the limitations of Study 1. One major limitation of Study 1 was its correlative research design. Although we assessed the variables in the order of the concepts proposed in our model, it did not take away the fact that all measures were assessed more or less at the same time. Any mediation model or moderated mediation model assumes a causal relationship which by definition requires a time lag between cause, mediator and effect (Maxwell, Cole, & Mitchell, 2011; Wu & Zumbo, 2007; Frazier, Tix & Barron, 2004). To overcome these limitations and to appropriately address our overall research questions, we conducted two experimental studies that tested first the influence of stereotype threat on females’ intention to major in STEM fields through mathematics/science self-efficacy (Study 2) and the role of social support in mitigating the implications of stereotype threat on females’ intention to major in STEM fields (Study 3).

STUDY 2

The results of Study 1 indicated that female participants were well aware of the presence of negative stereotypes of females' mathematics/science ability. It is known that stereotype affects performance and career choice of students particularly when it is primed or made salient, a condition known as stereotype threat (Steele & Aronson, 1995; Spencer et al., 1999). Therefore, Study 2 aimed at investigating whether the activation of an already existing negative stereotype about females' mathematics/science ability weakens female students' intention to major in STEM fields and whether this relationship is intervened by mathematics/science self-efficacy. More specifically, we tested the hypothesis that stereotype threat negatively influences intention and that this relationship is mediated by mathematics/science self-efficacy (Hypotheses 1 - 2).

Research Design and Participants

An experimental study was conducted to investigate the impact of stereotype threat on female students' future intention to major in STEM fields through math/science self-efficacy (see Figure 3). Stereotype threat was manipulated (stereotype threat versus no stereotype threat) and math/science self-efficacy and intention to major in STEM fields were measured. The participants of the study were 100 female students from a high school located in Dire Dawa city administration (Ethiopia) with an average age of 16.1 years ranging from 14 to17.

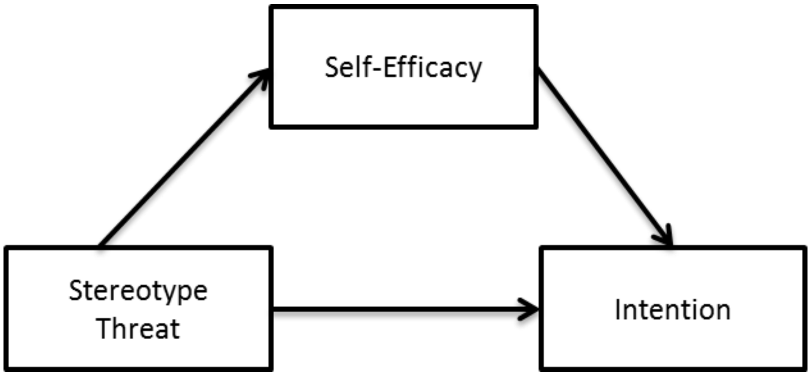

Figure 3. Mediation model, Study 2

Procedure

Participants were randomly assigned to two experimental conditions: the stereotype threat condition (experimental group) and the non-stereotype threat condition (control group). This was done in the following way. Early in the morning at the flag ceremony, female students were informed about and invited to attend a research study which was to be conducted at their school. Those students who were interested to participate in the research were kindly asked to meet the research assistants. Students were categorized into two groups based on their identity number given from the school. Students whose identity number ended with an odd number were assigned to room A and students whose identity number ended with an even number were assigned to room B. The students allocated to room A were assigned to the stereotype threat condition (experimental group) and the students allocated to room B were assigned to the non-stereotype threat condition (control group).

When participants arrived in the respective rooms, they were welcomed by a research assistant. The research assistant in the stereotype threat condition was male and the research assistant in the non-stereotype threat condition was female. We opted for this procedure because we assumed and former research has shown that a male research assistant was more likely to increase the stereotype threat reaction in our female participants than a female research assistant (e.g., Inzlicht & Ben-Zeev, 2003). After welcoming the participants, the research assistants introduced themselves and the goal of the study. In the stereotype threat condition, participants were informed that the male research assistant works at the Institute of Science and Technology and that the purpose of the study was to compare math and science achievements of female and male high school students. In the non-stereotype threat condition, participants were informed by the female research assistant that she works at the Institute of Gender Studies and that the purpose of the research was to study their family situation, residence and hobbies.

Participants in the stereotype threat condition received the following short text and they were asked to read the text carefully.

"*Dear participants,*

This study is conducted by the Institute of Science and Technology. The purpose of the present study is to compare math and science achievement of male and female high school students. Previous studies in Ethiopia have revealed that males' achievements in math and science excel females' achievements to a very great extent. The studies also revealed that females had inferior math and science ability. In fact, studies in other countries also showed male dominance in math and science areas. This research is part of a larger national study being conducted to determine why women are generally worse at math and science than men are. The Institute of Science and Technology, therefore, likes to know if the same differences exist among students in this school."

To increase stereotype-threat, participants were first asked about their gender, age and grade. Secondly, they were asked to report their previous average scores for mathematics and science subjects (i.e., Physics, Chemistry, and Biology). After providing this information, participants were asked to respond to the principal measures.

In the non-stereotype threat condition, participants received the following short text and they were asked to read the text carefully.

"*Dear participants,*

This study is conducted by the Institute of Gender Study, Haramaya University. Today I am here to collect data to conduct a study. The purpose of the study is to gather information about your family size, your parents' education, job and income. This research is part of a larger national study being conducted to determine how family size and parents' socioeconomic status are related to students academic results. Studies in other countries showed a positive relationship between parents' socioeconomic status and academic results. The Institute of Gender Study, therefore, likes to know if the same relationship exists among students in this school."

Moreover, in the non-stereotype threat condition, participants were first asked to provide information about their family size, their father's job, and their mother's level of education. Secondly, they were asked to report their previous average scores of social science subjects (i.e., Civics, Geography, History and English). After providing this information, participants were asked to respond to the principal measures. After participants responded to the measures, they were debriefed about the real aim of the study.

Measurements

Mathematics/science self-efficacy (α =.93) and *Intention to major in STEM fields* (α = .86) were assessed with the same measures and the same answer formats as used in Study 1.

Manipulations check of the independent variable was assessed by the following four items using a five-point answer format ranging from 1 (*strongly disagree)* to 5 (s*trongly agree*): "In Ethiopian, males excel females in science and math achievement to a very great extent", "In countries other than Ethiopia, males excel females in science and math to a very great extent", "Studies revealed that females had inferior math and science ability compared to males", and "The purpose of this study is to compare math and science achievement of high school male and female students" (α = .97).

Results

Manipulation Check

To verify the effectiveness of the manipulation of stereotype threat, an independent samples t-test was conducted on the manipulation check measure. The mean of the participants in the stereotype threat condition (n = 50, M = 4.51, SD = 0.50) was significantly higher than the mean of participants in the non-stereotype threat condition (n = 50, M = 1.50, SD = 0.54); t (98) = 28.87, $p < .001$, *Cohen's* d = 5.78. The significant difference in the means between the two groups and the large effect size imply that participants in the stereotype threat condition felt more targeted by the stereotype relevant to their math ability than participants in the non-stereotype threat condition (see Aronson et al., 1999).

Preliminary Analysis

Table 6 reports the means, standard deviations, and intercorrelations of the principal variables for the experimental and control group, separately. As the means indicate, participants in the stereotype threat conditions scored significantly lower on self-efficacy and intentions to major in STEM fields than participants in the control condition, $t_{Efficacy}(76.23) = -13.22$, $p < .001$ and $t_{Intention}(98) = -13.19$, p < .001.

Table 6 Means, standard deviations, and intercorrelations of principal variables for experimental and control group, Study 2

	Variables	M	SD	Min	Max	Pearson's r
Experimental Group	Self-efficacy	2.80	0.71	1.40	4.20	
	Intention to major in STEM fields	2.14	0.79	1.00	4.33	.27 †
Control Group	Self-efficacy	4.30	0.39	3.40	5	
	Intention to major in STEM fields	4.06	0.66	2.33	5	.41**

Note: ** Correlation is significant at the .01 level (2-tailed); * Correlation is significant at the.05 level (2-tailed); † Correlation is marginally significant at the .10 level (2-tailed).

Hypothesis testing

The hypothesis that stereotype threat negatively influences intention through mathematics/science self-efficacy was tested using again ordinary least squares regressions and applying the bootstrapping method with 10000 iterations in *Process* (Hayes, 2009, 2013). We estimated the specific indirect effect of mathematics/science self-efficacy in the relationship between stereotype threat and intention to major in STEM fields (#Model 4 testing indirect effects, Hayes, 2013). We entered stereotype threat conditions as a dummy variable (coded 1 stereotype threat and no stereotype threat), mathematics/science self-efficacy measure as an intervening variable and intention to major in STEM fields as a dependent variable into the model.

The model was statistically significant, R^2 = .6744, F (2, 97) = 100.445, p < .001. The estimate of the specific indirect effect supported our assumption, b = -.5988, *Boot SE* = 0.19585, 95% *Boot* CI [-.9921, -.2184]. This result suggests that the influence of stereotype threat on intention to major in STEM fields is indeed intervened by math/science self-efficacy. Table 7 reports the estimates and the direct, indirect and total effects. As the results show, stereotype threat negatively influenced math/science self-efficacy and the intention to major in STEM fields; on the one hand, math/science self-efficacy positively influenced the intention to major in STEM fields. The results support the proposed assumption that stereotype threat indirectly negatively influences the intention to major in STEM fields, that is to say, stereotype threat not only reduces the intention to major in STEM fields but also reduces math/science self-efficacy which has been identified as a supporting factor for intentions and/or performances (Cadaret et al., 2017; Rudasill & Callahan, 2010).

Table 7. Special intervening effect model (#Model 4, Hayes, 2013), Study 2

	Outcome: Math/Science Self-efficacy					
	Beta	SE	*t*	*p*	LLCI	ULCI
Constant	4.30	0.08	53.51	< .001	4.14	4.46
Stereotype threat	-1.50	0.11	-13.22	< .001	-1.73	-1.28
	Outcome: Intention to major in STEM fields					
	Beta	SE	*t*	*p*	LLCI	ULCI
Constant	2.35	0.54	4.34	< .001	1.27	3.42
Stereotype threat	-1.32	0.23	-5.69	< .001	-1.78	-0.86
Math/Science Self-efficacy	0.40	0.12	3.22	.002	0.15	0.64
	Total, direct and indirect effects					
Total Effect	*Effect*	*SE*	*t*	*p*	LLCI	ULCI
	-1.92	0.15	-13.19	< .001	-2.21	-1.63
Direct Effect	*Effect*	*SE*	*t*	*p*	LLCI	ULCI
(Stereotype Threat on						

Intention)						
	-1.32	0.23	-5.69	< .001	-1.78	-0.86

Indirect Effect	*Effect*	*Boot SE*	Boot LLCI	Boot ULCI
(Stereotype Threat on Intention through Math/Science Self-Efficacy)				
	-0.60	0.20	-0.99	-0.22

Discussion

The aims of Study 2 were to test whether stereotype threat activation weakens female participants' intention to major in STEM fields and whether this relationship is intervened by mathematics/science self-efficacy. More specifically, we tested the hypothesis that stereotype threat negatively influences intention to major in STEM fields through mathematics/science self-efficacy (Hypothesis 1).

The results of Study 2 supported our hypothesis that the activation of an already existing negative stereotype about females' mathematics/science ability reduces female participants' intention to major in STEM fields. Moreover, the results of Study 2 showed that the influence of stereotype threat on intention to major in STEM fields is mediated by mathematics/science self-efficacy. The latter means that stereotype threat not only reduces intentions but also reduces the positive effect of self-efficacy on intention to major in STEM fields.

The results of Study 2 have the following implications for the present research. First, the result showed that stereotype threat negatively influenced female high school students' intention to major in STEM fields not only directly but also indirectly. In other words, stereotype threat seems to be not only directly responsible for females’ poor intention to major in STEM fields but also for the lowering of mathematics/science self-efficacy which is known for its dominant positive influence on science learning, STEM intention, and career choices (Cadaret et al., 2017; Rudasill & Callahan, 2010; Hartman & Hartman, 2009; Bussey & Bandura, 1999). These results imply that the negative implications of stereotype threat are not only related to future behaviour but also to personal beliefs about one’ abilities. Consequently, an important question is – what possible factors exist that might protect female students from the negative implications of stereotype threat?

The present research proposes that social support represents such a factor that might mitigate the negative implications of stereotype threat. Previous research demonstrated the positive effect of social support on students’ (especially females’) performance, academic choices, and belief (Tomasetto et al., 2011; Kaufman & Yin, 2009; Williams, 2008; Stake, 2006). However, less is actually known whether social support serves as a barrier to stereotype threat effects. Thus, Study 3 tested experimentally whether social support mitigates the negative implications of stereotype threat for self-efficacy and behavioural intention.

STUDY 3

In Study 2, stereotype threat has been shown to influence STEM intention through mathematics/science self-efficacy. However, there are different variables that might affect the extent to which individuals become more or less vulnerable to the implications of stereotype threat. Study 3 aimed at testing such conditional effects, namely the effect of social support. More specifically, we assumed that social support will influence the implications of stereotype threat on mathematics/science self-efficacy and on intention to major in STEM fields (see Figure 4).

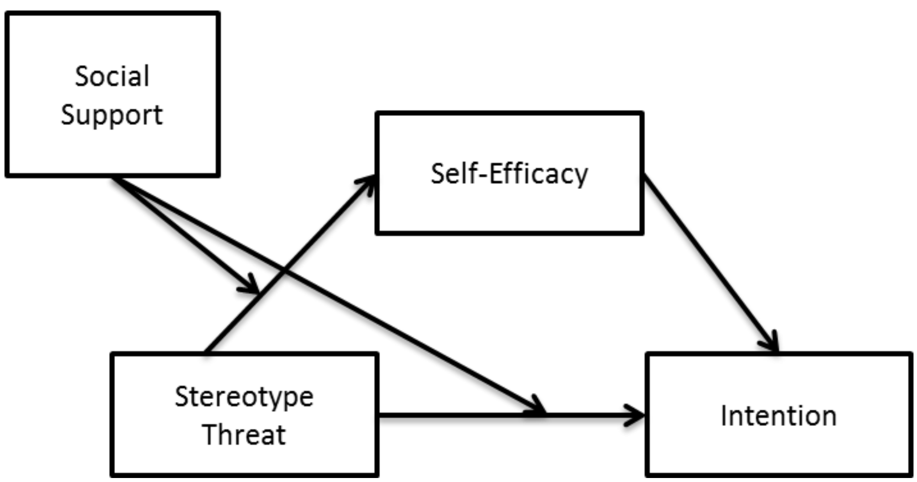

Figure 4. Moderated mediation model, Study 3

Study 3 hypothesized that social support from significant others moderates the relationship between stereotype threat and mathematics/science self-efficacy and the relationship between stereotype threat and intention to major in STEM fields. More specifically, we assumed that the negative influence of stereotype threat on mathematics/science self-efficacy and the negative influence of stereotype threat on intention is conditional upon social support, that is to say, participants who receive high social support from parents, teachers and peers will be less affected by stereotype threat implications compared to students who perceive low social support (Hypothesis 2).

Research Design and Participants

We again tested our hypothesis using an experimental research design by which we manipulated stereotype threat. Participants of the Study 3 were 104 female students from a high school of the same district as in Study 1 and 2; with a mean age of 15.7 years ranging from 14 and 17.

Procedure

Study 3 was conducted in two phases. Students were informed that female students could participate in a study and those interested students were told to remain behind in class. Interested students were provided with a brief verbal description that the study was about their schooling and social support they receive from significant others. They were also told that the study would have a second phase and reminded to write their school identity number on the questionnaire so that they could be matched with the measures of the second phase of the study. However, they were informed to write only their school identification number if they were willing to participate in the second phase of data collection.

In the first phase, the moderator variable (i.e., perceived social support of parents, teachers, and peers) was assessed. Then participants were classified into “low social support” and “high social support” groups using one standard deviation below the mean and one standard deviation above the mean. Participants with one standard deviation below the mean and exactly at the mean were placed in the low social support group and participants with one standard deviation above the mean were placed in the high social support group.

After one week, the experiment was conducted. Participants from the high social support group and the low support groups were randomly allocated to the stereotype threat (experimental group) and the non-stereotype threat conditions (control group). This procedure guaranteed that participants from each group (high and low social support) were more or less equally distributed in both conditions (stereotype threat and non-stereotype threat conditions).

The manipulation of the independent variable used the same material and followed the same procedure as in Study 2.

Measurements

Perceived social support was assessed using selected items from the scales used in Study 1. Parental support was assessed by five item: “My parents encourage me to learn math and science as much as I can”, “My parents think that I can do well at math and science”, “My parents think that being good at math and science is useful for my future”, “My parents get involved when I solve math and science problems”, and “My parents are happy with my math and science progress” ($\alpha = .92$). *Perceived teacher support* was measured by four items: “My math and science teacher/s provided me with academic assistance when I needed it”, “My teacher/s praised me when I worked hard at math and science subjects”, “My teacher/s helped my math and science grades improve” and “My teacher/s encouraged me to perform to the best of my abilities in math and science subjects” ($\alpha = .91$). *Perceived peer support* was measured by the five items used in Study 1: "My friends and I like to help each other on math/science courses", "My friends are interested in math and science subjects", "When my friends and I get together, we enjoy doing math and science problems", "My friends and I enjoy talking about math and science", and "My friends are important to get good grades in math and science" (α = .95). The answer format presented to the participants ranged from 1 (*totally disagree*) to 5 (*totally agree*).

Mathematics/science self -efficacy (α =.91) and *Intention to major in STEM fields* (α = .71) and the *manipulation check* (α =.91) were assessed with the same measures and the same answer formats as used in Study 2.

Results

Manipulation Check

As in Study 2, we first verified the effectiveness of the manipulation of stereotype threat using an independent samples t-test on the manipulation check measure. The mean of the participants in the stereotype threat condition (n = 50, M = 4.12, SD = 0.47) was significantly higher than the mean of participants in the non-stereotype threat condition (n = 54, M = 2.04, SD = 0.59); t (102) = -19.60, $p < .001$, *Cohen's d* = 3.89. Again, we interpreted the significant mean difference and the large effect size as an indication that participants in the stereotype threat condition were more likely to feel targeted by the stereotype relevant to their math ability than participants in the non-stereotype threat condition (see Aronson et al., 1999).

Preliminary Analysis

Table 8 reports the means, standard deviations, and intercorrelations of the principal variables for the experimental and control group, separately. The mean comparisons using the independent samples t-test revealed no statistically significant differences in the principal variables between the experimental group and control group, $t_s(102) < 1.07$, $p_s > .29$.

Table 8. Means, standard deviations, and intercorrelations of principal variables for experimental and control group, Study 3

		1	2	3	4	5
Experimental Group	M	3.66	3.68	3.00	3.25	3.02
	SD	0.98	0.97	1.14	1.12	1.18
	Min	1.60	1.50	1	1.20	1
	Max	5	5	5	4.80	5
Control Group	M	3.70	3.69	2.77	3.28	3.23
	SD	1.07	1.12	1.17	0.91	0.86
	Min	1.60	1.50	1	1.80	1
	Max	5	5	4.60	5	4.67
1 Parental support		-	.77***	.71***	.75***	.61***
2 Teacher support		.76***	-	.83***	.77***	.57***
3 Peer support		.73***	.80***	-	.77***	.57***
4 Math/Science Self-Efficacy		.58***	.71***	.72***	-	.64***
5 Intention to major in STEM		.53***	.57***	.78***		-

Note: *** Correlation is significant at the .001 level (2-tailed); ** Correlation is significant at the .01 level (2-tailed); * Correlation is significant at the.05 level (2-tailed). The upper part of the table reports the correlations coefficients of participants in the experimental condition; while the lower part of the table reports the correlations coefficients of participants in the control condition.

Hypothesis testing

We tested the second hypothesis, that social support from significant others moderates the relationship between stereotype threat and mathematics/science self-efficacy and the relationship between stereotype threat and intention to major in STEM fields, by estimating three moderated mediation models using ordinary least squares regressions and applying the bootstrapping method with 10000 iterations in *Process* (# Model 8, Hayes, 2009, 2013).

The first model included stereotype threat as an independent variable, math/science self-efficacy as an intervening variable, intention to major in STEM fields as a dependent variable, parental support as moderator, and teacher and peer support as covariates (Model 1). The second and third models included the same variables except that teacher support was the moderator variable in Model 2 and peer support was the moderator variable in Model 3. The results of the estimated models are reported below separately.

Model 1, which included parental support as variable to moderate the mediation model, was statistically significant, R^2 = .6664, F (6, 97) = 32.29, p < .001. Moreover, the indirect effect of the highest order interaction was statistically significant, b = .2792, *Boot SE* = 0.0998, 95% *Boot* CI [.1046, .4986], which suggests that the mediation is indeed moderated. The estimates and the conditional direct and indirect effects of Model 1 are reported in Table 9. As the results indicate stereotype threat negatively, teacher and peer support positively, and the interaction between stereotype threat and parental support predicted math/science self-efficacy; and math/science self-efficacy predicted intention. There was neither a direct effect of stereotype threat nor an effect of the interaction between stereotype threat and parental support on intention. Thus only the conditional indirect effect showed an impact. More precisely, the indirect effect of stereotype threat on intention to major in STEM fields through math/science self-efficacy reached only statistical significance when parental support was low (1 SD below mean).

Model 2 which included teacher support as variable to moderate the mediation model was also statistically significant, $R^2 = .6664$, $F\ (6, 97) = 32.29$, $p < .001$. Again the indirect effect of the highest order interaction was statistically significant, $b = .2025$, *Boot SE* = 0.1057, 95% *Boot* CI [.0014, .4184]. Table 10 summarizes the estimates and the conditional direct and indirect effects of Model 2. As the results indicate, stereotype threat negatively, peer support positively, and the interaction between stereotype threat and teacher support influenced math/science self-efficacy; and again only math/science self-efficacy predicted intention. Similar to Model 1, there was no direct effect of stereotype threat or an effect of the interaction between stereotype threat and teacher support on intention. Consequently, only the conditional indirect effect showed statistical significance. More precisely and similar to the finding in Model 1, the indirect effect of stereotype threat on intentions to major in STEM fields through math/science self-efficacy reached only statistical significance when teacher support was low (1 SD below mean).

Finally, we estimated Model 3 which included peer support as variable to moderate the mediation model. Although the model was statistically significant, $R^2 = .6667$, $F\ (6, 97) = 32.33$, $p < .001$; the indirect effect of the highest order interaction was not significant, $b = .1471$, *Boot SE* = 0.0820, 95% *Boot* CI [-.0029, .3149], which suggests that the mediation is not moderated in this model. In this model, math/science self-efficacy was only marginally influenced by stereotype threat but significantly by teacher and peer support. Intention to major in STEM fields was only predicted by math/science self-efficacy. The estimates of Model 3 are reported in Table 11.

Table 9. Moderated mediation model including parental support as moderator (#Model 8, Hayes, 2013), Study 3

	Beta	SE	*t*	*p*	LLCI	ULCI
Outcome: Math/Science Self-efficacy						
Constant	1.32	0.32	4.18	< .001	0.69	1.94
Stereotype threat	-1.41	0.45	-3.12	.002	-2.31	-0.51
Parental support	-0.03	0.11	-0.25	.80	-0.24	0.19
Teacher support	0.28	0.11	2.56	.01	0.06	0.50
Peer support	0.37	0.09	4.00	< .001	0.19	0.55
Stereotype threat x Parental support	0.35	0.12	2.98	.004	0.12	0.59
Outcome: Intention to major in STEM fields						
	Beta	SE	*t*	*p*	LLCI	ULCI
Constant	0.66	0.34	1.92	.06	-0.02	1.34
Stereotype threat	-0.26	0.48	-0.54	.59	-1.20	0.69
Math/Science Self-efficacy	0.79	0.10	7.82	< .001	0.59	0.99
Parental support	0.11	0.11	1.02	.31	-0.11	0.33

Teacher support	-0.21	0.11	-1.82	0.07	-0.44	0.02
Peer support	0.12	0.10	1.20	.23	-0.08	0.32
Stereotype threat x Parental support	0.01	0.12	0.08	.93	-0.24	0.26

Direct and indirect effects

Conditional *Direct* Effect of Stereotype Threat on Intention at values of Parental Support

Parental Support	*Effect*	*SE*	*t*	*p*	LLCI	ULCI
1 SD below	-0.23	0.18	-1.28	.20	-0.58	0.13
Mean	-0.22	0.12	-1.77	.08	-0.46	0.03
1 SD above	-0.21	0.18	-1.18	.24	-0.56	0.14

Conditional *Indirect* Effect of Stereotype Threat on Intention through Math/Science Self-Efficacy at values of Parental Support

Parental Support	Effect	Boot SE	Boot LLCI	Boot ULCI
1 SD below	-0.37	0.16	-0.72	-0.10
Mean	-0.09	0.10	-0.29	0.11
1 SD above	0.20	0.13	-0.04	0.46

Table 10. Moderated mediation model including teacher support as moderator (#Model 8, Hayes, 2013), Study 3

	Outcome: Math/Science Self-efficacy					
	Beta	*SE*	*t*	*p*	LLCI	ULCI
Constant	1.14	0.32	3.62	< .001	0.51	1.77
Stereotype threat	-1.05	0.46	-2.29	.02	-1.95	-0.14
Parental support	0.13	0.10	1.31	.19	-0.07	0.32
Teacher support	0.18	0.12	1.52	.13	-0.06	0.42
Peer support	0.36	0.09	3.83	< .001	0.17	0.55
Stereotype threat x Teacher support	0.25	0.12	2.12	.04	0.02	0.49
	Outcome: Intention to major in STEM fields					
	Beta	*SE*	*t*	*p*	LLCI	ULCI
Constant	0.63	0.33	1.90	.06	-0.03	1.28
Stereotype threat	-0.18	0.46	-0.40	.69	-1.10	0.73
Math/Science Self-efficacy	0.80	0.10	8.02	< .001	0.60	9.99
Parental support	0.12	0.10	1.20	.23	-0.08	0.31

Teacher support	-0.21	0.12	-1.74	.09	-0.44	0.03
Peer support	0.12	0.10	1.20	.23	-0.08	0.32
Stereotype threat x Teacher support	-0.01	0.12	-0.08	.94	-0.25	0.23

Direct and indirect effects

Conditional *Direct* Effect of Stereotype Threat on Intention at Values of Teacher Support

Teacher Support	*Effect*	*SE*	*t*	*p*	LLCI	ULCI
1 SD below	-0.21	0.18	-1.18	.24	-0.56	0.14
Mean	-0.22	0.12	-1.77	.08	-0.46	0.03
1 SD above	-0.23	0.18	-1.29	.20	-0.58	0.12

Conditional *Indirect* Effect of Stereotype Threat on Intention through Math/Science Self-Efficacy at Values of Teacher Support

Teacher Support	Effect	Boot SE	Boot LLCI	Boot ULCI
1 SD below	-0.30	0.16	-0.65	-0.001
Mean	-0.09	0.10	-0.29	0.11
1 SD above	0.12	0.13	-0.16	0.37

Table 11. Moderated mediation model including peer support as moderator (#Model 8, Hayes, 2013), Study 3

	Outcome: Math/Science Self-efficacy					
	Beta	*SE*	*t*	*p*	LLCI	ULCI
Constant	1.32	0.32	4.18	< .001	0.69	1.94
Stereotype threat	-1.41	0.45	-3.12	.002	-2.31	-0.512
Parental support	-0.03	0.11	-0.25	.80	-0.24	0.19
Teacher support	0.28	0.11	2.56	.01	0.06	0.50
Peer support	0.37	0.09	4.00	< .001	0.19	0.55
Stereotype threat x peer support	0.35	0.12	2.98	.004	0.12	0.57

	Outcome: Intention to major in STEM fields					
	Beta	*SE*	*t*	*p*	LLCI	ULCI
Constant	0.66	0.34	1.92	.06	-0.02	1.34
Stereotype threat	-0.26	0.48	-0.54	.59	-1.20	0.69
Math/Science Self-efficacy	0.79	0.10	7.82	< .001	0.59	0.99
Parental support	0.11	0.11	1.02	.31	-0.11	0.33

Teacher support	-0.21	0.11	-1.82	.07	-0.44	0.02
Peer support	0.12	0.10	1.20	.23	-0.08	0.32
Stereotype threat x peer support	0.01	0.12	0.08	.93	-0.24	0.26

Direct and indirect effects

Conditional *Direct* Effect of Stereotype Threat on Intention at Values of Peer Support

Peer Support	*Effect*	*SE*	*t*	*p*	LLCI	ULCI
1 SD below	-0.23	0.18	-1.28	.20	-0.58	0.13
Mean	-0.22	0.12	-1.77	.08	-0.46	0.03
1 SD above	-0.21	0.18	-1.18	.24	-0.56	0.14

Conditional *Indirect* Effect of Stereotype Threat on Intention through Math/Science Self-Efficacy at Values of Peer Support

Peer Support	Effect	Boot SE	Boot LLCI	Boot ULCI
1 SD below	-0.37	0.16	-0.72	-0.10
Mean	-0.09	0.10	-0.29	0.11
1 SD above	0.20	0.13	-0.04	0.46

Discussion

The aim of Study 3 was to test whether social support represents a condition that might reduce the negative implications of stereotype threat. More specifically, we hypothesized that social support reduces the negative implications of stereotype threat on mathematics/science self-efficacy and on intention to major in STEM fields (Hypothesis 2).

The results of Study 3 replicated the findings of Study 2, in that stereotype threat negatively influenced participants' personal beliefs about their abilities. The results further implied that social support indeed reduces this negative indirect effect of stereotype threat; in other words, social support mitigates the possible changes in females' beliefs about their own abilities due to stereotype threat. However, the results of Study 3 also suggest that social support is particularly effective if the support is perceived to come from authority groups such as teachers and parents. The support of peers seems to be less effective in mitigating the negative effects of stereotype threat.

The results of Study 3 are in agreement with previous research suggesting that the implications of stereotype threat are not only located within the person but also depend on the social circumstances facing the person (Aronson et al., 1999). Thus, the present results provide further evidence that social context like society not only develops, shares and reinforces negative gender-based stereotypes but also that social context plays an important role in mitigating the consequences of such negative gender-based stereotypes.

GENERAL DISCUSSION

The overall aim of this research was to investigate the effect of stereotype threat on female high school students' intention to major in STEM fields. More specifically, the present research investigated the intervening effect of mathematics/science self-efficacy and the conditional effect of perceived social support on the relationship between stereotype threat and STEM intention. To achieve this purpose, three studies were conducted consisting of one cross-sectional survey (Study 1) and two experiments (Study 2 and 3).

The purpose of Study 1 was to examine female and male participants' awareness and endorsement of a negative stereotype about females' mathematics/science ability. The study was based on the assumption that to be threatened by a stereotype, individuals must be aware of negative stereotype related to their group in certain domains (Quinn & Spencer, 2001; Steele, 1999). Moreover, Study 1 aimed to explore the interplay between mathematics/science achievement, perceived social support, mathematics/science self-efficacy, and intention to major in STEM fields. Study 2 used an experimental design to test Hypothesis 1 which stated that stereotype threat activation weakens females' intention to major in STEM fields and that this relationship is intervened by mathematics/science self-efficacy. To further demonstrate the conditions under which stereotype threat influences intentions to major in STEM fields through self-efficacy a third study was conducted. Study 3 tested experimentally the conditional effect of perceived social support on the implications of stereotype threat. Specifically, we tested the hypothesis that the effects of stereotype threat on intention to major in STEM fields through mathematics/science self-efficacy is conditional upon social support.

Summary of the Results

Study 1 provided evidence that female and male participants were well aware of the existence of the negative stereotype about females' mathematics/science ability within the Ethiopian context. Our participants shared the belief that the Ethiopian society indeed attributes less mathematics/science ability to females and better mathematics/science ability to males. Although female participants shared the belief that negative stereotype about females' mathematics/science ability exists within the Ethiopian society, they did not endorse it. The latter suggests that female participants perceive themselves as equally competent in mathematics and science domains as their male counterparts. It is important to note that male participants shared the female participants' perceptions in that they were also aware of the existence of negative stereotype about females' mathematics/science ability and that they did not endorse it either. Yet, the lack of stereotype endorsement does not safeguard anybody from experiencing stereotype threat and its effects. Previous research on stereotype threat indicated that the mere awareness of being negatively stereotyped was a sufficient condition for stereotype threat to occur (Spencer et al.,1999; Steele, 1997; McKown & Weinstein, 2003; Huguet & Regner, 2009). That is, the negative stereotype does not have to be believed in or endorsed by the targeted group members in order for them to experience stereotype threat; it is sufficient that they are aware of its existence.

Moreover, the results of Study 1 implied a positive relationship between mathematics/science achievement and intention to major in STEM fields for both female and male participants. This result is consistent with similar studies that demonstrated a positive and significant relationship between academic achievement and motivation (Armitage, 2008; Amrai, Motlagh, Zalani & Parhon, 2011). However, the positive influence of mathematics/science achievement on the intention to major in STEM fields was intervened by mathematics/science self-efficacy in male participants only. Additionally, the study showed that the interplay between academic achievement, mathematics/science self-efficacy, and intention to major in STEM fields was not conditional upon social support for both male and female participants.

In Study 2, we activated the already existing negative stereotype about females' mathematics/science ability and tested whether this activation reduces female participants' intention to major in STEM fields and whether this effect is intervened by mathematics/science self-efficacy (Hypothesis 1). The results implied as predicted, that stereotype threat negatively influenced not only the participants' intention to major in STEM fields but also their mathematics/science self-efficacy. Moreover, the results of Study 2 extended our understanding of the mechanisms underlying the stereotype threat effects on STEM intention by supporting our assumption that the influence of stereotype threat on intention to major in STEM fields was mediated by mathematics/ science self-efficacy. Because stereotype threat significantly influenced intention to major in STEM fields after controlled for mathematics/science self-efficacy, the mediation should be considered to be partial. The partial mediation effect of mathematics/science self-efficacy on the relationship between stereotype threat and STEM intention should not come as a surprise because psychological factors tend to have multiple causes. In summary, the results of Study 2 showed that stereotype threat negatively influenced female participants' intention to major in STEM fields directly and indirectly through mathematics/science self-efficacy.

The result of Study 3 showed that the indirect effect of stereotype threat on intention to major in STEM fields through mathematics/science self-efficacy reached only statistical significance when parental and teacher support was low. That is, the negative influence of stereotype threat on intention to major in STEM fields through mathematics/science self-efficacy was limited to participants who receive a low level of social support from parents and teachers. According to the present results, the support of peers seems to be less relevant in mitigating the negative effect of stereotype threat.

Implications of the Present Research

The results of our research have important implications. First, the results of Study 1 suggest that negative stereotypes about females' mathematics/science abilities exist in the society of Ethiopia too; which means that gender stereotypes seem to be shared across various cultures. A number of studies have been conducted in different cultures about gender stereotypes regarding mathematics and science ability of females and males (Catsambis, 2005; Zhen, 2010). The similarities in all these studies are the belief in mathematics and science as a male domain (Hoffmann et al., 1997; Catsambis, 2005; Zhen, 2010). Thus, the Ethiopian culture seems to be not immune to such negative stereotypes. However, it is important to note that neither the female nor the male participants of the present research endorsed those negative stereotypes (Study 1).

Secondly, the results imply that stereotype threat negatively predicted participants' intention to major in STEM fields directly (Study 2) and indirectly (Study 2 and Study 3). The results are consistent with other stereotype threat related studies. For instance, Flore and Wicherts (2015), Armenta (2010), and Spencer et al. (1999) demonstrated that stereotype threat negatively influenced mathematics performance and career aspiration of stereotyped groups such as women and Latinos. It is appropriate to assume that stereotype threat negatively affects not only performance on different domains (see Nguyen & Ryan, 2008; Flore & Wicherts, 2015; Pennington, Levy & Larkin, 2016) but also the motivation to engage in these domains in the future (Taylor & Walton, 2011).

Unlike previous studies, the present research extended the focus on the negative implications of stereotype threat on motivational processes like intention, that is the plan and desire to engage in future behaviour (e.g., majoring in STEM fields). Intention refers to people's inspiration to act (Armitage, 2008) and is considered to directly predict behaviour (Luszczynska et al., 2007). More specifically, it is assumed to be the central component that affects behaviour (Ajzen, 1991). Thus, when this important motivational element is hampered by stereotype threat, it is less likely that stereotyped groups will engage in domains they are negatively stereotyped. These implications of stereotype threat are partly reflected in the underrepresentation of women in STEM domains. Hence, the current research contributes to stereotype threat literature by extending our knowledge on the negative effects of stereotype threat on motivational processes.

Thirdly, the present research revealed that stereotype threat predicts STEM intention not only directly (Study 2) but also indirectly through mathematics/science self-efficacy (Study 2 and 3). This means that stereotype threat reduces mathematics/science self-efficacy, which in turn reduces intention to major in STEM fields. Self-efficacy plays an important role in students' academic life. In almost all studies of the present research, mathematics/science self-efficacy significantly predicted intention to pursue STEM disciplines. These results are in line with previous research in that self-efficacy influences goal-related choices, motivations for behaviour, career interest, and persistence (e.g., Bandura, 1997; Pajares, 2006; Schunk & Pajares, 2002). Self-efficacy theory by Bandura (1995, 1997) states that when people are persuaded that they lack capabilities, disbelief in one's capabilities (i.e., reduced efficacy) is imminent. This disbelief in one's capabilities creates its own behavioural validation by avoiding challenging activities. Female students who believe that they lack mathematics/science ability (as a result of stereotype threat or other factors) are likely to avoid and dis-identify with education and occupations that demand mathematics/science knowledge. The results of the present research provide evidence for the negative implications of these complex processes.

It is important to note that mathematics/science self-efficacy mediated only partially the relationship between stereotype threat and intention (Study 2). This partial mediation should not come as a surprise as many psychological studies that focus on the intervening role of factors found partial mediation effects. For instance, in Aronson et al.'s study (1999, Study 2), evaluation apprehension partially mediated the effect of stereotype threat on test performance. Likewise, performance expectancy (Sekaquaptewa & Thompson, 2003), problem-solving strategies (Quinn & Spencer, 2001), and anxiety (Spencer et al., 1999) partially mediated stereotype threat effects. The results of previous research, as well as the results of the present research, suggest that various mechanisms might be simultaneously at play that intervene the implications of stereotype threat.

Nevertheless, the repeatedly demonstrated intervening effect of mathematics/science self-efficacy on the relationship between stereotype threat and intention to major in a STEM field contributes to the stereotype threat research that aims at elucidating the underlying psychological mechanisms of the situational phenomenon of stereotype threat. Although a number of potential mediators such as anxiety, evaluation apprehension, working memory have been explored thus far (Inzlicht & Ben-Zeev, 2003; Schmader et al., 2004; Sekaquaptewa & Thompson, 2003; Aronson et al, 1999; Spencer, et al, 1999), only few studies addressed self-efficacy as an intervening factor. For example, Pennington et al. (2016) examined 45 experiments from 38 articles published between 1995 and 2015 that proposed mediators of stereotype threat. Of all these experiments, only three experiments tested self-efficacy as a mediator variable and the results were rather ambiguous. Among the three studies that tested self-efficacy as mediator variable, only the study by Chung, Ehrhart, Holcombe-Ehrhart, Hattrup, and Solamon (2010) found empirical support that self-efficacy mediated the relationship between anxiety and test performance as implications of stereotype threat. The present research adds empirical evidence to the study of self-efficacy as an underlying mechanism of stereotype threat by demonstrating its role for the motivational implications of stereotype threat.

The fourth contribution of the present research refers to our results implying that the interplay between stereotype threat and intention to major in STEM fields through self-efficacy is sensitive to contextual influences. It is obvious that stereotype threat does not affect all individuals equally. Some individuals are more or less affected than others. The results of the present research provided supportive evidence for this claim. Our results demonstrated that the mediated relationship between stereotype threat and intention to major in STEM fields through self-efficacy is conditional upon perceived social support (Study 3). More precisely, the negative effect of stereotype threat was limited in our research to participants who perceive to receive low or no social support from significant others (i.e., parents, teachers). This implies that the mere exposure to stereotype threat condition does not necessarily reduce the intention to major in STEM fields. Rather it is the interaction of stereotype threat with the lack of social support that makes its negative implications possible.

The conditional effect of social support as found in our research is in line with previous findings. For example, Aronson et al. (1999) showed the importance of social context in minority's underperformance in stereotype threat conditions. Within a supportive social environment, individuals feel not only less threatened but also more protected and secured. The experience of security and protection encourage individuals to put additional effort and persistence to achieve a desired goal even in the face of potential threats. This is what our results seem to reflect. Participants in the stereotype threat condition reported persisting in their STEM intention given that they perceive others’ support. These participants might feel that they have coping resources to manage any threats in the STEM contexts. Because of this, they might not avoid STEM activities and environments. Similarly, social cognitive theory stresses the importance of social support in human functioning (Bandura, 1986). Hence, a supportive social environment seems to be essential to improve the representations of women and girls in STEM fields.

Another important finding of the present research is that to have any desired positive effect, perceived social support does not need to be particularly strong – yet it has to come from authorities. An average level of social support by teachers and parents is already sufficient that the negative effect of stereotype threat disappears. This suggests that participants who receive negative information about females' mathematics/science ability (i.e., “females can’t do math”) need little counteracting information (i.e., “females can do math”) in order to be resistant to the negative effects of stereotype threat.

Thus, the present research implies that authorities (i.e., parents and teachers) play an important role in boosting students' socio-emotional skills including feeling safe and resisting negative pressure. In recent years, the Ethiopian government introduced the so called Parent-Teacher Association (Federal Democratic Republic of Ethiopia, MoE, 2008). This forum created the opportunity for parents and teachers to discuss students’ learning progress. While parents are advised to encourage and give study time to their children, teachers are advised to provide academic support in the form of tutorial programs designed for female students. Such activities of the Parent-Teacher Association are aimed at encouraging students to pursue their goal even in the face of great challenges. Given the findings of the present research, one could conclude that existing initiatives such as the Parent-Teacher Association (PTA) seem to be promising in reducing the negative effects of stereotype threat.

Limitations of the Present Research

Although the present research makes an important contribution to our understanding of the implications of stereotype threat, it is important to address some of its limitations. First, the present studies were conducted with convenient and limited samples from selected regions of one country (i.e., the regions of Harer and Dire Dawa in Ethiopia). Accordingly, the results cannot be generalized beyond the samples used in the present research. Moreover, the main findings are based on two experimental studies, which cannot be considered to be sufficient to generalize our findings to other situations either (Campbell & Stanley, 1963). Hence, future researchers are advised to apply different sampling techniques and conduct more studies controlling for different contexts in order to improve external validity. In addition to improving the external validity, future research should also be considerate in improving internal validity by (1) strengthening the design-based approach when testing indirect effects (Preacher, 2010), (2) by considering the perspectives of different influences such as social support (i.e., parents, principals and teachers might provide information about the type of support female students are being provided with to enhance their mathematics/science learning at home, at school and in the classrooms), and (3) by assessing high school mathematics/science teachers' reflections on their experiences as a mathematics/science student and their current experiences as mathematics/science teachers.

Secondly, the experimental studies in the present research applied only one approach to manipulate stereotype threat, namely explicitly reminding participants of the negative stereotypes about their group in the mathematics/science domain. There are many other approaches of manipulating stereotype threat. Shapiro and Neuberg (2007) recommend the use of different approaches when studying stereotype threat. Future research might overcome this limitation by using different approaches such as asking participants about their identification with a group prior to a stereotype-relevant intention (e.g., Steele & Aronson, 1995), having participants complete a questionnaire regarding common stereotypes of their group (e.g., Shih et al., 2002), labeling participants' intentions as diagnostic of their standing on a negatively stereotyped trait or ability (e.g., Marx et al., 2005), or placing stigmatized group members in a situation in which they have minority status (e.g., Inzlicht & Ben-Zeev, 2000).

Future research might also take into consideration that mechanisms of stereotype threat might vary across contexts which according to Pennington et al. (2016) have three reasons: (1) the implicit versus explicit priming of threat; (2) the samples studied; and (3) the methods used to measure the mediating variables. For example, Galdi, Cadinu, and Tomasetto (2014) showed that implicit stereotype endorsement mediates stereotype threat effects as compared to explicit–stereotype endorsement. Franceschini et al. (2014) also showed that implicit but not explicit gender-mathematics stereotype predicted mathematics self-efficacy and performances. Moreover, stereotype threat appears to influence different social groups in different ways, leading to different mechanisms of stereotype threat. For instance, Pavlova, Weber, Simoes and Sokolov (2014) found that implicit-explicit stereotype threat priming did not affect women and men equally. According to their study, women's performance on a social cognition task suffered when implicit stereotype threat was primed; whereas the relationship was inverse for men. Lastly, Pennington et al. (2016) argue that self-report measures, which are commonly used in stereotype threat research, are vulnerable to order effects and thus they are leading to inconsistent effects of mediation. For example, Brodish and Devine (2009) showed that women reported higher levels of anxiety when they completed a questionnaire before a mathematical test compared to after the test. Consequently, after reviewing various studies addressing anxiety as a possible mediator, Shapiro and Neuberg (2007) concluded that self-reported pretest anxiety measures (as opposed to physiological measures) tend not to statistically mediate the relationship between stereotype threat and performance.

Thirdly and closely related to the previous limitation is that although Study 2 and Study 3 defined academic self-efficacy as mediator variable, neither of the two experiments manipulated this variable. Given that the present research tested the hypotheses with real groups (i.e., female students) and that the experiments were conducted outside a lab context, we could not guarantee (1) that the manipulation of the mediator would have only affected academic self-efficacy and not another mediator; (2) that the produced estimates of the indirect effect are not specific for the subset of participants; and (3) that participants are not differently affected by changes in stereotype threat and academic self-efficacy (Bullock, Green & Ha, 2010). Consequently, we opted for the next best alternative to the design-based tradition; namely the model-based tradition (Preacher, 2015). Future research should overcome this limitation to maximize internal validity.

Moreover, the present research focused on one mediator and one moderator variable to elaborate the mechanisms underlying stereotype threat and intention relationship, which does not cover the complexity to explain intention to major in STEM fields. Stereotype threat effects can be intervened through and conditional of more than one factor. That is why different studies propose more than one mediator variable at a time. For example, Mayer and Hanges (2003) explored four potential mediators of the stereotype threat effects: increased anxiety, increased cognitive interference, reductions in self-efficacy, and increased evaluation apprehension though they could not find any support for the hypothesized mediators. Moreover, out of 45 stereotype threat experiments reviewed by Pennington et al. (2016), about half of them (23) tested more than one mediator.

Fourthly, our research relied primarily on self-report measures to assess the principal constructs (e.g., social support, self-efficacy). Self-report measures have their own limitations. In some occasions, they tend to provide inaccurate data due to social desirability (Hoskin, 2012). That is, sometimes participants are more likely to report experiences that are considered to be socially acceptable. For example, participants may choose a higher rating for the item, “I am sure that I can do even the hardest work in my math/science class” in order to be perceived positively by others. Even if they try to be honest in their answers, the reference bias still could be at play (Hoskin, 2012). Reference bias occurs when survey responses are influenced by different standards of interpretations. For instance, "hardest work" might be interpreted differently by different participants and/or because of a different context.

Another limitation of self-report measures is that participants may be unable to remember or to unequivocally report what goes on in their own mind. For instance, Bosson et al. (as cited in Pennington et al., 2016) found that even though stereotype threat heightened individuals’ physiological anxiety, the same individuals did not report increased anxiety on self-report measures. In such instances, a direct measure of anxiety using physiological evidence would provide valid and appropriate data compared to self-report measures. However, some psychological concepts represent theoretical constructs (i.e., latent variables) rather than observable phenomena (Bollen, 2002). One could argue that social support represents an observable phenomenon that could be measured directly for instance by counting the frequency of conversations about STEM fields initiated by parents with their children. On the other hand, one could argue that self-efficacy represents a latent variable which cannot be measured directly.

However, in the present research we treated all variables as observable. Our decision was less informed by theoretical elaborations – which according to Bollen (2002, p. 631) are rather difficult because psychology still lacks a common definition of what defines a variable as latent – but rather by constraints with regards to certain statistical analysis techniques (i.e., regression versus structural equation modeling) due to the rather small sample sizes in our studies. Future research should, therefore, pay attention to whether the implications of stereotype threat are defined as *a priori* latent variables or observable variables.

Fifthly, the present research conceptualized stereotype threat as social identity threat and not as personal identity threat (i.e., self-stigmatization). In stereotype threat research, the target of the threat could be the personal self (i.e., concerns to an individual's personal identity) or the social self, that is to say the social group one belongs to (i.e., concerns to one's social identity) (Pennington et al., 2016; Shapiro & Neuberg, 2007). Personal identity as target threat focuses on personal ability of the individual. On the other hand, social identity as a target threat is experienced when individuals confirm a negative stereotype regarding the abilities of their social group (Shapiro & Neuberg, 2007). Stereotype threat is typically viewed as a form of social identity threat. That is why the majority of stereotype threat studies employ social identity as target prime (Pennington et al., 2016).

Moreover, research indicates that individuals are more susceptible to stereotype threat when they strongly identify with the social group that is targeted (Armenta, 2010; Schmader, 2002; Steele & Aronson, 1995). However, group membership does not mean group identification (Shapiro & Neuberg, 2007). This is to say, a strong sense of identity cannot be presumed by simply being a member of a particular group. Belonging to and identifying with a social group is however important for the experience of social identity threat. Although the present research is based on the outlined argument, it did not assess participants' level of gender identification. Future research should overcome this limitation of the present research.

Lastly, although the present research provides the first evidence that the effect of stereotype threat influences indeed motivational processes, it does not provide evidence that stereotype threat has long-term implications for motivational and behavioural processes. Future research might, therefore, address stereotype threat implications by applying a longitudinal study design because not only the effects of stereotype threat but also the psychological mechanisms might change over time.

Future Research

Both the results of the current research and the outlined limitations raise questions that should be addressed in future research. First, future studies might address the role of identification with mathematics/science domain when studying intentions. Previous research suggests that the effects of stereotype threat on performance are particularly strong for individuals who strongly identify with the stereotyped domain (Murphy et al., 2007; Kiefer & Sekaquaptewa, 2006; Spencer et al., 1999). Thus the question arises whether stereotype threat affects only those students' intentions to major in STEM fields who strongly identify with the mathematics/science domain?

Secondly, future research might further elaborate the protective function of social support in academically challenging environments (e.g., stereotype threat). It is generally assumed that social support removes anxiety and/or insecurity and boosts coping resources (London et al., 2011; Bandura, 1995). Studies indicate that the underperformance of members of negatively stereotyped groups in situations of stereotype threat is due to the anxiety about confirming the negative stereotype (Halpern et al., 2007). Spencer et al. (1999) confirmed the indirect effect of anxiety on the relationship between stereotype threat and test performance. Similarly, in their research on women in nontraditional fields of study, London et al. (2011) revealed that social support reduced insecurity in female STEM students. Thus, the question arises what kind of social support potentially removes anxiety that is inherent in threatening conditions and/or potentially ensures a sense of security for stereotyped groups in a threatening environment?

More specifically, it is generally assumed that social support increases students' coping resources to manage stereotype threat. Social and health psychological research on stress suggests that the impact of a stressor depends significantly on the effectiveness of the coping strategies employed to deal with that stressor (London et al., 2011). It is also suggested that people are likely to avoid activities and environments they believe exceed their coping capabilities (Bandura, 1995). Participants of the present research who intended to major in STEM in spite of evoked stereotype threat might have felt that they have coping resources to manage any potential threats in the STEM environment. The belief of having coping resources is likely to reduce the negative effects of stereotype threat on their STEM intention. Thus, the question that arises is what coping resources are particularly relevant to the STEM environment. Future research should identify these coping resources in order to tailor appropriate intervention programs.

The present research found that social support by peers (i.e., friends) did not influence (in any direction) the negative effect of stereotype threat. One could speculate that our female participants were thinking about other females (targeted in-group) rather than males (non-targeted out-group) when we assessed the social support by peers. Future research should control whether peers are associated as in-group and/or out-group members. The same is actually true for the social support by teachers and parents because we did not control whether teachers are associated as male teachers and parents are associated as fathers. One could argue that social support might particularly reduce the implications stereotype threat if it is provided by members of the relevant non-targeted out-group.

Another question that future researchers might consider is the role of subjective task value in influencing students' occupational choices (Eccles, 2009). It is true that intentions and self-related beliefs regarding one's ability play a critical role in influencing future behavioural choices. However, not much is known about their long-term effects. In other words, irrespective of strong intentions and self-related beliefs students might have regarding STEM fields, it is still possible that they might not enrol in or stay in STEM fields. For instance, a longitudinal study by Frome, Alfeld, Eccles and Barber (2006) revealed that 83 percent of the 12th Grade female participants who intended to major in male-dominated occupations switched to female-dominated or neutral occupational aspirations after seven years. Similarly, at each successive educational level, women are more likely than men to leave math-intensive careers (Ceci et al., 2009). Thus, identifying the factors that make women change from male-dominated to female-dominated occupations would provide important information to stakeholders that are trying to promote women's entry into and success in STEM occupations.

Recommendations for Interventions

Irrespective of the limitations and the many questions resulting from the present research, the main contribution is to demonstrate that stereotype threat does indeed influence motivational processes. Moreover, the present research not only demonstrated the psychological mechanism (i.e., self-efficacy) but also conditions that shield against the negative consequences of stereotype threat (i.e., social support). Thus, the findings of the present research provide some guidance for evidence-based intervention programs to improve the representation of female students in STEM disciplines and therefore for the implementation of the Ethiopian Government's strategy to transform the country to a middle-income country by 2025 by expanding science and technology (Federal Democratic Republic of Ethiopia, MoE, 2010).

It is a well-documented fact that the mere awareness of negative cultural stereotypes impedes the entry, persistence, and advancement of women in some professions (Vaughan, 2016; Isaac, Kaatz, Lee, and Carnes, 2012). Ethiopia is a patriarchal society where religion and culture are often used to legitimize negative stereotypes referring to women as belonging to subordinate positions (Beyene, 2015). In such traditional societies, gender stereotypes are deeply embedded and any attempts to change these belief systems amounts to broader societal changes. Such societal changes could, however, not be achieved if interventions focus only on one particular age or gender group. Rather, multi-level and extensive intervention programs are required to introduce (and change) the public discourse on gender (in) equalities. To this end, a starting point could be within the Ethiopian education system by introducing gender equity as an ideal into the curriculum, extra-curriculum activities and on organizational levels.

The curriculum level refers to contents of education and the strategies used to explicitly challenge negative cultural norms or traditions. Previous research indicates that curriculums are often silent or reinforce gendered stereotypes and inequalities rather than being critical of them (Vaughan, 2016; Fennell & Arnot, 2008). However, a curriculum that is critical of the existing stereotypic gender relations and cultural norms is a fundamental building block for individual and societal changes (Vaughan, 2016; UNESCO, 2004). Studies by Johns, Schmader, and Martens (2005) and Isaac et al. (2012) showed the effectiveness of educational interventions designed to counteract gender stereotypes. For instance, Isaac et al. (2012) used an individual-level education intervention that provided female students with strategies to recognize and to mitigate the impact of negative gender stereotypes on their leadership self-efficacy at an early stage in their STEM careers. Based on a pre-post research design, the result showed that the 16-week long intervention improved not only females' leadership self-efficacy but also increased their self-esteem and personal mastery and most importantly decreased perceived constraints. Follow-up studies also demonstrated that these changes had long-term effects and thus the enduring value of course participation. Based on the findings, Isaac et al. (2012) recommended that educational interventions aiming at mitigating negative cultural stereotypes against women might be an effective addition to other strategies to promote their persistence in academic STEM fields.

Whether teaching female students about stereotype threat is a useful intervention, which reduces the detrimental effects of stereotype threat, was experimentally tested by Johns et al. (2005). Participants were randomly assigned to one of three conditions in a 2 (gender) x 3 (test description: problem-solving, math test or teaching intervention) factorial design. In the problem-solving condition, participants were informed that they would be asked to complete a problem-solving exercise. In the math-test condition, participants were told that they would be completing a standardized test for a study of gender differences in math performance. In the teaching-intervention condition, participants were given the same instructions as in the math-test condition. In addition, the researchers described stereotype threat and suggested to women that "it is important to keep in mind that if you are feeling anxious while taking this test, this anxiety could be the result of these negative stereotypes that are widely known in society and have nothing to do with your actual ability to do well on the test" (Johns et al., 2005, p. 176). The results replicated previous findings that the math performance differences between female and male participants were found in the math-test condition but not in the problem-solving condition. Most importantly, no gender differences in performance were revealed under the teaching intervention condition. These results imply that teaching stigmatized individuals about stereotype threat might be a simple approach to counteract the negative implications of stereotype threat. More importantly, the positive effect of teaching interventions lasted beyond the immediate testing situation. Hence, education interventions on curriculum level that aim at weakening societal negative stereotypes about women's choice and performance in certain domains (e.g., leadership, math performance) are worth considering for the context of Ethiopia.

Intervention at the curriculum level could include specific courses that counteract traditional gender role stereotypes at all levels of education. The contents and approach could focus on challenging stereotypical views such as girls being less able to succeed in mathematics or science, and teaching how stereotype threat negatively influence performance as suggested by Johns et al. (2005) and Isaac et al. (2012).

However, curricular changes by only focusing on course content will not have the expected effect if not negative stereotyping of women in textbooks and other teaching materials are removed. Teaching materials have implicit power in shaping students' mind and they reinforce negative gender stereotypes. Forum for African Women Educationalists (FAWE, 2005) indicated that science and other textbooks in most sub-Saharan Africa countries reinforce gender stereotypes by portraying only boys and men in science experiments and thus by stressing the superiority and authority of men. Likewise, in most primary and secondary textbooks used in Ethiopia women and girls are underrepresented. For instance, out of the total names mentioned in the second cycle primary school Social Studies textbooks, female names make up only 12.2 percent (Dejene, 2017). All the names referring to freedom fighters or to the national crisis represent male names although there were many women who were active participants (Dejene, 2017). Even when women and girls are represented in the textbooks, they are given stereotypical roles like housewives and child caretakers. For example, in grade four English textbook females are described to work only as a typist, a cook, or as a housewife (Andualem, 2009). Such underrepresentation and misrepresentations of women and girls have implications because they reinforce negative stereotype and hinder females from professional occupations. Hence, changes on curriculum level should include the removal of gender stereotypes in textbooks and other teaching materials.

Along with the formal curriculum, schools can also establish extracurricular programs that improve female students' interest, confidence and aspirations in STEM fields. Strong extracurricular programs provide numerous opportunities for students to expand on classroom curriculum. Various researchers indicate that extracurricular programs have positive influences in improving academic achievement and developing skills like leadership and entrepreneurial spirit (Mancha & Ahmad, 2016; Claudia, 2014; Hancock, 2012).

In relation to STEM, extracurricular activities are assumed to be an important gateway through which the pipeline for STEM careers is strengthened. They are considered as part of enhancing supportive learning environments which are instrumental in increasing girls' self-confidence and ability beliefs in STEM (UNESCO, 2017; PISA, 2012). Several studies demonstrated the positive effects of science clubs on STEM-related beliefs and career aspirations. For instance, participation in STEM clubs significantly influences the attitude and aspirations of pre-college students toward STEM (Ozis, Ali, Akca, & DeVoss, 2018; Afterschool Alliance, 2011; Hartley, 2014). Afterschool Alliance (2011) classified the impact of afterschool STEM programs in the United States into three major areas: improved STEM knowledge and skills, improved attitudes towards STEM fields and careers, and improved pursuit of college and intention of majoring in STEM fields.

Moreover, science clubs play an important role in making education equitable by narrowing the gaps and improving the knowledge, interest and aspirations of underrepresented populations such as minority ethnic groups, females, and marginalized rural students (Ozis et al., 2018; UNESCO, 2017; Hartley, 2014; Sahin, 2013; Afterschool Alliance , 2011). More importantly, the absence of science-related extracurricular activities is assumed to be a factor for the low number of students choosing to major in STEM fields and thus the poor successes of countries in science subjects (Sahin, 2013; PISA, 2012).

Although science clubs are known to enhance interest, confidence and aspirations to STEM, they are given minimal attention in Ethiopian schools and the education system in general. Hartley (2014) describes science clubs as "An underutilized tool for promoting science communication activities in school" (p. 21). Hence, establishing science clubs in schools is an imperative intervention strategy to achieve successes in science subjects in the Ethiopian context.

Starting up science clubs is not an easy task. It needs extra time, effort, and commitment of stakeholders, administrators, and teachers. Science clubs can be initiated by schools themselves or in collaboration with other stakeholders like universities. The "Science Learning Centre for Africa" project in South Africa (Hartley, 2014) can be taken as an example of initiating science clubs within the Ethiopian context. This science development project started with forming science clubs in rural primary and secondary schools across South Africa. The clubs were established in three phases. In Phase 1, teachers were trained in various science areas including science contents, pedagogical skills and experimental skills. Moreover, the teachers were informed about the importance of science clubs. In Phase 2, the teachers established a science club at their respective schools. Initially, the teachers started the clubs with a small number of interested students and with limited science activities like competitions among participating students. In Phase 3, the number of clubs and students was increased in size and variety of science activities. This project has won the National Science and Technology Forum award as a science communicator for public awareness in 2009 for its effort in science and technology education (Hartley, 2014). Such experiences of forming science clubs and building a science culture among students and teachers should be implemented in Ethiopian schools.

Intervention on organization level can be considered as an essential strategy to achieve success in science. Interventions at this level include increasing the number of female teachers in schools in general and in mathematics/science domains in particular. Female teachers at schools serve as a role model to young female students. Social cognitive theory suggests that role models influence career choice directly and indirectly through their influence on self-efficacy (Bandura, 1999). A recent experimental study conducted at Chinese schools (Eble & Hu, 2017) showed that assigning a female math teacher to female students who perceive themselves to be of low math ability caused large gains in perceived ability, aspirations, investment, and math academic performance compared to female students in the control group. This implies that teacher-student gender match improves self-efficacy and aspirations of students even when they do not consider themselves good in mathematics. Similarly, observing successful female math teachers lead female students to be confident that they can also manage tasks in similar fields and stand firm against stereotype threat (London et al., 2011; McIntyre, Paulson, & Lord, 2003; Bandura, 1997). On the contrary, the absence of female teachers in schools is assumed to have negative consequences on female students' academic life and career choices. Various researches indicate that the absence of role models in an environment where group stereotypes might apply induces threat which results in reduced efficacy and career intention (UNESCO, 2017; Murphy et al., 2007).

Reports indicate that over 80 percent of the teaching staff in Ethiopian secondary schools are male (Federal Democratic Republic of Ethiopia, MoE, 2017). The actual number of female math/science teachers in secondary schools of the country was not mentioned. Yet it is assumed that they cannot be more than five percent given that at secondary schools in Addis Ababa, the ratio of female teachers to males is less than one to seven (Andualem, 2009). Again, the number of female math/science teachers in these schools is expected to be less than the above ratio. If the number of female teachers in the capital city of the country where there is relatively better infrastructure is that small, it can be inferred that their number in rural parts of the country would be significantly lower. Such contextual variables (i.e., lack of female role models in non-traditional subjects such as physics and mathematics) lead to adverse consequences like stereotype threat. Consequently, there would be fewer female students who opt for physics and mathematics subjects or enroll in STEM fields in their post-secondary education. Thus, it is crucial for the Ethiopian government to increase female high school math/science teachers so that they can serve as role models to young female students who aspire to be STEM professionals.

In regard to increasing female math/science teachers, the government can use the following three strategies. First, introducing quota schemes for women who apply for math/science teaching positions. This means that certain proportions of math/science teaching positions should be reserved for female applicants and the remaining positions would be assigned on the basis of competition with their men counterparts. This strategy is likely to open opportunities for recruiting females in science teaching positions. Second, the government can introduce scholarship programs for female teachers (UNESCO, 2017). In return, the scholarship beneficiaries must commit to serve in schools as a teacher for a particular time. This strategy helps to recruit females in the teaching profession and to retain those who are already in the pipeline.

Thirdly, allocating lower course loads/ teaching hours to female math/science teachers could also be considered as another strategy. This strategy is proposed on the basis of two premises. First, women in developing countries are responsible for child care and other domestic roles (Beyene, 2015; Cross & Linehan, 2006). This is likely to create problems in their professional careers. Therefore, allocating lower course loads would enable female teachers to have sufficient time for their family and to engage in self-empowerment activities like reading and conducting research. The second premise is related to the expectancy-value theory (Eccles, 2009). This theory suggests that perceived cost of engaging in a task contribute for gendered choices of occupations. According to the theory, the extent that one loses time, for example, for family affairs by engaging in careers that need much time and to the extent family affairs is high in one's hierarchy of importance, then the subjective cost of engaging in careers increases. Thus, cost minimization through lower course load can be one viable strategy for increasing female teachers.

In conclusion, stereotype threat causes occupational segregations of men and women. The deep-rooted negative stereotypes about females' STEM ability in the Ethiopian society need well-designed interventions. This research recommends three intervention areas; curriculum modifications that include introducing new course about gender relations, removing misrepresentations of females in textbooks and other teaching materials, introducing extracurricular activities, and increasing female teachers in schools. These interventions are believed to challenge negative stereotype about females' mathematics/science ability, foster a conducive learning environment, boost mathematics/science self-efficacy and improve STEM aspirations among high school female students. Finally, such intervention strategies might enable Ethiopia to increase its technology-oriented human resources consisting of both females and males which is considered as necessity for the progress of transition into a middle-income country by 2025 (Federal Democratic Republic of Ethiopia, MoST, 2012; Federal Democratic Republic of Ethiopia, MoE, 2010).

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